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TWO FAST TRANSATLANTIC RUNS were finished on June 26 by the "St. Paul," of the American Line, from Southampton, and the "Lucania," of the Cunard Line, from Liverpool The "St. Paul" made the course of 3,113 miles in 6 d. 8 h. 19 min., or at an average speed of 20.44 miles per hour, the daily runs being 457, 507, 498, 489, 515, 540 and 103 miles, while the vessel's highest record is 6 d. 5 h. 32 min., with a maximum daily run of 522 miles. The "Lucania" made the course of 2,855 miles from Queenstown in 5 d. 13 h. 35 min., or at an average speed of 21.30 miles per hour, the daily runs being 96, 524, 529, 507, 542, 562 and 95 milets, while this vessel's highest record is 5 d. 7 h. 23 min. The "Lucania" has engines of 30,000 HP., consuming 540 tons of coal per day; while the "St. Paul" has engines of 20,000 HP., consuming 315 tons of coal per day.

◆

THE RUSSIAN TRANSPORT "KHERSON," on its recent trial trip made an average speed of 19.6 miles per hour for 12 hours, the engines making 90 revolutions per minute. The vessel resembles an ocean steamer, and is 500 ft. long, and 54 ft. 3 ins. beam, with a gross tonnage of 6,000 tons. It has twin-screw engines and three batteries of Belleville water-tube boilers. The armament will include three rapid-fire rifled guns and 20 small guns.

◆

A BALLOON TRIP TO THE NORTH POLE is to be attempted by Mr. Andree,a French aeronaut, who expects to start from Spitzbergen about the end of June. The balloon is nearly 70 ft. high, and the basket is 6 ft. diameter and 5 ft. high. Two persons will accompany Mr. Andree, one of whom will be a photographer. Steering sails are fitted above the basket, and the balloon will also be steered by a long drag rope trailing on the ground, which can be hitched to any part of the ring of the balloon. When the long guide rope is trailing heavily in the snow below, at right angles to the plane of the sail, the wind will strike the sail in full and the balloon will go straight ahead before the wind. But when the upper end of the rope is shifted to any position on the ring desired, thus deflecting the strain, which can easily be done by means of an apparatus constructed expressly for that purpose, then the balloon will be compelled to shift its position, thereby placing the sail at an angle with the wind, which must result in changing the direction of the balloon. That it will do this is said to have been proved by an experimental trip.

◆

A CURIOUS BOAT, which is, of course, to revolutionize ocean navigation, has been built by Peter Beckman, of Bucksport, Me. A horizontal cylinder, 10 ft. diameter and 13 ft. long, closed at the ends, except for a hole at the axis, has floats or buckets 8 ins. wide and 24 ins. apart, attached to the outside, and is driven by gearing on the inside. This big paddle wheel has a superstructure for decks and is intended to roll along the water. The idea is old, but as the builder of this particular craft has no pretensions to mechanical knowledge, he probably considers it both new and good.

◆

MAKING FLYING SWITCHES is said by the New York State Board of Railroad Commissioners to be not a dangerous practice. This was in answer to a complaint against the practice by which the engines of passenger trains approaching the Grand Central terminal station in New York are switched off in front of the train, the engine being uncoupled and running ahead of the train. This decision is about on a par with the board's statement to the effect that radially stayed fireboxes are specially dangerous, which statement was discussed in our issue of June 18.

◆

ELEVATORS AT RAILWAY STATIONS have been applied at many large terminal stations where the tracks are elevated above the street level, and have recently been installed at the terminal station of the Lake St. Elevated R. R. in Chicago. There are two electric elevators, each accommodating 20 passengers, and running at a speed of 120 ft. per minute.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred on the Chicago, Milwaukee & St. Paul Ry., near Davis Junction, Ill. A car in the middle of a freight train jumped the track and was run into by a fast freight going in the opposite direction on the second track. Thirty-five cars were wrecked, one man was killed and two injured. The wreck caught fire and burned.

◆

A LOCOMOTIVE BOILER EXPLOSION occurred on the New York Central R. R., June 23. The engine was backing a local train onto a sidetrack at Utica, N. Y., when the boiler burst. The engineman was killed and the fireman seriously injured.

◆

A MINE DISASTER in which a large number of men, estimated at nearly 60, have lost their lives, occurred at Pittston, Pa., on June 28. The men were at work about 100 ft. from the surface. The mine had shown signs of caving for several days and a large extra force had been put to work on the timbering. Work of rescue is in progress, but the great extent of the cave and successive falls have made it impossible to reach the buried men.

◆

HE LOSS OF THE STEAMER "Capulet" occurred on the coast of Newfoundland, June 22. The vessel was bound from Halifax to Liverpool, and struck on the rocks in St. Mary's Bay in the afternoon, during a thick fog, the vessel being about to touch at St. John's to land the mail. The crew and passengers got off in the boats, and were picked up by a fishing schooner.

◆

THE PARTITION OF A WATER POWER is a question which has just been brought before the Supreme Court of Iowa. The water power in question is located at Cedar Rapids and a suit for its partition was brought some time ago. Mesrs. Clemens Herschel, of New York, Prof. Williams, of Mt. Vernon, Ia., and Samuel Sherwood, of Independence, Ia., were appointed referees by the court. They presented a report setting forth that an actual partition or division of the property into the required fractional parts was impracticable without an indefinitely continuing intelligent operation and supervision of the appliances that might be erected, and that in their judgment a sale of the property and a division of the proceeds was the only practicable method of partition.

Exceptions were taken to this report and were sustained by the court, and afterwards J. T. Fanning, W. P. Clark and A. H. Conner were appointed referees to make partition in kind, and recommended the erection of adjustable weirs so as to measure out to each owner the share of water to which he was entitled. They also recommended that the court direct the owners of the property to employ a competent inspector of the weirs who should, as often as necessary, see that they were kept in proper adjustment and repair.

The lower court approved this finding and an appeal was taken to the Supreme Court. That body now decides that this is not a case where there can be a fair division of the property in kind. The only way in which partition can be made is to sell the property and divide the proceeds.

◆

A BID FOR CAST-IRON PIPE at a recent water-works letting at Petrolea, Ont., was submitted by an Alabama firm at a price lower than the bid of any Canadian foundry, notwithstanding the duty of $10 per short ton and the long freight haul. About eleven miles of 12-in. force main and 7½ miles of 12 to 4-in. distributing mains are included in the contract, which was finally awarded to Carson & Co., of St. Catherines, Ont., who put in a lump bid for the whole plant, except pumps and filters.

◆

THE LATEST PHILADELPHIA WATER SUPPLY scheme is said to be as follows: The Philadelphia Water Supply Co. offers to furnish filtered Delaware river water for a period of 50 years for 60% of the gross revenue of the city water-works, based on present rates. The details of the scheme are rather mixed in the newspapr reports at hand, but these state that there will be two 11-ft. steel conduits, one 21 and the other 80 miles long. The latter would take water from the river above Easton, and the former at a point six miles above Trenton.

◆

A SUIT FOR HYDRANT RENTAL brought by the Peoria Water Co. against the city of Peoria, Ill., has been decided against the company in the Appellate Court of Illinois, where the decision of the Circuit Court was affirmed. The suit was for some $13,500, something over a quarter's charges for water used for public purposes. The court held that under the franchise the contract is a yearly one, and that since the bonded indebtedness of the city exceeded the constitutional limit, without an obligation for water for 1895, none could be legally incurred. This decision has no bearing upon the validity of the company's franchise, but seems to leave the city powerless to secure water for public purposes until its debt is reduced, unless it secures the necessary money by taxation in advance. The decision also seems to affect other branches of the municipal service.

◆

A RIFE WATER RAM or hydraulic engine at Rondout, N. Y., on the Ulster & Delaware R. R., delivers 900 gallons of water per hour at an elevation of 47 ft. 6 ins., through 580 ft. of 2½-in. pipe, the driving stream flowing through a 4-in. pipe having a fall of 9 ft. 6 ins. in 33 ft. 6 ins. The machine is used to supply a locomotive supply tank.

◆

COMMISSIONERS TO PROVIDE a new water supply for Cincinnati have been appointed by the Governor of Ohio, as follows: Messrs. August Hermann, Leopold Markbreit, C. M. Holloway, Dr. T. W. Graydon and Maurice J. Freiberg. Mr. Herrmann is, or was at the time of his appointment, a member of the Board of Administration, which has charge of the water-works. He has been elected president of the commission. The estimated cost of the proposed new supply is about $6,000,000. Injunction suits have already been filed to test the legality of the act under which the appointments were made. One of the principal points of attack is that the act is special legislation, as Cincinnati is the only city in the state which could possibly come under its provisions.

◆

BIDS FOR BATTLESHIPS have been invited by the Navy Department at Washington. The specifications call for three battleships each of 11,000 tons displacement and each to cost $3,750,000 exclusive of armament. Bids may be offered in two ways: On the plans furnished by the government, or on plans furnished by the bidder. The speed to be maintained at sea for four consecutive hours is to be not less than 16 knots per hour. For failure to attain this speed $25,000 for each quarter-knot deficiency shall be deducted from the contract price, and if the speed falls below 15 knots the vessel may be rejected. The department is also inviting bids for 13 torpedo boats, the fastest of which shall maintain 30 knots per hour.

THE SALT LAKE & MERCUR RAILROAD.

By W. P. Hardesty, C. E.

The Salt Lake & Mercur Railroad is a standard-gage mountain road, for giving the Mercur mining camp connection with the railway system of Utah. This camp is situated in Camp Floyd Mining District, in the Oquirrh Mountains, and near the center of the State. This district has, within the past two or three years, attracted a great deal of attention, on account of the discovery and working of enormous bodies of gold-bearing ore, so that within the past few months it has been enjoying a veritable western mining boom. The gold found is not free-milling, not the usual "quartz" gold, but is in a form that requires the application of the cyanide process to secure it. The town of Mercur is the site of the first developments of the gold mines and is the commercial center of the district. It lies just over the divide, and on the west side of the Oquirrh range, which divides Tooele County on the west from Utah County on the east.

The Tintic branch of the Union Pacific Ry. traverses Cedar Valley on the east side of the range, and from the station of Fairfield, which is 49 miles from Salt Lake City, the Salt Lake & Mercur R. R. is built to the Mercur Camp.

The Oquirrh main range, though not high, is difficult to surmount on account of its slopes rising abruptly to its narrow summit, it having no considerable mountain streams with their canons, and it is entirely different in these respects from the Wasatch range of mountains.

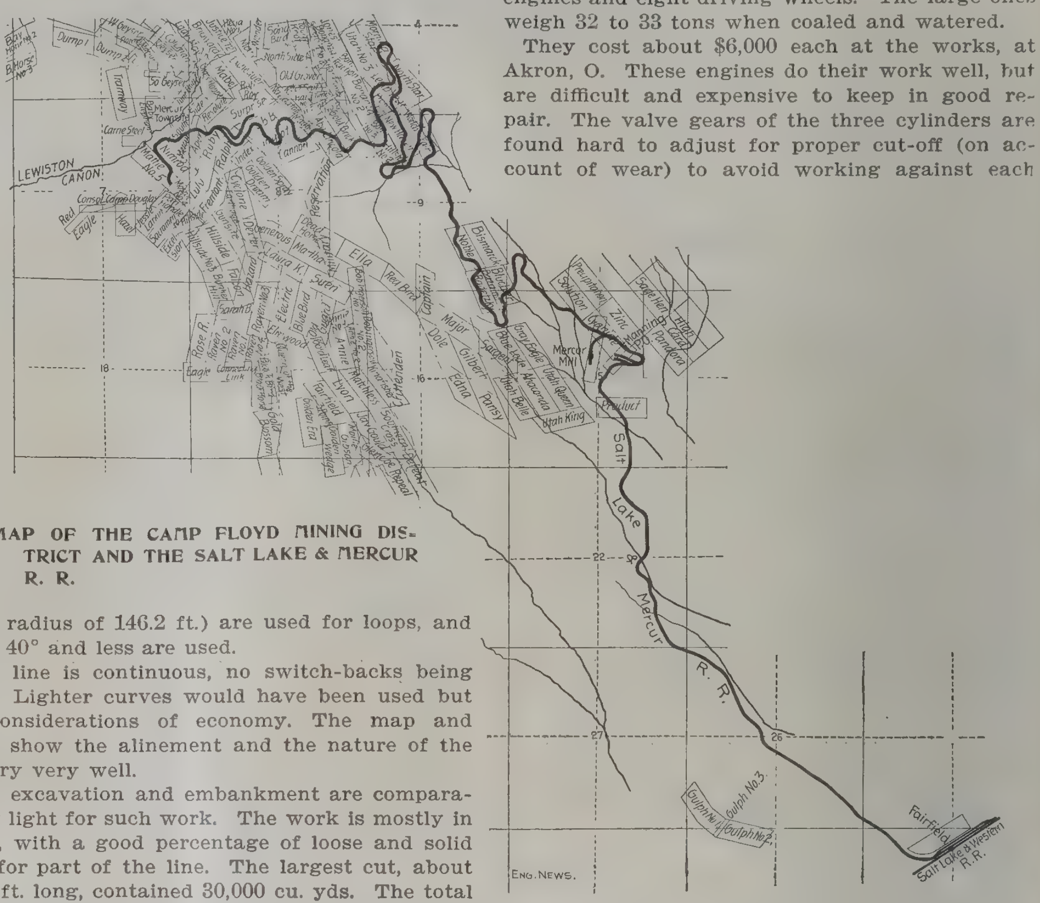
From Fairfield to Mercur the distance in an air line is 6 miles. The Salt Lake & Mercur R. R. Co. was organized to build this road. Col. Chas. D. Moore, who has had an extensive experience on the location and construction of western railways, was selected as chief engineer, and work commenced in July, 1894.

A large gulch comes down from Mercur divide on the east side of the range and opens out into Cedar Valley, directly opposite Fairfield station. Up the general line of this gulch the road is located. From Fairfield to the mouth of the gulch the distance is 4¼ miles by the line. The road is fairly straight and direct from this portion, and an average ascending grade of 3.75% is used, with a maximum of 4.2%. Then the development begins.

A STATION ON THE SALT LAKE & MERCUR R. R.

Here at the mouth of the gulch are located the shops of the Salt Lake & Mercur R. R., and also the Mercur mill, for reducing the ores of the famous Mercur mine. The station here is called Manning. From Fairfield to Manning the rise is 844 ft.; from Manning to the summit the rise is 1,142 ft. more, in a direct line of less than 2½ miles, and by the railway of 5⅓ miles.

The total elevation overcome from Fairfield to the summit (called Mercur divide) is 1,986 ft., the length of line 9.58 miles in a direct distance of less than 5½ miles. The maximum grade used is 4.2%, and the maximum curvature 42°, the grade being equated for curves at the rate of .02% per degree. Six of these sharp curves (having a radius of 146.2 ft.) are used for loops, and many 40° and less are used.



MAP OF THE CAMP FLOYD MINING DISTRICT AND THE SALT LAKE & MERCUR R. R.

The line is continuous, no switch-backs being used. Lighter curves would have been used but for considerations of economy. The map and views show the alinement and the nature of the country very well.

The excavation and embankment are comparatively light for such work. The work is mostly in earth, with a good percentage of loose and solid rock for part of the line. The largest cut, about 1,000 ft. long, contained 30,000 cu. yds. The total cost of grading was about $30,000.

There are four 45-ft. culverts for crossing main gulches. But little trouble with either wash-outs or snow has been experienced in the operation of the line. Standard ties are used throughout. 35-lb. second-hand rails were put down. These are to be replaced on the east side of the summit during the summer of 1896 by new 52-lb. rails, the old ones being used for the extension and switches on the west side.

The rails were elevated on curves for a speed of 12 miles per hour. The gage was not widened on curves, Col. Moore deeming it a disadvantage to do so under the conditions here, and of little benefit in any case.

The railway cost, fully equipped, about $75,000. Shay geared locomotives are used, it of course being impracticable to use ordinary mountain engines on such a road. There are one 18-ton and two 28-ton Shay locomotives in the service, the former being geared 3 to 1 and the latter 2 to 1. Each locomotive has three cylinders or engines and eight driving wheels. The large ones weigh 32 to 33 tons when coaled and watered.

They cost about $6,000 each at the works, at Akron, O. These engines do their work well, but are difficult and expensive to keep in good repair. The valve gears of the three cylinders are found hard to adjust for proper cut-off (on account of wear) to avoid working against each other. The wheel base of the small engines is 47 ins., of the large ones 52 ins.

The ore cars used by the road are 30 ft. long, weigh 20,000 to 21,000 lbs., and have a rated capacity of 15 tons, though 18 to 20 tons are often carried. The 34-ft. box cars of the Union Pacific Ry. are hauled over the line with no trouble at all. At one time a 46-ft. furniture car was also taken up to Mercur. It is found that any wheel base of over about 6 ft. 8 ins. gives trouble. The sharp curves, unless reversed, do not seem to affect train motion to any appreciable extent. The ability of the cars to stick to the track seems to depend mostly on their ease of swiveling on their trucks.

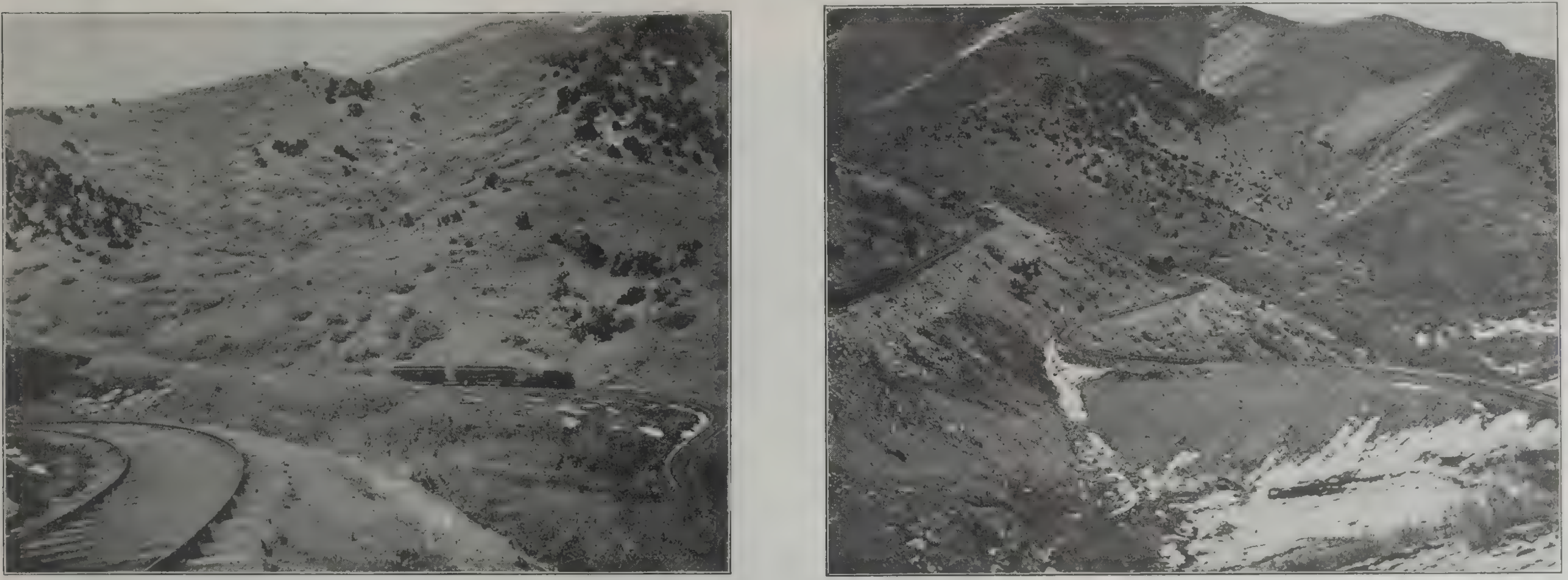
At one time a car got loose and ran for three miles, presumably at 40 or more miles per hour, before being ditched by a broken rail. At another time one got loose and was derailed by the workmen hurrying down the hill-side and placing a tie across the track, catching the car in its return down a loop.

For down trips an air pressure of 20 lbs. is kept on the drivers of the engine, and is applied to the cars only for stops. All cars are equipped with Westinghouse air brakes and with hand brakes. The water brake is not used with the Shay engines, as it is thought that there would be a possible danger of their cogs stripping if it were. Chilled steel brake-shoes are used and are worn out very fast.

On up trips two passenger coaches or three box cars is counted a fair load, while seven empty ore cars are taken up at one trip. Mercur station is located nearly one mile further and 132 ft. lower than the summit, being 10½ miles from Fairfield. The depot is 253 ft. higher than the center of the town, which lies in the bottom of Lewiston Canyon. An extension of the road is now being built that will get down into the town on a comparatively easy grade, with a distance of about two miles. This requires extensive development, and two switch-backs are also used. The grade on the west side of the summit is all 2.4% descending, except one level portion of 500 ft.

The operation of this road has proved very profitable, and has fully justified the enterprise of the projectors. An average of 200 tons of ore per day are carried from the Mercur mine to the Mercur mill at Manning, at a contract rate of 35 cents per ton. With a number of other mines that have about begun shipping, the revenues from these sources may greatly increase. A considerable business is also done carrying miscellaneous freight and passengers, high rates being charged. The road has been in operation since January 20, 1895.

The only other road of any importance in Utah that exceeds the Mercur road in heaviness of grades is the Utah Central, running from Salt Lake City to Park City, distant 31.6 miles. This road has 6% and 6½% grades for considerable of its length, and one very short strip of 7¼%; while 4% and 5% grades are very common.


VIEWS ON THE SALT LAKE & MERCUR R. R. IN UTAH. MAXIMUM GRADE, 4.2 %; SHARPEST CURVE, 42°. ELEVATION OF 1,986 FT. ATTAINED IN A DISTANCE OF 9.58 MILES.

It has three switch-backs, however, and moreover is exceedingly difficult and expensive to operate, both on account of the heavy grades and because of snow, being located on the wrong side of the valley it traverses. It is a narrow-gage road, with maximum curvature of about 20°. It runs over the Wasatch Mountains, following up the valleys of Parley's Creek and its forks.

By a proper location, using more distance, the grade could have been kept down to 4%, giving a line with better ground for construction as well as much more freedom from snow.

The summit of the divide crossed by this road (19 miles from Salt Lake City) is 7,046 ft. above sea-level, that of the Mercur divide being nearly as high. The Utah Central road, with an engine weighing 40 tons without tender and something like 60 tons with tender full, can haul up ten empty flat cars at one trip, these weighing 6½ to 7 tons apiece.

The great expense of operating this direct connection between Salt Lake City and Park City, is compensated for by the fact that its only competing line, the Union Pacific, runs by way of Ogden and requires about three times the distance for the same connection.

The Alta branch of the Rio Grande Western Ry., running from Bingham Junction to Wasatch, Utah, has about one mile of 5% grade.

This road is about 8 miles long, and is operated only during the summer season, though it is not troubled with snow.

* * *

THE BRITISH BATTLESHIP "HANNIBAL," recently launched, is said to be the heaviest warship ever built. It is 390 ft. long, between perpendiculars, 75½ ft. beam, and 10,180 tons displacement. A double bottom extends for 220 ft. in the central part, and terminates in a protective deck, which forms an arch across the ship, and covers the engine and boiler rooms and magazines. For 216 ft. of the length are armor belts, 14¾-in. wide and 9 ins. thick; where the side belts terminate, bulkheads 12 to 14 ins. thick extend across the ship, and the belts inclose the citadel. The main battery will include four 12-in. and twelve 6-in. breech-loading rifles.

SCIENCE AND ENGINEERING.*

Thomas Curtis Clarke.**

The subject of this address is "Science and Engineering," showing the necessary relations between them, which are becoming closer and closer every day, as engineering extends over wider and wider fields of action. Science is the discovery and classification of the laws of nature. Engineering, in its broadest sense, is the practical application of such discovered laws.

The education of the engineer is now becoming as broad as that of any of the other professions. Engineering has become a profession, but it is the latest of the professions.

Herbert Spencer has shown that our present professions, law, medicine, architecture and engineering, have all developed from the clerical profession. A profession requires special education and instruction on the part of its professors, and in early times there was but one educated class—the clergy—and they were the only ones who knew enough to be lawyers, doctors, architects and engineers.

An art requiring so much technical skill as architecture was originally practiced by the clergy, as temples, churches and monumental structures naturally fell under their supervision. The great cathedrals of the middle ages were built by the higher clergy of those days, among whom William of Wykeham and Abbot Suger are deservedly famous.

The earliest engineers of whom we have any record were the priests of Egypt, whose wonderful works in masonry are surpassed by no masonry works of our days; and the only way in which we can show our superiority is by our greater skill in the use of metals. Civil engineering did not become separated from the clerical* profession until in much later times. The Latin word "pontifex" means a bridge builder and also a priest, and from it the words "pontiff" and "pontifical" are derived. The building of a bridge was considered such a remarkable feat that the name pontifex became the highest clerical title.

Men of inventive talent, not clergymen, displayed much skill in inventing and operating engines of war, hence the name engineer. Civil engineer was a later title, and thus indicates a later development. Civil engineering is the youngest of the professions, and the reason of its late evolution is that if engineering be the application of nature's laws, there could be no engineering profession until these laws were discovered. These discoveries did not come until late in the world's history, and the progress of science was much retarded by the conservative spirit. The works of Copernicus were suppressed. Galileo was imprisoned and Bruno was burned. Even Newton's splendid discovery of the laws of gravitation was not accepted.

Equally wonderful with some of the later discoveries of pure science are the discoveries in those branches of science which can be applied to the use of man, and in whose application the engineer takes no mean part. We have now the new chemistry, which is synthetic as well as analytic. In other words, it not only investigates the composition of bodies, but has learned how to create them by its own processes. It has revolutionized nearly every art and manufacture.

Another important very late discovery in medico-biological science is that of the presence of microbes, which exercise such a great influence upon human life and health. Here the labors of the engineer have come into play and have shown us how to purify water and sewage.

By far the most striking application of science in this century has been in electricity. Morse and Henry have given us the telegraph; Bell, the telephone; Edison, the incandescent lamp; Tesla, the alternating current, and McFarlan Moore hopes soon to give us artificial daylight from glass tubes, in which are no loops nor carbons, but only repeated interruptions of an electric current in a high vacuum. It has also given us the separation of metals from their solutions, and the economic transmission of energy, which has re-created our street railways, machine shops and manufactories, and may soon supersede steam locomotives, where frequent stops are necessary.

Its new discoveries come so fast that one can hardly write them down. Even while preparing this address a great discovery is announced. It has been the dream of investigators to find some means of producing electrical energy from coal without combustion. We now hear of a very simple process by which over 80% of the potential energy of carbon can be converted into electrical energy by causing the oxygen of the air to combine with carbonaceous material, through an intervening electrolyte, preferably melted caustic soda, according to Prof. Cross, of the Massachusetts Institute of Technology.* Assuming that this is true, we may say positively that this discovery will not be of value until the engineer has put into it such practical shape that it will be commercially successful. It may take the place of chemical batteries, but that it can supersede the steam boiler, where great power has to be produced, seems doubtful.

The discovery of the X-rays is but in its infancy. It can show our bones, but has not been able to penetrate a steel eye-bar and show the bridge engineer any hidden defects. It seems probable that its application to incandescent lighting is near at hand. The engineers are working at this problem.

By military engineers the laws of Nature are applied for the defence of mankind, and experience in the last great wars has shown that that nation which has made the greatest advances in engineering is the most formidable in war. It has been well pointed out by the President of the British Institution of Civil Engineers that all improvements in modern instruments of both attack and defence are the work of engineers.

Before the close of this century we may see another new branch of engineering. Through the labors of engineers man may soon extend his dominion over the air, and aviation engineers may be as numerous as mining engineers now are.

All the great discoveries of science have been made by the application of what is called the scientific method of investigation. This is as necessary to the engineer as it is to the investigator of pure science. Unless he is equipped with it and understands its use he will always occupy a subordinate rank instead of taking his true place as a master of creative science, which I shall show that engineering really is.

Scientific method consists of observation, deduction and experiment. We must not be deceived into thinking that one thing has no connection with another, because we do not see that connection. We must not draw hasty conclusions, but sift the facts after collecting them, rejecting those that have no bearing, and taking great care not to overlook or reject those that are of importance.

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*Abstract of the address delivered June 30, 1896, at the annual convention of the American Society of Civil Engineers, held at San Francisco, Cal.

**President, American Society of Civil Engineers.

*Sodium hydrate is melted in an iron pot and a carbon cylinder is immersed in the molten material. Air in fine jets is blown through the hydrate. The oxygen from the electrolyte combines with the carbon and an electrical current results from the direct oxydation of the carbon, without any material accompanying generation of heat. The supply of air constantly regenerates the hydrate by supplying fresh oxygen to replace that which has entered into combustion with the carbon.

In forming a theory to account for the phenomenon, one must be very patient and get all the facts first, and not form the theory first and then try and find facts to fit it. This is the pit which scientific men too often dig for themselves and fall into. The first step, after forming the theory, is to test its truth by renewed observation and by careful experiment, which Huxley calls an artificial observation of facts. The art of experimenting is not to be learned in a day, but should form the apprenticeship of the engineer.

When a man, having formed a plausible theory, and having found it corroborated by experiment, suddenly runs against some obstinate beast of a fact that upsets it altogether, what shall he do? Shall he abandon the theory, ignore the fact, or go on patiently looking for newer facts? This is the test which shows whether he is imbued with the true scientific method or not.

True science begins with the use of mathematics and the invention of instruments of precision. Astronomy began to be a science with the invention of the telescope, and engineering with the invention of some kind of leveling instrument.

Fortunately we have now an abundance of technical schools, in which those intending to be engineers can be trained both mentally and physically in the very things that they ought to know. They can be trained in mathematics and the physical sciences; while in chemical, physical and electrical laboratories they can be taught the essential arts of experimenting. They learn the use of delicate instruments, and the art of drawing. Already has our profession felt the great influx of young men, trained and cultured in all these things.

Looking at the great numbers of young men who are yearly graduating from the technical schools and entering the ranks of our profession, the fear has sometimes been expressed lest there may not be room for all.

Engineering, following the general law of evolution, has become, and is still becoming, specialized, and specializations come constantly to meet new wants. Thus, we now see developing a special class of engineers created by the great value of land in cities, calling for very high buildings, and requiring experts to design their metallic frames and their foundations, made complex by their limited spaces, and the necessity of avoiding encroachment on others.

Some persons confuse civil engineering with structural engineering. We read in the prospectus of one of our technical schools that courses are given in mechanical, mining, electrical and civil engineering. What is meant is structural engineering, or the art of constructing earthworks, piers, walls, dams, bridges, roofs, viaducts, etc. The term civil engineering has a much broader meaning, and comprehends all engineering except military and naval. It includes all useful works of sufficient magnitude and intricacy to require scientific method, knowledge and skill in their construction. The civil engineer's true position is similar to that of the architect, who commands the services of many different professions and handicrafts. Mechanical and electrical engineers and many others aid him in their several lines, but from him comes the comprehensive design, and he alone is the director-general of the works. Such is the position claimed for civil engineers in Britain and on the continent of Europe. The members of our society should claim it here, and not only claim it, but show that they are capable of filling it. There is but one way in which they can do this, and that is by showing themselves masters of scientific method and knowledge.

The war between theory and practice has nearly come to an end. We now recognize that either without the other is not of much value. The practical man is one who has had experience in his own special line, and within his narrow limits he is not likely to make mistakes. The theoretical man without experience is a dangerous guide. Hence we wisely treat the young man, trained only in the schools, as an apprentice, and make him follow instructions until he gets experience. When he has got it, he rises very fast, and soon becomes a master, and in the race of life passes the "rule of thumb" man.

The progress of civil engineers in the future will be far greater than it has been in the past. Civil engineers will take a much higher rank in public estimation than they have done, and greater emoluments will follow.

When science (the accurate knowledge of what others have done) and experience (the knowledge of what we ourselves have done) are united in the same person, then we may truly say that we have seen the evolution of engineering from a craft to a profession.

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A MUNICIPAL ELECTRIC LIGHTING PLANT is again under discussion at Milwaukee, and it is proposed to have Mr. Geo. H. Benzenberg, M. Am. Soc. C. E. City Engineer, still further investigate the subject. A year ago, it is said, he went into the subject quite exhaustively.

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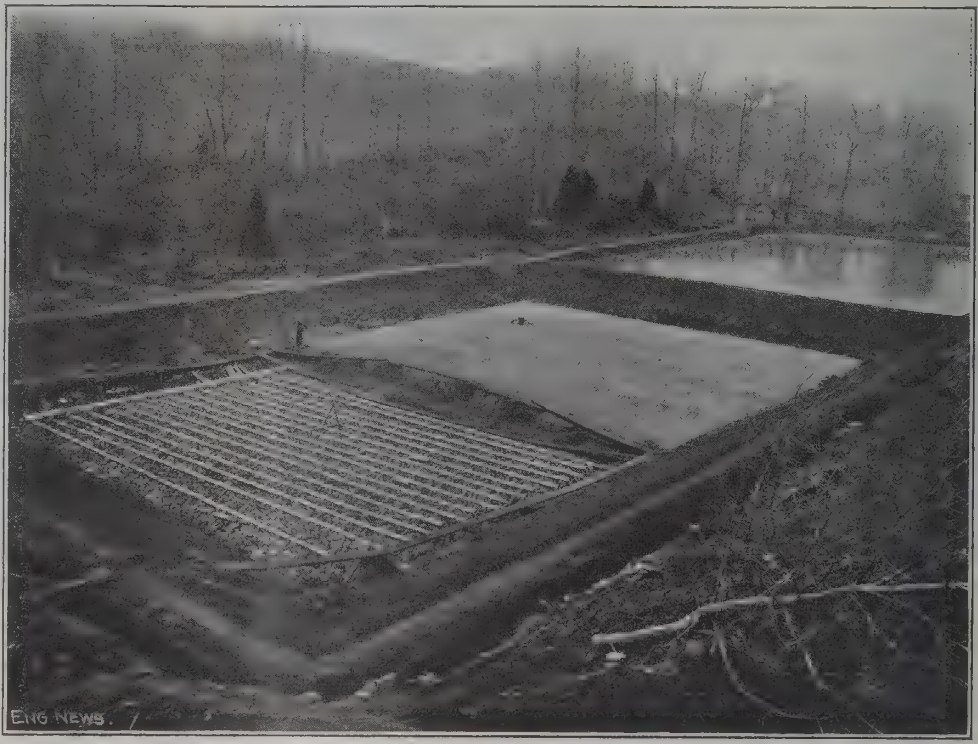
WEIR GAGINGS OF THE GENESSEE RIVER at the site of the proposed storage dam, near Mount Morris, N. Y., are reported as to be made by Mr. Geo. W. Rafter, M. Am. Soc. C. E., of Rochester.

SAND FILTER BEDS FOR THE WATER-WORKS OF LAMBERTVILLE, N. J.

By Churchill Hungerford.

The water supply of Lambertville is impounded in two reservoirs made by building dams across a small stream at points about 2,000 ft. apart. The reservoirs are very shallow. The bottom consists of a light, clayey soil, which makes the water very muddy when agitated by wind or currents. In addition to this, large numbers of carp, which infest the reservoir, probably increase the turbidity. The clay in suspension is so finely divided that a week's sedimentation has very little effect upon it. As there is very little inflow to the reservoirs during the months of July, August and September, the water becomes stagnant and highly charged with organic matter, giving rise to a very strong "fishy" taste and odor. It was with the intention of removing these objectionable features that the filter beds were constructed.



THE FILTER BEDS AT LAMBERTVILLE, N. J., DURING CONSTRUCTION.

The beds are situated on a small plateau immediately below the lower or distributing reservoir and occupy two rectangular basins, each of which is 130 ft. long, 92 ft. wide and 9 ft. deep. As there was 10 ft. difference in the elevation of the opposite corners of the plateau, the basins were so arranged that the excavation necessary to form one supplied the material to make the embankment for the other.

A puddle trench, 4 ft. wide, excavated to the underlying rock runs through the middle of all embankments. This varies in depth from 4 to 16 ft. A single row of 2-in. hemlock sheet-piling was set to prevent crawfish from penetrating the banks. After the basins were finished, a layer of sand, 1 in. thick, was placed on the natural clay bottom. Paving with rough stone followed this, and sand was sifted into the interstices, thus insuring the filtered water against coming in contact with the clay. This pavement formed a foundation for the underdraining system which consists of:

(1) A 12-in. conduit, running the entire length of each basin, composed of vitrified pipe with a 4-in. tee every 2 ft. This conduit connects with a 12-in. cast-iron pipe leading to the receiving chamber, where it terminates in a gate or valve. The 12-in. joints in the vitrified pipe are calked with jute.

(2) A series of lines of 4-in. vitrified pipe, running at right angles from the main conduit to the opposite side of the basin. These lines are 2 ft. apart, plugged at the end and laid with open joints. They are not laid level, the ends opposite the conduit being slightly higher. The intervening space between the lines was filled with riprap to the top of the pipes. Gravel would have done equally as well, but as all sand and gravel had to be hauled three miles, besides paying 32 cts. toll for each two-horse load, it was found more expedient to use random stone.

Two layers of gravel, the lower layer coarse and the upper fine, were placed over the pipe. They had the same rate of grade as the pipe; the gravel was washed before placing. The only sand that could be obtained contained a large amount of loam, and had to be thoroughly washed before being used. Great care was exercised during this operation, as it was found that too much washing was worse than too little, on account of the finer particles being carried away with the loam, leaving the residue too coarse. Besides containing loam, the sand was not sharp, and about 20% of it consisted of rounded nodules of slate, which could not be removed by washing. The sand was found to contain 33% of voids.

The filter beds proper, or sand layers, average 2½ ft. in thickness, being thickest at the corner nearest to the receiving well, each bed measuring 60 × 100 ft. on the surface. The sand was placed while wet, so that there would be less settlement when covered with water. To insure a perfect contact with the banks, sand was beaten into the slopes as high as the surface of the sand bed.

The slopes were riprapped to within 1½ ft. of the top of the embankment, to prevent the unfiltered water, which stands on the surface of the sand to a depth of 3 ft., from washing the slopes. The flow line in the filter is 10 ft. lower than that in the reservoir, but two butterfly valves, operated by floats, regulate the inflow. These floats are in the receiving chamber, and are operated by the filtered water. As the sediment layer on the surface of the beds increases in thickness, the flow of water through them is retarded, and the level of the filtered water in the chamber is slightly lowered, thus opening the butterfly valves and causing the unfiltered water to rise until the head has increased sufficiently to close the valves. This process continues until the water over the sand is 4½ ft. deep, when it passes out of the overflow. It then becomes necessary to clean the filters. A waste pipe was provided for each basin, so that their contents could be drawn off at any time.

The filter was put in operation on May 4, 1896, at which time the average daily consumption was only 225,000 gallons. Water was allowed to enter the basin at a slow rate until it was 1 ft. deep over the sand, when it was turned on at full head. A peculiar feature noticed in the sand was its instability. A workman having occasion to go on the bed when there was about 3 ins. of water over it, sunk down through the sand to the gravel beneath. It immediately settled around him and he had great difficulty in withdrawing his legs. The bed was a veritable quicksand.

On the following day the water was drawn off and an examination made. A few saucer-shaped depressions about 3 ins. deep and 12 ins. in diameter, appeared on the surface of the sand. On investigation, these were found to have been caused by the displacement of the lower layer of gravel, which allowed the material above to fall into the voids in the riprap. As it was found no sand had entered the pipes, the depressions were simply filled with sand and no further trouble was experienced from this source.

On May 10, after five days operation, the water was again lowered. Although the unfiltered water was slightly turbid, there was no indication of a sediment-layer on the surface of the sand. On the contrary, it was covered with the nodules of slate before mentioned. Some of these were 1-10-in. on their longest diameter and oscillated with the slightest motion of the water. The basins were again filled, and two days later, May 15, a marked change being noticed in the effluent, an analysis was made which showed a marked improvement. On the day following, the surface of the sand was examined and found to be evenly covered with a thin sediment layer. The bed was compact and hard.

On May 19 the flow line had risen about 3 ins. above the 3-ft. level, but on the day following it dropped back to the normal level. As the effluent was good, the filter was allowed to run until May 26, when the trouble was located in the basin next to the dam. After the water was drawn off, an examination showed that at a point where a ledge had been blown out, water had penetrated the seams in the rock above the sand and then found its way into the gravel layer beneath, thus contaminating the filtered water. A plating of clay on the slope where the rock was taken out remedied this defect and no further trouble was experienced with the working of the filter.

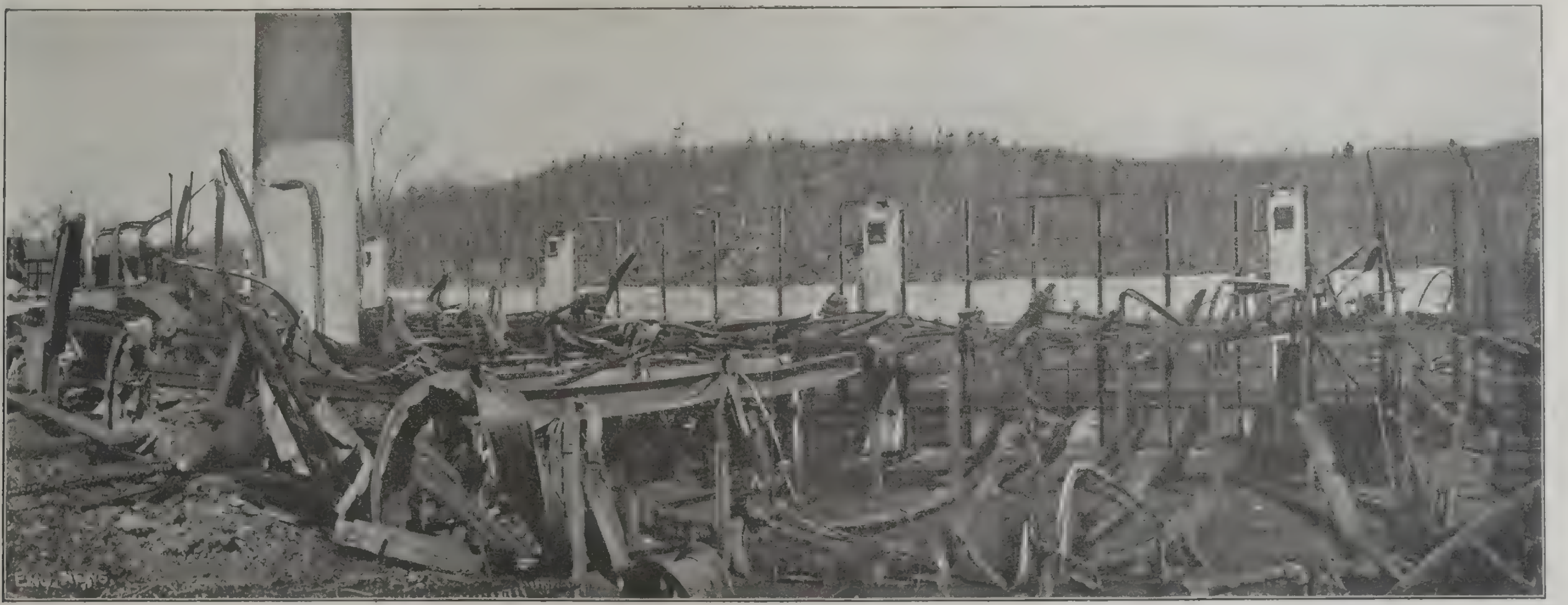
The beds were cleaned on May 28, at a cost of $6, or 50 cts. per 1,000 sq. ft. At this rate, the cost of filtration, not including interest on plant, is $1 per 1,000,000 gallons.

An experiment was made to determine how nearly the friction in the underdrains had been compensated for by varying the thickness of the sand layer. (As before stated, this layer was thickest at the corner nearest the receiving chamber and thinnest at the corner diagonally opposite.) Water was let into the filter until it was even with the surface of the sand and two holes, about 3 ins. deep, were made at the points where the sand was thickest and thinnest, respectively. Water was then drawn from the filter at the rate of 3,000,000 gallons per diem per acre. As soon as it disappeared from the surface of the sand, the elevation of the water in the two holes was taken and found to be 0.11 ft. lower at the point near the receiving chamber. This difference in elevation is probably due to the fact that the friction of the water on entering the joints is greater than estimated, consequently, that portion of the bed nearest to the outtake is performing higher duty than the more remote portions. While, in moderate sized filters, this difference in the rate of filtration of the various parts of the bed is undoubtedly regulated by the sediment layer, it is extremely doubtful if the best results can be obtained from filters of considerable area, having pipe underdrains, without compensating in some manner for the friction in the underdrains.

The plant was constructed for the Lambertville Water Co., from plans made by the writer, at a cost of $5,600.

THE RESULT OF A FIRE IN A STEEL-FRAME FACTORY BUILDING.

The accompanying view is an excellent example of the way in which unprotected iron structural work fails when subjected to fire. The building was the wire factory of the Quinsigamond Works of the Washburn & Moen Mfg. Co., at Worcester, Mass., and the fire occurred about 9 a. m., on Sunday, April 5. The following particulars are taken from the April circular of the Boston Manufacturers' Mutual Fire Insurance Co., and for the photograph from which our illustration is taken we are indebted to Mr. John R. Freeman, M. Am. Soc. C. E., of Providence, R. I., and Mr. T. J. Porden, President of the State Mutual Fire Insurance Co., of Providence, R. I. The view shows the complete twisting and distortion of the ironwork. The loss involved was $151,130.



EFFECT OF A FIRE IN THE SPRING FACTORY OF THE WASHBURN & MOEN MFG. CO. AT WORCESTER, MASS., APRIL 5, 1896.

The building was two stories in height, with a basement under one end, and had a steel frame supporting the floors and roof. The posts were built up of steel shapes; the floor beams were built-up I beams spaced about 8 ft. c. to c. The second floor was of plank covered by a hardwood top floor. The roof beams were 6 × 12-in. timbers covered with the ordinary plank and gravel roof, the whole supported by the built-up steel columns. The walls were of brick up to the window sills, the remaining part being mostly glass. The window frames were of steel, so that all the woodwork there was in the building was the plank and timbers in the roof, the plank in the second floor, and also the plank over a portion of the first floor, the remaining part of the first floor being of brick. At the end where the fire started the floor was of brick.

The basement at the south end was occupied by the boiler and engine rooms. The first story was occupied by the japanning room, which was separated by a brick wall from the remaining part of the building, and by the hardening and annealing furnaces, the floor at the end of the building occupied by the furnaces being of brick; and the second story was occupied by the special machines for shaping the springs. The floor of this building was free from oil, but the brickwork in the floor below was saturated.

Oil was used as a fuel at the tempering and hardening furnaces in this building, this oil being stored in two large tanks located outside of and near the lower end of the main building. From these tanks the oil was pumped to a secondary tank located on a trestle work near the upper end of the building, from which it flowed by gravity through a 2½-in. pipe to the burners, the pipes being arranged in such a way that when the pumps stopped, the oil in the secondary tank flowed back to the storage tanks, and it was supposed that the oil remaining in the feed pipe would flow to the burners and there be burned up. Located in this feed pipe was a so-called trap, consisting of eight or ten feet of 3-in. or 4-in. pipe. This trap was provided to catch the first delivery of the oil when the machine was started up, this first flow of oil not being of the right consistency to properly feed the burners.

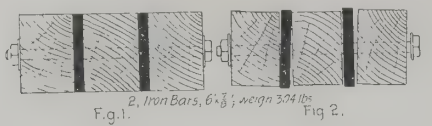
The repair hands were at work making some changes in this feed pipe, and when they disconnected it a small quantity of oil in the pipe immediately flowed out and down onto the portion of the ovens located near the burners. These ovens had not been operated since the afternoon of the day before, but were still hot enough to vaporize this oil and set it on fire. The flames immediately spread throughout the building and almost entirely destroyed it. When the flames reached the upper story the columns supporting the roof immediately collapsed, being bent and twisted. According to the story of eye-witnesses the roof immediately fell, thus adding a large amount of material to the flames.

Nearly the entire building was destroyed. The boiler and engine room in the basement was, however, nearly intact, due to its being fully protected by automatic sprinklers.

It was at first thought that the fire spread over the brick floor in the first story, but it appeared later that fire was communicated from one end of the building to the other upon a condensed and somewhat gummy deposit on the bottom and sides of the I-beams as well as upon the bottom of the planks upon the second floor, generated from the dipping of the heated springs into fish oil for tempering. This thin film of oily deposit on the ceiling and beams of the first floor, and the opportunity on every square inch of that floor to ignite the plank, would sufficiently account for the rapid spread of the fire. The most singular point disclosed in this study of gaseous fires was the very small quantity of oil or of oily or of loose and fibrous stock which will generate a great volume of gas. The adhesive gum said to have been deposited on the ceilings and beams from the effect of the immersion of heated steel in oil would correspond to a coat of shellac varnish, the danger of which is well established. Fortunately the combination of conditions is very uncommon.

The ends of the building, in contemplation of extensions, were of boards fastened to the steel frame. One end was destroyed, the other was impaired but not consumed.

The work done in this building was making steel springs, and there was no wood of any consequence in the building except the material of the floors, roof and ends as above described. There was no fire in or about the building at the time when it was ignited and destroyed. The steel springs, for the manufacture of which the building was devoted, were tempered in the basement in fish oil and the bricks had apparently become saturated with this oil. The operations in the works had ceased, and the pits in which a part of the work of heating is done had been free from heat for a period of time estimated at 16½ hours before this fire occurred. In undertaking the repairs of the oil pipe, the work was done in such a way that a very small quantity of crude petroleum contained in the sag of the pipe went into the works. It there ignited from the heat retained after the regular work had ceased for over 16 hours, undoubtedly generating combustible gases, which, passing along the floor and along the ceiling, may have generated additional gas from the fish oil which had been absorbed by the brick, or possibly from deposits upon the ceiling derived from the constant heating of oil with heated steel. The heat and gas passing upward created the very uncommon condition of very rapid gaseous fire to which previous reference has often been made, and to which infrequent cause in at least three cases very heavy losses have been attributed, one being the heaviest ever incurred by the company. It is noticeable that the excessive heat by which the frame was distorted must have been mainly in the two upper stories. This was proved by finding some parcels of paper and some varnished wooden boxes on the main floor above that part of the basement where the sprinklers worked which were unimpaired after the extinction of the fire.



Figs. 1 and 2.—Flitch-Plate Bolster for Freight Car Before and After Shrinkage.

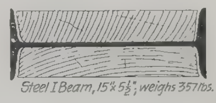


Fig. 4.—A Poor Design for Combination Wood and Iron Bolster.

This building was not protected throughout by automatic sprinklers. Whether automatic sprinklers could have stopped such a gaseous fire in the upper stories is an open question on which the several experts who have examined the case since the fire were at variance. The only rule under which sprinklers could have been called for in such a building would have been the absolute rule often advised but not yet insisted upon as a condition of taking insurance on such buildings as this, except in the place where they were put in; namely, to put sprinklers everywhere, especially in the works or departments of works where fire or loss seems least likely to occur. The general conclusion is that sprinklers would have so cooled the air as to have prevented the distortion of the steel frame.

The question arises in this case on the relative merits of heavy timber as against unprotected steel, and it is apparent that the destruction of this building with its contents may be almost wholly attributed to the heat developed from the oil, rather than from the combustion of the wood of the floors and roof, which was the incident in the course of the destruction, rather than the cause. This will be apparent from the fact that the floor over the first story was left much less impaired by fire than the floors above, where the principal effect of the heat developed by the rising gas was most fully destructive upon the steel frame. The wooden beams which constituted the support of the roof were impaired to the depth of only about 1 in., and would have sustained the roof except for the giving way of the metallic framework underneath. There is little doubt in the minds of all the experts who have examined the conditions of this loss that a heavy timber frame would have resisted the conditions of this fire until it could have been extinguished with moderate loss, the pumps at the other works having been started in time.

A CENTRAL AMERICAN EXHIBITION is to be held in Guatemala in 1897, and manufacturers and others of the United States have been invited to exhibit.

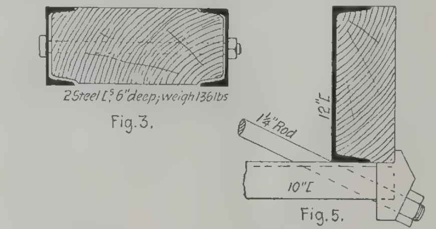
METAL UNDERFRAMING FOR FREIGHT CARS.*

(With inset.)

With the gradual and steady increase in the carrying capacity of freight cars and in the hauling power of freight locomotives, the insufficiency of the earlier methods of freight car construction, developed from wagon building, consisting of timber framing held together by nails, spikes, straps, lag-screws and bolts, became more and more apparent.

The lessons learned on the repair tracks led to the strengthening of freight car body bolsters and longitudinal sills with truss rods, and, finding this to be still insufficient, the timbers have been reinforced with iron and steel as in the well-known flitch-plate bolster, Figs. 1 and 2, or in the fairly effective plating of bolsters, end and longitudinal sills as at Figs. 3 and 5, where the metal is disposed to the best advantage and the shrinkage of the timber can be readily followed up, or as at Fig. 4, where the metal is disposed in its weakest position to withstand the main load that a bolster has to carry.

Some designers, recognizing the inherent weakness in any composite form of construction where wood is used, went at once to iron for body bolsters, and the iron body bolster of which Fig. 6 shows two general types was the result, although in its earlier forms it was made too flimsy and was not sufficiently braced to withstand the bending strains, side-bearing pressures, etc. A more recent form of iron bolster is shown in Fig. 7. A simple, very strong and cheap steel bolster, which has stood the test of service well, is shown at Figs. 8 and 9. Here should also be mentioned the Schoen pressed steel, American and Shickle, Harrison & Howard cast-steel body bolsters, which have been extensively illustrated in the technical journals and are well known to the members.



Figs 3 and 5.—Method of Strengthening Wooden Bolsters and Side Sills. Lehigh Valley R. R.

Figs. 22, 23 and 24 mark a long step ahead in that the center sills, as well as the bolsters, are of steel. It is very probable that the use of iron and steel in car construction would have advanced far beyond its present standpoint but for prejudice which has grown up in the minds of many against any and all iron or steel cars, as the result of some unfortunate ventures in which the designers either did not fully understand the service and strains a freight car has to withstand, or from lack of experience; and in an endeavor to keep the weight and cost of their cars down to limits which would enable them to make sales, placed cars in service that have become a by-word on account of their frequent and prolonged sojourns on the repair tracks.

It would be quite as unjust to condemn all iron or steel car construction on account of these failures as it would be to condemn the use of wood in car construction because some of the earlier builds of cars, and even some comparatively recent designs, are so poorly proportioned that they are constantly failing. The obviously proper course is to profit by these early failures in iron car construction, make use of the experience gained and go on with the development of the steel car frame, trying to avoid the errors of the past. It is only necessary to remind those present of some of the exhibits at the Chicago Exposition to show that progress has been made in the right direction.

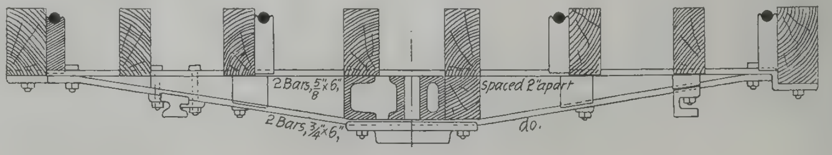


FIG. 6.-TWO EARLY DESIGNS FOR IRON BODY BOLSTERS.

It would be eminently desirable if the M. C. B. standards could be issued in advance for the guidance of railway companies instead of being adopted after the need for such standards has led to the use of a multiplicity of designs, which add to the expense and delay in car repairs. Car building is anything but an exact science, and the evolution of a standard design for an iron or steel car frame must come after many experiments, errors and failures, profiting by which experience we will ultimately achieve success.

Even if the members of your committee felt that they could present a design for standard steel framing for freight cars which would be practically perfect and require no future modification (which is not the case), it would not be practicable to do so until greater uniformity in the lengths and sizes of interchange freight cars for given capacities has been brought about. It is hoped that a thorough inquiry into the subject will be made by the association by means of a committee to recommend standard lengths of sills and widths over sills for refrigerator, box, stock, flat, drop-bottom and drop-end gondola cars of 60,000, 70,000 and 80,000 lbs. capacity, and that the association will adopt such standards.

After this step has been taken, then with sufficient experience and knowledge to guide them a committee could take up the subject of steel underframing for freight cars, and with good hope of success present to the association a series of designs for M. C. B. steel underframes that could be adopted and used, as far as their general features are concerned, without fear of serious failure ensuing.

As long as the main framing of foreign freight cars coming on our repair tracks is of timber (which can be cut and dressed to suit by the ordinary carpenters' tools), and of iron truss rods and bolts (which can be cut or welded by any blacksmith), odd sizes of sills, etc., are not such a serious matter, but when we come to steel and iron, which require heavy machine tools and shop treatment, and where odd sizes or shapes must be specially ordered and rolled or forged at the forges or mills, the question of uniformity of sizes becomes one of paramount importance.

With standard lengths, depth, width of flange and weight per foot for sills of all flat-bottom cars of 60,000, 70,000 and 80,000 lbs. capacity, the rolling mills can carry the stock ready for instant shipment, feeling safe that they will not have it left on their hands as obsolete stock; the sills and shapes in stock at any railroad shop store would be certain to suit any foreign car that might come on the repair tracks, only requiring that the holes, etc., should be laid off and punched or drilled to suit the details of the particular car, but before this happy state of things can be brought about, the standards for lengths and widths of cars must be adopted, and, when steel-framed cars are built, rigidly adhered to.

Pending the adoption by the association of the standard lengths and widths for given capacities, your committee present the following rules or recommendations, which they feel justified in asserting should be seriously considered by designers of steel framing for freight cars:

1. Specially forged, pressed or rolled shapes, cast steel, etc., or patented forms of construction are undesirable for cars to be used in general interchange business, no matter how well designed theoretically, for the reason that when such parts are damaged there must necessarily be long delays in ordering and obtaining these special parts, and should the parties who have furnished them go out of business, or change their molds or patterns, the parts cannot be duplicated for repairs except at enormous expense and loss of time.

2. Steel and iron bars and shapes of standard bridge specifications and regular market sizes should be generally preferred, so that railroads and car builders can avail themselves of the competition in the open market when purchasing, or if not equipped to put steel frames together themselves, can have this work done for them at any of the numerous bridge-building concerns on competitive bids, the underframes, riveted or bolted together, can be shipped by carload lots to the car shops to be completed into finished cars.

3. Get-at-ableness in the design is of the greatest importance in keeping down the first cost and maintenance; parts that are to be riveted together should be so arranged that they will be equally convenient for hydraulic or power riveting when the car is being built, or for field riveting in repair work.

4. In designing riveted work, it should be laid off with plenty of rivets, these to be spaced close, as in boiler work, and the same care to insure true fair holes, hot rivets, well driven and completely filling the holes as in first-class boiler work, is necessary. Complaints sometimes heard against riveted work in car frames and tender frames, on account of loose rivets, can be directly traced to an insufficient number of rivets and poor riveting.

5. If bolts are used to hold iron or steel parts in position, not merely to carry weight, they must be turned bolts (a driving fit), in carefully reamed holes, fitted with the greatest care. When so fitted they will probably give no trouble from working loose, but as this is machine shop work, such bolts should be avoided as far as possible, as it is not likely that such bolts will be fitted in this way on the repair tracks, while it is reasonable to expect that a hot rivet, well driven, can be put in anywhere with the aid of a portable forge. In both riveted and bolted work it is of the utmost importance to per-

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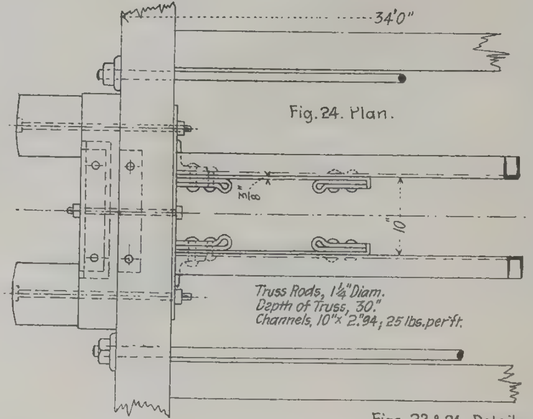
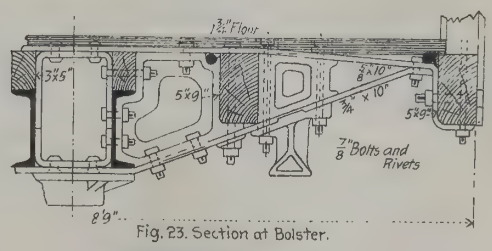
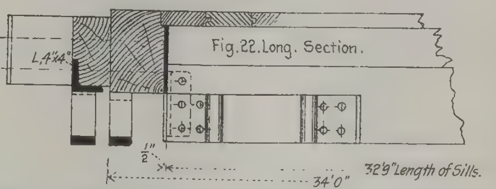
*Report of a committee of the Master Car Builders' Association, presented at the convention at Saratoga, June 18, 1896.







Figs. 22 & 24. Details of Buffers and Draft Connection

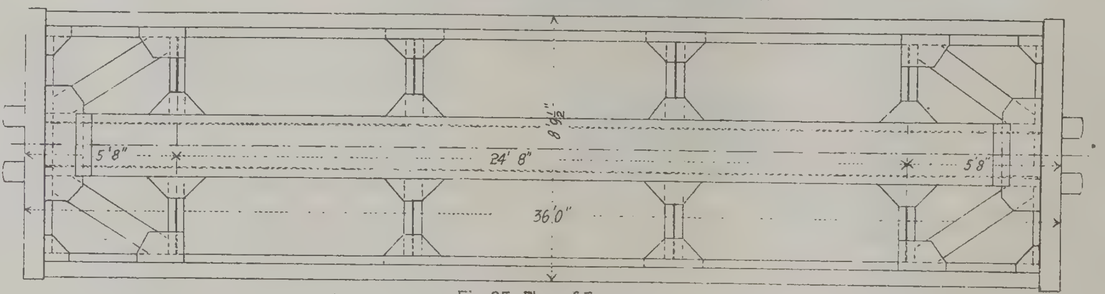
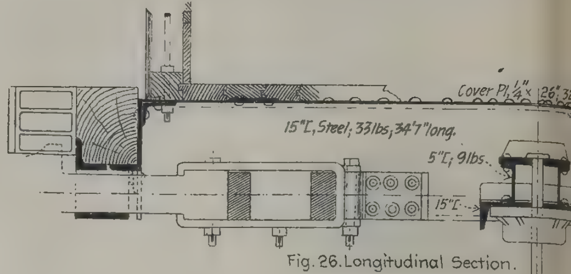
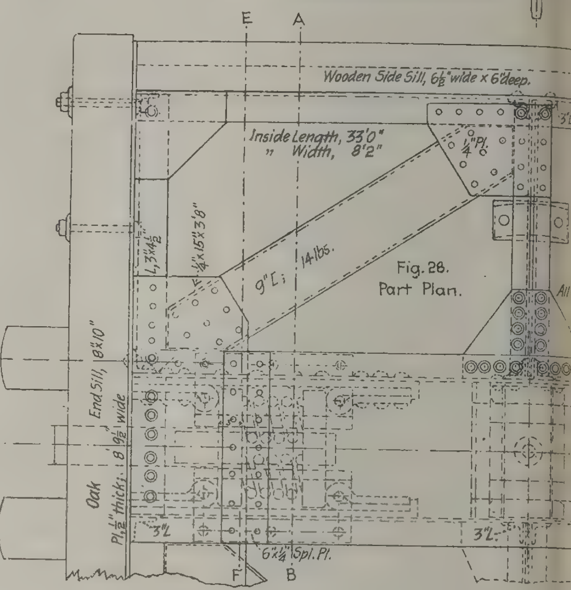


Fig. 25. Plan of Frame.

Figs. 22 to 25. Under Frame with Steel Center Sills for Box Car, 60,000 lbs. Capacity, Chicago, Burlington & Quincy R. R.


Cover Pl. ¼"×
15" C, Steel; 33 lbs; 34'7" long.
5" C; 9 lbs.
15" C
Fig. 26. Longitudinal Section.



Figs. 26 to 31. Design for Steel Underfram
C.
(Total weight, 9,509 lbs. Weight

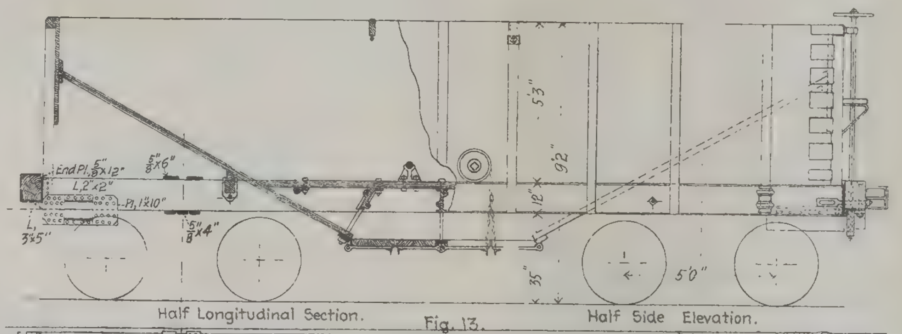


Fig. 13.

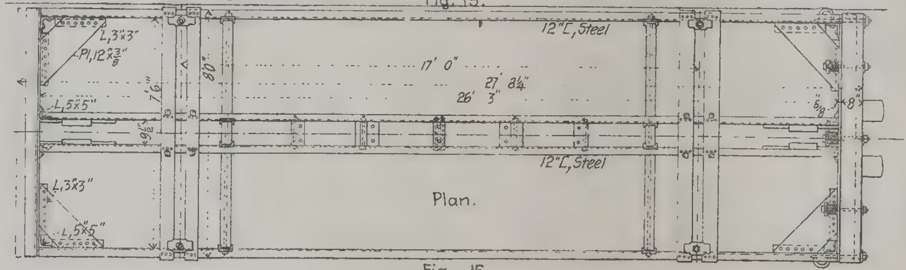


Fig. 15.

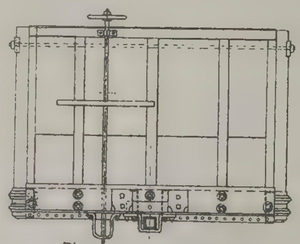


Fig. 14. End Elevation.

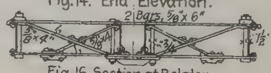


Fig. 16. Section at Bolster.

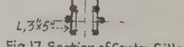


Fig. 17. Section of Center Sills and Drafts.

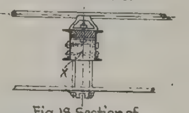
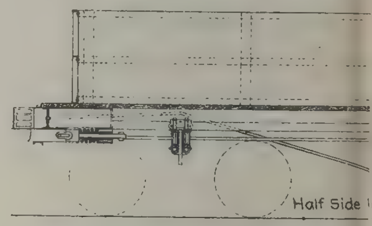
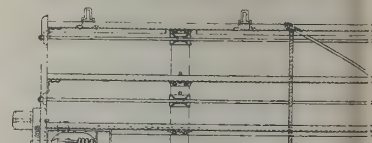


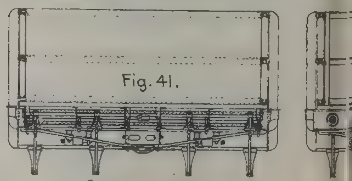
Fig. 18. Section of Center Sills at Center. (Brake Rods run through at "x.")

Figs. 13 to 18. Steel Frame Hopper Bottom Coal Car, 60,000 lbs. Capacity, Norfolk & Western R. R.

(Light weight, with brakes, 29,800 lbs., or 1,500 lbs. more than other cars of same dimensions with wooden sills.)







Cross Section.

Steel Car Construction, D
Atchi

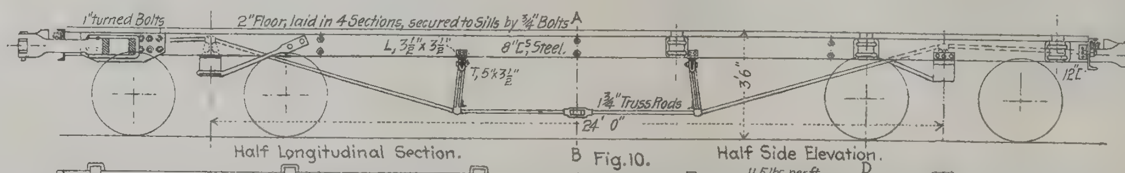


Fig. 10.

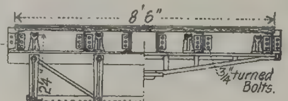


Fig. 11.

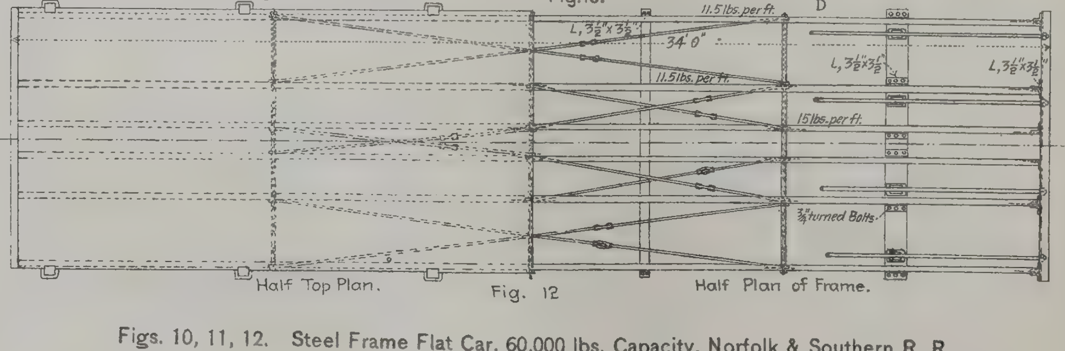


Fig. 12

Figs. 10, 11, 12. Steel Frame Flat Car, 60,000 lbs. Capacity, Norfolk & Southern R. R.

(Light weight, without brakes, 20,3000 lbs. deflection at center, with 80,500 lbs. loading, $\frac{7}{8}$ in.)

½ Section A-B.
Fig. 47.

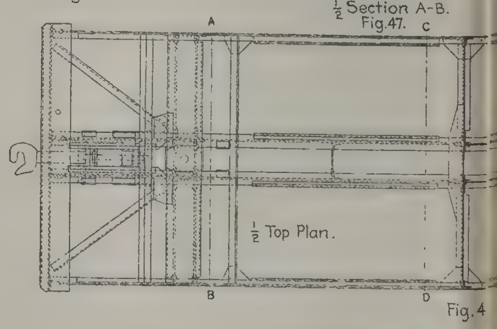


Fig. 4

Figs. 46 to 50. Steel Flat Car, Designe

RECENT PROGRESS IN S

(Accompanying Report of Committee on "Metal Underfr

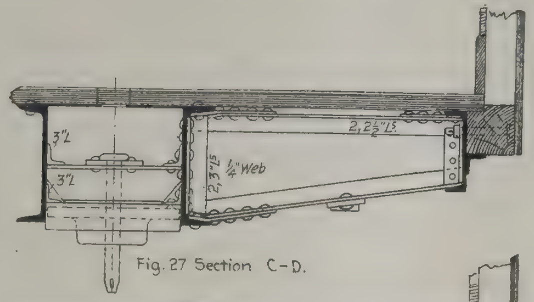


Fig. 27 Section C-D.

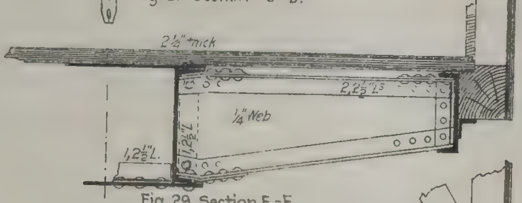


Fig. 29. Section E-F.

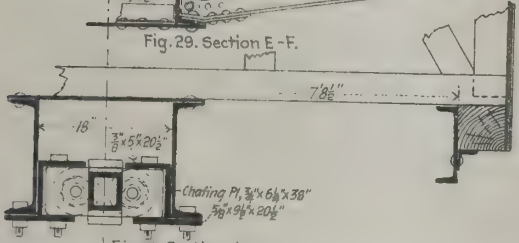


Fig. 30. Section A-B.

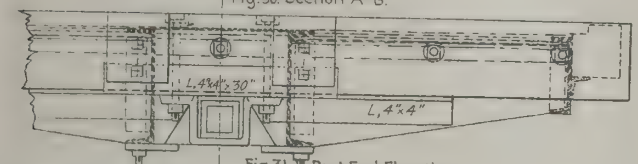
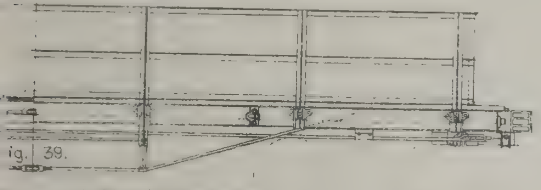
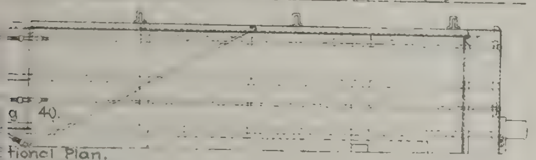
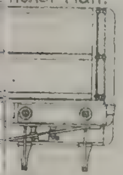


Fig. 31. Part End Elevation.

d Draft Connection.
of 60,000 lbs. Capacity, by R. P. C. Sanderson and
rth, C. E.
nding parts of wooden sill car, 9,628 lbs.)

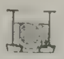

ig. 39.
Half Longitudinal Section.

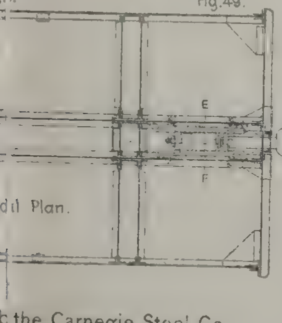

g 40.
tional Plan.


ation.

39 to 42.
John Player, Superintendent of Machinery,
& Santa Fe Railway.

C-D.


½ Section E-F.
Fig. 49.



dil Plan.

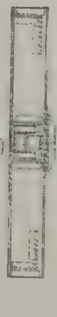


Fig. 50. End Elevation.

the Carnegie Steel Co.

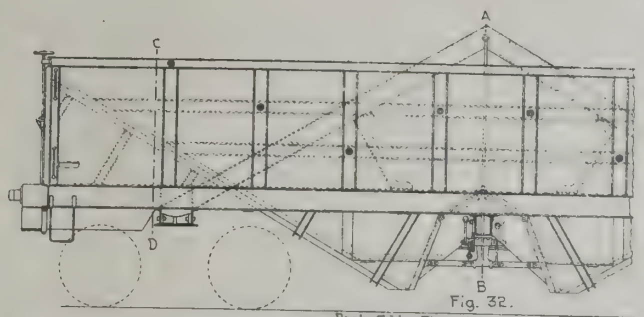
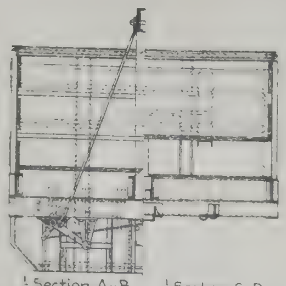
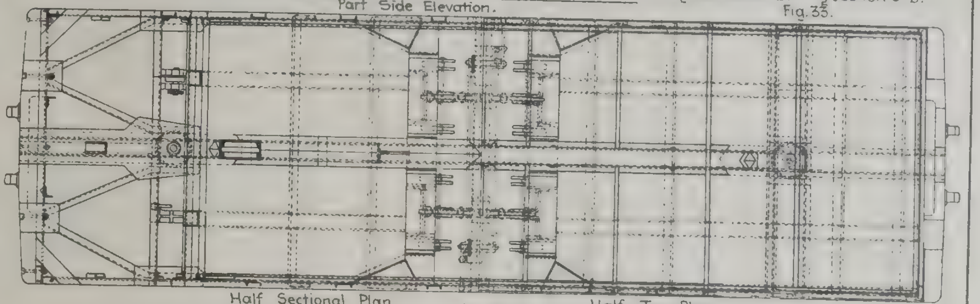
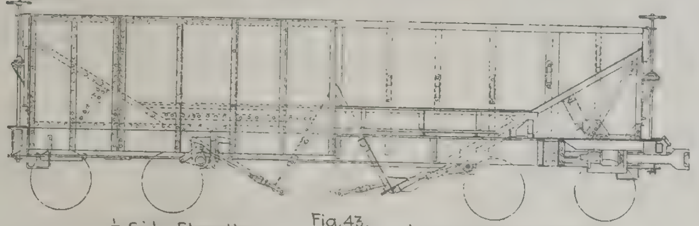


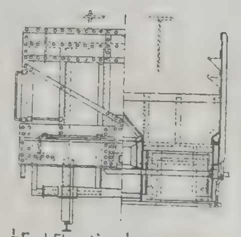
Fig. 32.
Part Side Elevation.

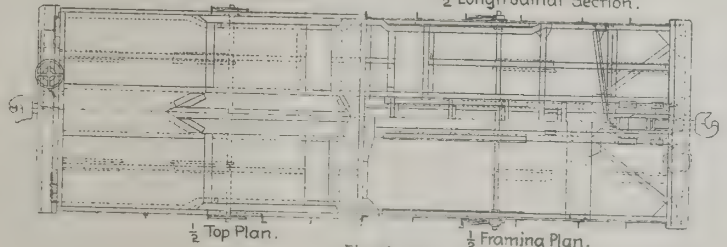

½ Section A-B. ½ Section C-D.
Fig. 33.


Half Sectional Plan. Fig. 34. Half Top Plan.

Figs. 32, 33, 34. Trapp's Hopper Bottom Steel Car, 80,000 lbs. Capacity.


½ Side Elevation. Fig. 43. ½ Longitudinal Section.


½ End Elevation. ½ Cross Section.
Fig. 44.


½ Top Plan. Fig. 45. ½ Framing Plan.

Figs. 43, 44, 45.
Hopper Bottom Steel Car, 100,000 lbs. Capacity, Designed and Built by the Carnegie Steel Co.

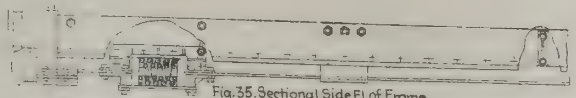


Fig. 35. Sectional Side El. of Frame.

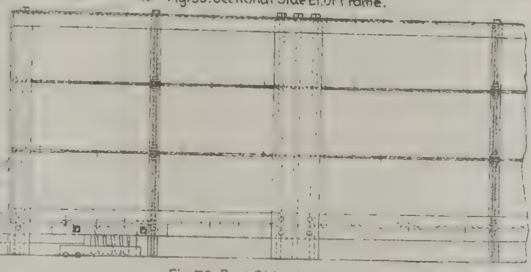


Fig. 36. Part Side Elevation.

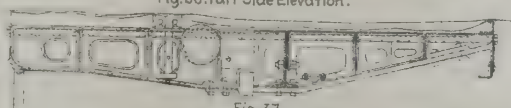


Fig. 37.

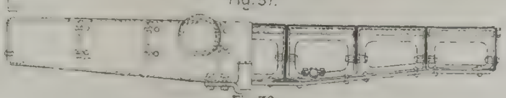
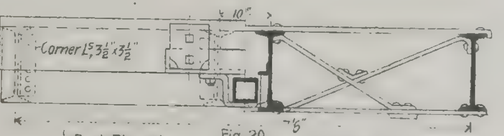


Fig. 38.
Figs. 37 & 38. Designs for End Sills and Bolsters.

Figs. 35 to 38.
Steel Car Framing, Designed by Willard Pennock,
Minerva, Ohio.



½ End Elevation. Fig. 20. ½ Section A-B.

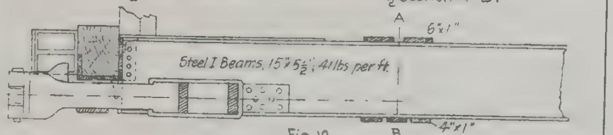


Fig. 19.
Part Longitudinal Section.

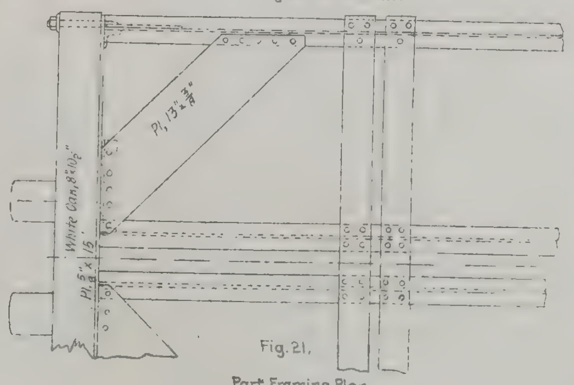


Fig. 21.
Part Framing Plan.

Figs. 19, 20, 21.
80,000 lbs. Capacity, Norfolk & Western R. R.
Design for Steel Frame, Hopper Bottom Coal Car,

R CONSTRUCTION.

Freight Cars," Master Car Builders' Association.)

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

fectly fill the holes, remembering that it is the "initial wiggle," if only 1-1,000 part of an inch, that will surely produce loose rivets and bolts and oblong holes; no amount of hammering on the heads of rivets, or tightening up nuts or bolts, or the use of lock-nuts, nut-locks or fibrous washers will be of any use if the holes are not perfectly filled.

6. Every structure has a foundation, every machine has a bed-plate, every animal, bird, fish, and most of the higher works of nature, have a backbone or spine on or around which the structure is framed; this cardinal principal of design seems to have been largely overlooked in freight car construction, and it is believed that the center sills of a freight car should be made its main strength and reliance, and that the entire load shall be carried from the platform, the upper works being simply arranged as a housing to confine and protect the load.

7. To enable the center sills to withstand collision and severe shocks to the best advantage, these sills should be placed so that they will be directly in line with the dead blocks, and thus take the buffing and collision shocks in direct compression. Also there depth should be such that at least the center line of draft and centers of the dead blocks will be within the vertical dimensions of the sills. When so arranged there will be no tendency from shocks or pulling strains to bend the center sills, either laterally or vertically, or to bend or break the end sills.

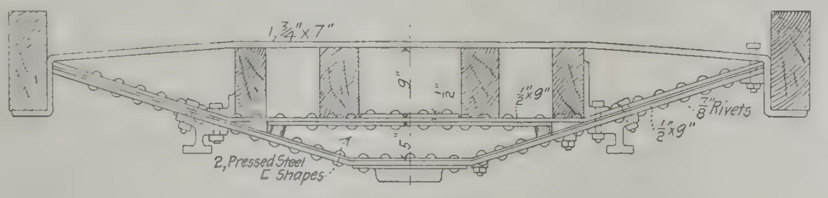


FIG. 7.—RIVETED PLATE BOLSTER FOR 70,000-LB. CARS. NORTHERN PACIFIC R. R.

8. That care should be taken to avoid punching or drilling holes in the flanges of channels or I-beams where these are subject to heavy strains, especially tension or bending strains, unless additional material is added to compensate for this.

9. That with the change from wood to steel, the necessity for truss rods no longer exists for cars of reasonable lengths, but that ample and sufficient strength can be obtained within reasonable limits of weight without the use of truss rods and consequent need of adjustment.

10. On account of the sweating and rusting of iron and steel, wood is preferable to iron or steel for flooring, siding and lining of merchandise and stock cars. Much has been said and written on the subject of corrosion of iron and steel break beams, bolts, pipes, rails, etc., from the action of sulphuric acid leachings from coal cars and salt-water drippings from refrigerator cars and manure drippings from stock cars. There is no doubt that there is serious corrosion from these, and other causes under certain conditions, but evidence exists that steel framing under tenders and iron work under coal cars in constant service, and steel framing of cars exposed to very damp and destructive climatic influences for many years, have not suffered materially from these causes. Doubtless preservative paints can be found that if properly used when the steel frames are first built and with occasional repaintings will sufficiently protect the steel from corrosion, but as this is a very important subject your committee would recommend that it be made a special subject for committee investigation by a series of tests ranging over nine or ten months' time.

There is an economical side to this question which your committee desires to call attention to before closing their report, namely, how much additional weight and how much additional first cost dare be put on a car without ultimate loss.

1. As regards the question of increased light weight of freight cars of given capacities having steel underframes, your committee feel that they need only state that it is proved to be quite practicable to build cars with steel frames of greater strength and capacity with less light weight than when wooden or composite underframing is used, and that with more experience in the right methods of construction and a proper appreciation of the capabilities and best uses of steel the proportion of carrying capacity to light weight can be still further increased for large capacity cars without danger of increasing the subsequent running repair account.

2. With regard to the question of probable increased first cost of freight cars having steel underframing, the burning question here is, "Will it pay?" There are so many factors governed by local conditions which must enter into the calculation, that each company must perforce figure this out for its own set of conditions.

One factor, namely, the repair account, should, however, here receive passing notice. From the best information obtainable your committee believes that it is very nearly correct in stating that the charge for wheels, axles, springs, paint, chain, brake-shoes, brasses, couplers, and other parts that will wear out and fail as much under the most perfect steel-framed car as under the poorest design of wooden-framed car in the same service will constitute about 50½% of the average total cost of freight car repairs, exclusive of inspection, oiling and packing. Then the two questions remain:

1. Of the remaining 49½%, how much can probably be saved by the use of a perfect steel underframing which would require no repairs except painting during the life of the car?

2. Will this saving, added to the increased freight earnings of the car and to the increased mileage earnings when away from home (due to a less number of days per annum spent on the repair track), pay the interest and depreciation on the extra first cost of the steel car?

Taking the figures given in "Poor's Manual," the freight earnings per revenue car for 1894 were about $1.38 per day, and the average mileage earnings of cars away from home are only about 15 cts. per day.

Where the freight car repair work is being kept up currently, the number of cars on the repair tracks can be kept down to 4% of the total equipment; this means that each freight car would spend about 14½ days on the repair tracks each year. If we assume that only 40% of this could be avoided by the use of perfect steel framing, we can possibly save about six days on the repair tracks per annum.

This would mean, if the freights were available, increased freight earnings of $8.28 per annum per car, or 90 cts. additional mileage earned per annum per car away from home.

It is about right to assume, including private cars, that 30% of all freight cars are constantly away from home.

Taking one lot of 1,000 cars we can assume that as above the freight earnings could be increased.............	$8,280	per annum
The mileage earned from foreign roads increased..........	300	" "
	$8,580	" "
Estimated possible saving in repairs, say 20% of $72 per car per annum..	14,400	" "
	$22,980	" "

As the steel framing when put up in lots by bridge builders ought not to increase the cost of cars more than $75 per car at most, this figure of $22,980 per thousand cars for savings and increased earnings would approximate 36% per annum on the extra capital invested, amply sufficient to cover the depreciation and interest charges under the conditions above assumed.

In conclusion your committee begs to present the accompanying drawings of designs for metal underframing for freight cars for the consideration of the members, and begs that members will criticise these designs, using the ten rules or recommendations previously given as the basis for such criticism.

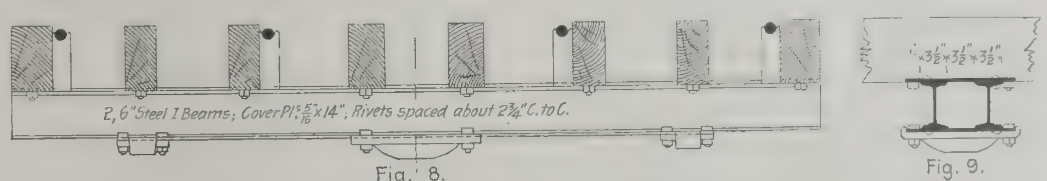

2, 6" Steel I Beams; Cover Pl.s 5/16"x14"; Rivets spaced about 2¾" C. to C.
3½"×3½"×3½"

Fig. 8.

Fig. 9.

FIGS. 8 AND 9.—ELEVATION AND SECTION OF BOLSTER MADE OF I-BEAMS FOR CARS OF 60,000 LBS. CAPACITY. NORFOLK & WESTERN R. R.

R. P. C. Sanderson, Chairman,
J. D. McIlwain,
J. R. Skinner,
John Player,
Roanoke, Va., May 10, 1896. Committee.

THE NICARAGUA CANAL REPORT to the House of Representatives by the Committee on Interstate and Foreign Commerce, states that the committee believes the canal entirely feasible and strongly recommends that the government assist in the completion of the work even if it costs more than $150,000,000. The difference of opinion between the engineers for the government and for the company is thought to affect in no wise the practicability of the project. The committee believes that the main question now is, who shall build the canal and who shall control it when built. The committee feels justified in recommending that Congress should take immediate action to give such aid to the enterprise as may be necessary to obtain the funds which are requisite to complete the work.

GARBAGE AND ASHES must be kept in separate receptacles by New York householders after Aug. 1, in accordance with a regulation of the Health Department and an order issued to the various city departments by Mayor Strong. The new ruling is due to the fact that a contract has been made for the disposal of garbage by one of the utilization systems, as already noted in these columns.

AN AIR-CUSHION FOR ELEVATORS is provided for the safety of the elevators in the new Congressional Library Building at Washington, D. C. It comes into action in case a car should drop and the safety grips should fail to work. At the bottom of the elevator shaft is a well about 13 ft. deep, with the sides ⅛-in. from the car at the top and 1½-in. at the bottom, thus preventing a sudden shock. Satisfactory tests have been made with baskets of eggs in the elevator car and with the car carrying a load of 2,600 lbs.

A HOT-WATER MOTOR CAR for street railways is being tried experimentally at Van Cortlandt, N. Y., on a sidetrack of the New York Central R. R. The water is stored under high pressure in reservoir cylinders on the car, and flashes into steam as it escapes into the engine cylinders. The system is the invention of Mr. W. E. Prall.

THE MASSACHUSETTS PIPE LINE GAS CO. has been chartered by the Massachusetts legislature. The company has power to lay its mains practically anywhere it chooses, the location being subject to the approval of local governing bodies, or in case of non-approval a "reasonable location" is made by the State Board of Gas and Electric Light Commissioners. The company is not permitted to sell gas directly to consumers except through the purchase and operation of existing plants. The prices to be charged for gas are limited as follows: For fuel gas sold to other gas companies or to towns operating plants, per 1,000 cu. ft. of gas having an average heat value of 580 B. T. U., 20 cts. within five miles of the state house; 25 cts. between 5 and 15 miles; 30 cts. beyond 15 miles. For illuminating gas sold to gas companies or towns, the rates are limited to 5 cts. per 1,000 ft. in advance of the above prices, the candle power to be equal to that required by the state law. For both fuel and illuminating gas sold to individuals after the purchase of local plants, the prices must not exceed, within eight miles of the state house, 60 cts. per 1,000 cu. ft.; outside the above limit, in any city having over 75,000 inhabitants, 75, and in any other city, 90 cts.; in any town, $1.25 per 1,000 cu. ft.

THE CATARACT POWER & CONDUIT CO. has been incorporated with a capital stock of $2,000,000 to distribute current supplied from Niagara Falls by the Cataract Construction Co. The latter company will transfer to the new one the franchise granted it by the city of Buffalo. Among the directors of the new company are Messrs. Edw. D. Adams, President, and F. L. Stetson, First Vice-President of the Cataract Construction, D. O. Mills and John Jacob Astor, all of New York, and Geo. Urban, General Manager of the General Electric Co., of Buffalo.

AMERICAN MACHINERY FOR RUSSIA is to be supplied by several of the leading manufacturers of machine tools, as a result of the negotiations which are said to have been successfully carried out for the establishment of new locomotive works at Nijni-Novgorod by an American syndicate. Mr. E. D. Smith, of Philadelphia, and Mr. Walter F. Dixon, formerly with the Rogers Locomotive Works, are at the head of the concern.

RESPONSIBILITY FOR REPAIRS TO PHILADELPHIA street pavements are disclaimed by the street railway companies where the pavements are torn up by other corporations. The street railway companies are reported as saying that the contractors who put down the pavements for them, on streets where there are street car tracks, claim they are not required to make repairs under their guarantee where the pavements are torn up as above noted.

THE RAISING OF THE STEAMER "Ailsa" by means of barrels and caissons filled with air, is proposed by the Midland Salvage Co. The caissons are wooden cylinders 30 ft. long and 8 ft. diameter, with attachments for chains which are passed under the hull of the vessel. The chains are to be made tight with the caissons submerged, and the water then pumped out or expelled by compressed air. The "Ailsa" was sunk in the Narrows, New York harbor, on Feb. 29, by collision with the French Line steamer "La Bourgogne."

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AND
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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

The statutory regulation of interlocking signals for railway grade crossings which was inaugurated in this country by the passage of a special law by the State of Illinois some nine years ago, has been slow to gather disciples, despite its very excellent results in that state, and it is with considerable gratification that we note on another page the recent adoption of a similar law by the State of Ohio. An examination of the Ohio law will show the following provisions: (1) By the installation of an interlocking plant satisfactory to and approved by the railway commissioners of the state, trains will not be required to stop before passing such a crossing. (2) When one of two or more railways crossing at grade desires to install interlocking signals, and the others object, that railway can by petition request the intervention of the railway commission, which, after due and proper hearing of all parties interested, may grant or deny the petition. If the petition is granted the objecting railways shall be compelled to co-operate in the installation of the interlocking plant within such time and at such a proportion of the expense as the commission may determine. (3) All future crossings constructed at grade shall be provided with interlocking plants at the expense of the railway desiring the crossing. (4) Any railway refusing or neglecting to obey the order of the commission for an interlocking plant shall pay a penalty of $500 per week for each week of delay.

The law applies to crossings of electric and steam railways as well as steam railways alone, being much more definite on this point than the older Illinois law. This is unquestionably as it should be, since the recent growth of electric railways has introduced an element of danger the importance of which was unsuspected a decade ago. It is only to be regretted in view of the many recent disasters from electric cars running into open drawbridges that definite provisions were not made by the law for signals in such cases, although the general intent of the law will probably be construed to cover such cases if the question should be brought up. Another provision of the law to be noted particularly is that it compels all steam and electric railways seeking to cross the tracks of any other steam or electric railway to protect the crossing by interlocking, and to pay all expenses of installation, maintenance and operation.

◆

Apropos of the recent discussion on "cheap engineers" in our column of "Letters to the Editor," a correspondent sends us a marked copy of a trade journal, containing on one page a letter from an "engineer," whom we will call J. Blank, and in a "Directory of Consulting Electrical Engineers," the professional card of the same man. We reprint an extract from the letter and the professional card in parallel columns as a luminous exhibit of combined innocence and assurance.

"I think the Steam Engine Indicator is the greatest instrument made from an economical standpoint, but until very recently I did not think much of it. Why? Because I never used one and did not know anything about it. Up to about two months ago, I was using far too much fuel; tried everything in the line of economy, but to no purpose; finally bought an indicator; put it on according to directions; first diagram shows a ratio of 124 to 60, or that one end was doing over twice as much work as the other, hence the belts would jump, engine would shake, dynamo would jar and spark. We equalize the engine; result, $27.35 saved in coal the first month, and we are still improving. The Indicator is a fixture in our plant."

J. Blank.

J. BLANK,
ENGINEER
AND
ELECTRICIAN.

Engines Indicated.
Power tests made.
Electrical testing and repairing.
Small Isolated Plants erected.
Plants overhauled and repaired on premises.
Repairing Arc Lamps a specialty.

◆

We have recently received two pamphlets entitled "Results of Tests made in the Engineering Laboratories of the Massachusetts Institute of Technology." They contain in tabular form the detailed results of many hundred tests of specimens of iron, steel, copper wire, timber, etc., besides records of trials of steam boilers, condensors, injectors and other apparatus. If the object of these pamphlets is to show that a vast amount of testing is being carried on in the laboratories of the Institute, they no doubt accomplish their object; but if the intention is to convey useful information to engineers, the pamphlets appear to be a failure. There is no index; the classification is imperfect; all tests of steel, for instance, to the number of about 240 are arranged in the order of the date of the test instead of being classified as to grade of steel, size of specimen, etc. The chief defect, however, is the lack of any summary of results or of any explanation whatever as to what the tests are intended to show and do show.

Perhaps it may be said that the tests were not intended to show any especial thing, but were merely the ordinary routine tests carried on to give the students training in the conduct of tests. But if this be the case, is it really worth while to spend the Institute funds to print these records in detail, merely on the chance that some information contained in them might be of value to some engineer?

On the other hand, it is stated in a very brief prefatory note that it is proposed to publish "such results of tests made as part of the regular work in the engineering laboratories of the Institute as may be of interest to the engineering public."

We gather from this that the professors who supervised these tests and selected them for publication, think that there is something in them more than mere routine work. Probably, too, they know what this "something" is. Then why not say, boldly and plainly, just what information of practical value is contained in this labyrinth of tables? In the absence of some guide of this sort, we greatly fear that the busy practising engineer will never attempt a search through this bewildering mass of figures merely on the chance of digging out some valuable piece of knowledge. Even the technical editor, whose special province it is to hunt up useful information in all sorts of likely and unlikely places, well nigh despairs at the task of hunting out the "two grains of wheat from the two bushels of chaff" in this case.

◆

We have for example looked over the detailed record of 240 tests of steel. We find that the modulus of elasticity of all the steel tested of whatever class is usually between 28,000,000 and 31,000,000 lbs., so that out of 40 tests, about 36 will run between these limits, and the other 4 generally not more than 1,000,000 lbs. beyond them. We also discover that one piece of plate steel, kind not stated, showed a modulus of elasticity of 35,455,000, and a piece of Bessemer steel a modulus of only 24,811,000. The "engineering public" might be interested to know whether these extreme results are due to the inaccuracy of tests by students or whether they are figures which are actually characteristic of the steel, and likely to be found at any time in any steel, although the practicability of finding them in any particular case is less than 1 in 100. What causes the high and the low modulus, and with what other physical or chemical characteristics are they coincident? The pamphlet, however, gives us not the slightest information on this subject, and in the absence of any other knowledge we can only conclude that the low modulus may be due to a flaw in the steel, and the high one to an error in measurement.

Now there may be other and highly valuable information hidden in this record of 240 tests, but if there is, who should know it, if not the professor that supervised the tests; and if he knows it, why not give the profession the benefit of his knowledge?

Turning over to the tests in the steam engineering department, we find some tests of an ejector and a pulsometer, and we look to see what information is given concerning the efficiency of these devices. We find that the ejector did from 500,000 to 1,200,000 ft.-lbs. of work per 1,000,000 B. T. U., while the pulsometer, with the same amount of heat, gave from 1,000,000 to 7,000,000 ft.-lbs. of work. Examining further, however, we find the statement that:

> The duty (foot-pounds of work done per 1,000,000 B. T. U. used) was calculated assuming that the heat put into the delivery water was not wasted. The heat used per pound of steam was taken as the total heat of the steam less the heat of the liquid at the delivery temperature.

A similar statement is made for the pulsometer test. We have to conclude, therefore, that the duty or efficiency given above is applicable only to the case in which either of these devices is used in a brewery, tannery, dye-house or some similar situation, where the heat imparted to the water by the steam is of value. But to the best of our knowledge, by far the more frequent applications of these instruments is in situations where the addition of heat to the water raised is of no importance whatever. Hence the efficiencies or duties above noted are not comparable with those of other low-duty water-raising devices, such as small, direct-acting steam pumps.

Perhaps the conductor of these tests had some good reason for the method which he chose; but if he had, why not state it? The fact is often lost sight of that the sole object of statistics, tables, diagrams, etc., is to convey ideas to the mind. The table or diagram which is published with no accompanying explanation of the truth which it shows, will in the great majority of cases be passed over by the busy reader unnoticed.

THE CONSTRUCTION OF STEEL CARS.

Probably the most important question which was considered at the recent convention of the Master Car Builders' Association, whose proceedings we reported in full last week, was the construction of steel cars. It is true that at the present time very few steel cars have been built; but the concensus of opinion of the best informed men engaged in rolling stock construction is that a change from wood to steel for the center sills (which structurally are the most important members of a railway car) is inevitable. We reprint in this issue the excellent report of the committee on this subject which was presented at the meeting, and our inset sheet shows the various designs of steel cars which accompanied that report. It is altogether likely that the subject of steel car design will be brought before a great many bridge companies and engineers engaged in structural iron work during the next few years, and we commend to them the principles laid down by the committee to govern such design. We venture to say that the designer who fails to observe any one of these rules, lessens by so much his chances of success. The only exception we would make in the list of ten requirements which are laid down by the committee, is that in the specification for riveting, it would have been better to have likened the quality of workmanship required to first-class bridge work instead of to boiler work.

On the other hand, some of the points touched upon by the committee seem to deserve greater emphasis. We may note for example the recommendation that truss rods should be dispensed with, and we may add to this that the main members of the under frame should be straight girders. The car frame may well be likened to a bridge. It is a continuous girder resting on two supports, some 20 ft. apart, and its end overhanging these supports about 7 ft. No engineer building a girder bridge for such a span would think of using truss rods beneath it, nor would he at the present day attempt to use anything but a straight beam or girder. Exhaustive tests with steel cars already constructed show that they stand up under loads 50% in excess of those they were designed to carry with exceedingly small deflection. There is, therefore, no need, either for strength or stiffness, to complicate the construction by using either trussing or by adding members beneath the frame at the center to aid the beams to carry their load.

Another recommendation of the committee which deserves emphasis is that with respect to making the center-sills of the car its backbone, so to speak. It is evident that the load which the car frame has to carry may be supported either by a series of, say, four to six shallow beams running parallel to each other the length of the car, and spaced an equal distance apart, or the bulk of the metal can be concentrated in two deeper beams at the center with lighter beams on each side. Of these two types of construction, the latter is the one evidently favored by the committee, and the reasons will be evident to anyone who has studied the forces which are exerted in a serious railway wreck. These deep beams have much more stiffness as well as strength than the shallower construction. In a collision these beams will be subjected to end compression, and will act as columns. A heavily loaded car might, in this way, it is conceivable, be subjected to a strain which would give it a permanent sag at the middle, and it will be more likely to suffer in this way the shallower the beams with which it is made. Again, the buffing shocks, which are the most serious the car has to sustain in service, will, if the metal is concentrated in the center sills, be transmitted through the train, with less strain on the connections between the center and side sills than would be the case if all the sills were of uniform depth.

We have alluded to the very great strength of steel car under frames. The Universal Construction Co., of Chicago, which has actively taken up the promotion of steel car construction has piled upon the frame of one of its cars of the Pennock pattern of 80,000 lbs., nominal capacity 126,000 lbs., 140,000 lbs., and finally 159,200 lbs., this last load deflecting it only ⅝-in. at the center. To make these tests the car body was supported not on its trucks, but on special blocking. It is evident from this that steel car under frames may and probably will be designed to easily carry much greater loads than are carried by any car now in regular service. A barrier is thus removed which has hitherto stood in the way of the economical construction of cars of very large capacity, and it is proper to inquire what are to be the results. What limit are we to set to the capacity of freight cars? It is but a very short time ago that the 60,000 lbs. car was considered an innovation of doubtful propriety. Now, every railway which handles great quantities of bulk freight at a low cost endeavors to move it in cars of this capacity. Again, the 80,000-lb. car is hardly in the future. Already a standard axle journal box, etc., for cars of this capacity has been designed by the Master Car Builders' Association, and the roads that handle coal and iron ore are ready to use it. The use of steel underframes will certainly mean an impetus toward the construction of cars of this capacity, and larger capacities, for whereas the cost of, say, a 40,000-lb. car would be much more if built in steel than in wood, when it comes to a car of 80,000 or 100,000 lbs. capacity, the difference in cost tends to disappear on account of the great amount of timber of first-class quality which it is necessary to put into such a car.

Again, the introduction of steel underframes is likely to mean another extension in the length of freight cars. An increase in length is, in fact, necessary, if we are to go beyond 60,000 or 80,000 lbs., for only the heaviest classes of freights can be loaded beyond this limit. There is a demand for an increase in length also from the shippers of bulky freights, who want longer cars in order to reach the allowable limit of weight.

Now, in view of these manifest tendencies, it is true that the question was asked whether a material increase in the length or carrying capacity of freight cars is desirable and should be permitted. Are 40 ft. freight cars and cars of 100,000 or 120,000 lbs. capacity going to cheapen the cost of rail transportation, or can they be safely permitted?

The question of safety deserves first consideration. We have seen that the car frame can be made strong enough for all demands, and metal truck construction also enables us to design a truck to carry any desired load. Axles, too, can be made of any size; but when we come finally to the wheels, it would appear as if some limit might be set. The American railway freight car is likely to have eight wheels and no more for a long time to come, and those wheels are likely to be made of chilled cast-iron and nothing else, so long, at least, as the product of car wheel foundries is sold at such astonishingly low prices. Chilled cast wheels are now running by thousands under loads per wheel reaching 10,000 to 12,000 lbs., and some are loaded, we presume, to 13,000 lbs., or even more. How much farther can we go? Is 15,000 or 18,000 or 20,000 lbs. a safe load for a chilled cast-iron wheel? Where shall we set the limit? That a limit there must be, somewhere, must, we think, be conceded. The thickness of a car-wheel flange is fixed and cannot be increased. The bearing surface between the rail and wheel, too, cannot be altered, save in a long term of years, for a freight car may go with its load anywhere, over rails of any section, from 100 lbs. down to, perhaps, 35 or 40 lbs., on some remote road. It will doubtless occur to many of our readers that if the wheels do not set a limit to the capacity of freight cars, the condition of rails and bridges on some railways will be likely to stop the progress of cars of excessive capacity at some point in their journey.

If an 80,000-lb. car weighs 35,000 lbs. empty and we allow for safety that it may be overloaded 10% when a consignment of steel rails or bridge iron comes along, such a car loaded may have a total weight of 123,000 lbs., or, say, 15,000 lbs. per wheel. A car of 100,000 lbs. capacity weighing 40,000 lbs. would increase this to nearly 18,500 lbs. If this is not near the limit which should be placed on the use of cast-iron wheels run at modern freight train speeds reaching at times 40 miles or even 50 miles per hour, then it must be uncomfortably near it. We are aware that the cast-iron wheel has done wonders; to it in no small degree is due the astonishingly low cost of moving freight in this country; but when engine driving-wheel loads exceeded the limits which were common a dozen years ago, cast-steel and wrought-iron centers began to displace cast-iron; and steel-tired wheels have very generally displaced chilled wheels under engine trucks. It is reasonable to believe, therefore, that there is a safe limit, not very far ahead, to the load on a chilled wheel.

But we must pass to the question of economy. A vast deal has been said, and truthfully said, of the reduction in the cost of freight transportation, due to the increase in car capacity; but at the same time it is well to recall that for general interchange service there is such a thing as too large cars. For local freight service on a very large number of railways the 30,000-lb. car is more economical than any larger size. The advantage of the 60,000-lb. car lies in the handling of bulk freights, or in general wherever full car loads and plenty of them can be had. For picking up local freights on small branch lines, cars of less capacity are, it is very certain, more economical.

To as large an extent as possible the railways meet these conclusions by keeping their old, light-weight cars in local service, and the newer, larger cars on the through freights; but this distribution can only be partially made. In times of car famine, such cars as are on hand are sent where the demand is most urgent, and necessarily go through with their loads. In general, then, the question what is the limit to which cars should be built for use in general interchange is a question deserving attention. If it is admitted that for a large percentage of the traffic of the country the 60,000-lb. car is too large for the best economy, does it not follow that we have gone far enough in the direction of enlarging the capacity of cars for use in general interchange?

If the coal carrying roads, the ore roads, or the roads moving great train loads of grain can employ 80,000-lb. or 100,000-lb. cars with profit, as seems altogether likely, let them build such cars, use them in their own traffic, and keep them on their own routes. To put such cars into general interchange service, however, would appear to be against the best interests of both the owner and the user and it will doubtless be avoided if the matter is correctly understood. The question relating to the size and capacity of cars for general interchange service were discussed in our issue of March 12.

As for an increase in the length of freight cars it is very doubtful whether an increase in the length of cars for general interchange service would be a real gain. Doubtless for the shipment of bulky freight a gain would be made; but if a car is to go out and roam over the country carrying now furniture, now flour, now machinery, etc., etc., it is better to design it for general service than to give it a size or capacity which increase the percentage of dead weight hauled during a large part of its life.

There are many other problems in connection with steel car construction which deserve study; but space permits us to speak of only one more. We have alluded already to the buffing shocks which a car body has to sustain. There seems reason to believe that if the time comes when solid trains of steel frame cars are run the shocks due to buffing will be much more severe, both upon the lading and upon the drawgear, than at present, unless some means are taken to absorb them.

It is a matter of common knowledge that wood absorbs shock in a much greater degree than iron. What part of a buffing blow is taken up by compression of the car sills is unknown, but it seems reasonable to believe that it may be a good deal. Besides this we have the compression of the end sills, draft sills, etc., at the points where the iron members that receive a blow are attached, to aid in absorbing the impact.

With a steel underframe, on the other hand, the shock received at one end of the car will be transmitted through practically solid metal to the other end. Suppose a 50-car train of steel cars running through sags and over summits. Will not the couplers between the cars be hammered to pieces if they have to resist the entire effect of the blows? Or, on the other hand, suppose the couplers are protected, as they should be, by iron buffer-blocks. Will not the shocks that will result tend to displace and injure the lading to a greater extent than now?

We make these merely as suggestions of points that deserve consideration in studying the general problem of steel car design. If it is found that the shocks do occur, as we have surmised, it may be found necessary to adopt some special form of spring or friction buffer to absorb shock between the cars, or even to use wooden buffer blocks, which could be easily and cheaply replaced when battered to pieces, instead of cast-iron. That the difficulty could be met in some such way, should it be found necessary, we do not doubt.

LETTERS TO THE EDITOR.

Garbage Disposal in England.

Sir: In the Engineering News of June 25, 1896, Mr. Rudolph Hering gives some very interesting progress reports of the operation of the garbage destructors at Berlin.

The tendency of modern practice in European cities for the disposal of city refuse is growing toward cremation as the safest and least expensive method. The city of Hamburg, directly after the terrible cholera epidemic of 1892, found itself placed in a peculiar and trying position. On account of the danger of infection from cholera germs which might be lodged in the garbage and house refuse, nobody could be found who was willing to receive it, as had been done before; and the city was therefore driven to provide some means for speedily and economically getting rid of it. Destruction by fire offered them the only solution, and as a result their present efficient and compact plant was evolved from the studies made under the direction of their Chief Engineer, Mr. F. Andreas Meyer. At the time of my visit to this plant, in November, 1895, only six cells were in operation, but the results from these were so encouraging that thirty new cells were under construction, and, I understand, have since been finished.

Many other continental European cities are debating this question, and watching the results of the Hamburg and Berlin experiments.

In Great Britain destruction by fire is the universal practice for the inland towns and for many seaports as well. There are more than 47 towns having destructors with a total of over 500 cells. The list can not be made complete, as many of the plants are constantly adding new cells as they are needed. Manchester has 68 cells,* Leeds, 50 cells; Birmingham, 37** cells; Bradford, 35, and so on.

The Hamburg plant is one of the largest garbage destruction plants in the world, and has a greater number of cells in one combination than any other.

The experiments in Hamburg, the results of which are not yet made public, promise to be very interesting and valuable. They go into the determination of the proper dimensions to be given to the various parts of the furnaces and flues to produce the best results. They include, among other things, a determination of the quantity of air required for the combustion of a ton of garbage, pyrometer tests and anemometer and barometer tests of the draft below and above the grates, as well as in the flues and stacks; also the relative efficiency of combustion with steam draft and with air blast. With either of these forms of artificial draft the quantity of oxygen supplied to the fires can be regulated at will, the difference between the two being in the amount of moisture supplied with the draft.

The process of burning is entirely chemical in action and is most complete when the conditions are proper for just a sufficient supply of oxygen to the fire and when the sections of the furnaces and flues are just sufficient to remove all the products of combustion, as they are formed. It is the province of the Hamburg experiments to determine some of these factors so that the designing of destructors may be based on scientific investigation.

The Hamburg destructors are built by the Horsfall Company, under their patents, and embody many improvements suggested by the Hamburg authorities, as a result of their studies.

In Mr. Hering's article, referred to above, the analysis given in the first Berlin progress report, for English refuse, might be considered as representative of the composition of the average ash-bin refuse of England. It is the analysis made by Professor Forbes of the Paddington refuse. Below is given Mr. Joseph Russell's* analysis of the average composition of the London ash-bin refuse, which I have arranged in the same manner as that given in the Berlin analysis, for purposes of reference; it will be seen that the London refuse is exceedingly rich in the products of imperfectly burned fuel; even more so than that given in the Berlin report for English cities:

Coal and coke	.84
Breeze (cinders and ashes)	63.69
Paper	4.28
Rags	.39
Bones	.48
Straw and other fibrous material	3.22
Vegetable, mineral, etc	4.61
Fine dust	19.51
Broken glass	.47
Iron	.21
Broken crockery	.55
Tins	.79
Bottles	.96
	100.00

The city of Leeds, in June, 1894, made a series of interesting tests of their destructors to determine their capacity and what it would cost to burn different quantities of garbage per day.

The results of these tests are set forth in a very interesting paper read before the Public Medicine Section of the British Medical Association, Aug. 2, 1894, by Mr. J. Spottiswoode Cameron, M. D., D. Sc., etc. It was published in the "British Medical Journal" and also in "Public Health," November, 1895.

A short abstract from this paper may not be uninteresting here. Before giving this extract, however, it may be well to state the disposition which they make of the different classes of city wastes. The horse droppings on the streets are largely cleaned up by farmers' lads sent in for the purpose. Each has a small cart and a pan and brush and the city allows them the privilege, without cost to either party. What these lads do not collect the city gathers up and mixes with the stuff from pans and closets and sells it for manure. The sweepings from the paved streets they take to certain localities and stack in piles to use as a binding material for the surface of newly macadamized roads. Sewage sludge they pump into pies about 50 × 60 and 2 ft. deep, surrounded by an earthen embankment. The water is allowed to drain and then the farmers come in and take the sludge away. The city used, formerly, to get five shillings a ton for this partially dried sludge. After a while they were glad to get one shilling for it, then sixpence, and now they are glad to be able to get rid of it without expense. The ash-bin refuse is taken to the destructors and burned, together with the refuse from markets and manufactories. The sorting of the materials at the destructors is done by hand and consists merely of removing the pieces of iron and other large incombustible materials.

The following is a description of the cells in which the tests were made, taken from Dr. Cameron's paper:

> The cells are placed back to back and fed from the top. The material passing over a bull-nose division to the two sets of cells, passes on to the concave side of an arc of a circle of fire brick. At the lower part of the curve the material reaches the fire-bars. These are sloped at an angle of about 30° and have an area of 7 ft. wide by 5 ft. long. The walls of the furnace are lined with fire-brick and just above the bars a strip of iron is fixed, but not in contact with the brickwork, to prevent the clinkers from fusing into the latter.

Underneath the fire-bars steam jets are introduced, two to each cell. These jets are made of two frustums of cones joined at the small ends, at which point they are 6 ins. in diameter; at the larger ends they are 9 ins. in diameter; the total length being 3 ft. The jets of steam vary in size from ⅛-in. in diameter to ½-in., with the boiler pressure of 60 lbs. per sq. in. Dr. Cameron continues as follows:

> In 1891 experiments were made at the Kidacre St. destructor to ascertan, amongst other things, what the difference in temperature was with the steam jets and without, with the following result: The experiments extended over two periods of 24 hours each, similar material being used on each occasion (19 hours dry ash-bin refuse and five hours wet ash-bin refuse), and temperatures taken hourly. It was found that the ten cells burned 6.2 tons per cell without, and 6.7 tons per cell with steam jets. The same number of men were working in each case. The temperature without the jets averaged 1,118° F., counting three observations when the pyrometer index touched its maximum as 1,500° F. With the jets the average was 1,464° F., but these included 17 observations when the pyrometer could register no higher. It is possible that the excess of temperatures of 346° F. would have been more like 500° if we could have registered it.

These temperatures are presumably in the cells, although the record of the experiments does not say so.

In Liverpool, Mr. H. Percy Boulnois writes me that a set of temperatures recently taken in his destructors gave the following values:

	Degrees F.
Temperature in the cells	900 to 1,000
In flue close to cells	900 " 1,000
In flue before cremator	600 " 700
In cremator	1,500 " ...
In base of chimney	675 " ...

They have a natural draft only, from a tall chimney.

Quoting again from Dr. Cameron's paper on the tests at Leeds:

> The amount of work done by our destructors in 1894 was equivalent to the burning of 63,132 loads of rubbish, weighing 65,151 tons.* Some of the cells were not working full time, but the quantity named was burned in 11,644 cell-days, which is equivalent to nearly 5.6 tons per cell per day.

The experiments made in June, 1894, by Messrs. Darley & Putman, at the request of Mr. Hewson, City Engineer, were conducted under the following general conditions:

> The furnaces . . . had a grate area per cell of 35 sq.ft., were in full go, and were clinkered immediately before the commencement of the tests. The tipping floor was cleared; all the material placed upon it afterwards was weighed, the material at the end of the experiment being weighed and deducted from the gross amount placed there. The clinker removed was also weighed, but no computation was made as to the increase or decrease in the amount of flue dust. The experiments lasted for either 12 or 24 hours each, and ended with a clinkering of the cells. The wages were calculated at the rate of five shillings per working day of eight hours. The steam jets (used in all the experiments but one) were two for each cell.

Experiments in 1894 with Destructor Cells at Leeds, England, by Messrs. Darley & Putman.
(Area of grate bars, 7 × 5 ft.; jets, 2 to each cell; pressure, 60 lbs.; wages at rate of 5 shillings for 8 hours.)[1]

Date.	No. cells.	Durat'n experiments, hrs.	Diameter stm jets.	Frequency clinkering, once in.	Tons burnt.	Temperature flue.	Men empl'y'd.	Wages firemen.	Per cell-day			Wages pr ton burnt.	Clinker.
									Tons burnt.	Men emplyd.	Wages paid.		
1. June 12	4	12	⅛-in.	2 hrs.	20.4	1,500°F.	3	$3.75	10.20	1.5	$1.87	$0.17	36.5%
2. June 13	4	12	None.	2 "	16.5	1,050 "	3	3.75	8.25	1.5	1.87	.21	35.5%
3. June 25 and 26	4	24	½-in.	1 hr.	63.1	2,000 " [2]	12	15.00	15.78	3.0	3.75	.23	35.4%
4. June 26 and 27	4	24	¼-in.	1 "	60.15	2,000 " [2]	12	15.00	15.04	3.0	3.75	.24	32.2%
5. June 27 and 28	4	24	⅛-in.	1 "	54.35	1,500 "	12	15.00	13.59	3.0	3.75	.26	37.0%
6. June 28 and 29	2	24	½-in.	½ "	53.50	2,000 " [2]	12	15.00	26.75	6.0	7.50	.27	35.9%

[1] Figures for cost have been reduced to American money by allowing 25 cts. per shilling, and 2 cts per pence. The tons are doubtless long tons. [2] Frequently 2,000° F.; i. e., melted copper.

> The general lesson from these experiments, not carried out for the purpose of exploiting any patent, but merely to test our own existing plant, is to the following effect: The amount consumed per cell increases with the frequency of clinkering, but the cost per ton burned is increased at a more rapid ratio. The frequency of clinkering can be rendered practicable by increasing the rapidity of combustion. This can be done by steam jets, and the most frequent clinkering and the greatest amount burned per cell was accomplished with two ½-in. jets at 60 lbs. boiler pressure. The cost in firemen's wages, however, in obtaining these tremendous results (26¾ tons per cell per day) was nearly 53% higher per ton burned than when the clinkering was every two hours and the consumption ten tons per cell per day. It must also be added that the wear and tear of the plant is much greater at the higher output, though exactly in what proportion the experiments do not enable us to say. On the whole, the high output method of working the destructors is not economical.

The writer visited these works (Leeds) last December and was informed that the most economical rate of combustion appeared for them to be about 6½ tons per cell per day, but that the rate would vary greatly with the varying composition of the refuse. On market days, for instance, it would not burn nearly so well as when it was ordinarily dry and contained much coal. The stuff which they were called upon to dispose of varied considerably; sometimes they would have large quantities of spoiled canned goods and occasionally large quantities of condemned meat. On one occasion they had a lot of condemned hogs which they put into the furnace whole. They burned very readily, a whole hog disappearing into ashes in about half an hour.

In Cambridge, England, the writer visited the new destructors built under the direction of Mr. John Wood, C. E., of Liverpool. These furnaces are remarkable in the results obtained in the development of power from the burning of garbage. It must be said that the composition of the garbage is very favorable for such purposes, containing, in the writer's opinion, a large quantity of paper, straw, rags, wood, unburned coal and cinders. The destructors are arranged so as to develop the greatest possible heating qualities for the purpose of generating steam, to pump the sewage of the city to the farm, two miles distant, where it is spread over the surface. The destructors are alternated with Babcock & Wilcox boilers in such a manner that each boiler has two destructors to furnish it heat. Cremator fires can also be built in the fire-boxes under the boilers, in order to destroy the unconsumed gases resulting from the loss of heat in heating the boilers and to supply extra heat for the boilers if necessary. The work which they get from their plant is sufficient at present to pump 1,250,000 gallons of sewage per day, with a lift of 40 ft. The pumps are in duplicate, made by Hawthorne, Davey & Co., of Leeds, and are of about 70 HP. each. They run now on 50 lbs. steam pressure, which is generated by the heat from two destructors. They run the pumps in two shifts of six hours each per day. They do not get enough garbage at present to run all day and night too, and so they are obliged to use coal under the boilers at night until the morning collections come in. The cells are fitted with Boulnois & Brodie's patent charging cars. They burn from 8 to 10 tons per day per cell, with forced draft, supplied by a fan blower forcing air under the grates. They develop about 30 HP. per cell in this way. Southampton also has recently made plans for increasing its present destructor plant with four new cells arranged on the same lines as these Cambridge destructors, and they are anticipating an addition of 120 HP. therefrom.

James H. Fuertes.

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*Some of these are Galloway boilers in which they burn mechanically sorted refuse, for steam power.

**In 1894.

*In a paper read before the Sanitary Institute, Feb. 10, 1892.

*This is equivalent to about 325 lbs. of refuse per person per annum.—(J. H. F.)

CENTRIFUGAL PUMPING.

By J. Richards, San Francisco.

The writer, who has for a good many years watched with diligence the design, construction and effect of machinery for raising large volumes of water, finds that in this, as in all branches of constructive art, the course of evolution is not regular or always progressive, but is sometimes backward.

The best field for observation has been in the Netherlands, in so far as permanence or durability and also efficiency are concerned, but even there, owing to an intense conservatism, we find plants of questionable merit when judged in the light of present practice. The great pumps by Farcot, of Paris, erected about five years ago at Khatatbek, on the Nile, in Egypt, have various features that have much increased the cost of construction without any perceivable gain in the qualities of efficiency and durability, and they are certainly no improvement on the great plant at Ferrara, in Italy, erected by J. & H. Gwynne, of London, in 1873.

This plant, in northern Italy, drains 200 sq. miles of swampy lands, and raises the enormous quantity of 2,000 tons of water per minute, equal to 72,960 cu. ft., or more than 500,000 gallons. This, if flowing in a canal at the rate of two miles an hour, would form a stream 103 ft. wide and 4 ft. deep. There are eight pumps of 54-in. bore, driven in pairs by four compound condensing engines.

The drainage of Haarlem Meer before centrifugal pumping had a place in the methods available, and the drainage of the Zuider Zee, now going on with centrifugal pumps, must ever remain notable examples of what can be done in the drainage of valuable lands when unstinted capital and high skill are brought to bear; but there is another standard that must be set up when the lands are less valuable and their permanent reclamation a problem, as is the case in the great valleys of California. This latter California practice, now quite extensive, has added a good deal to the art in the way of attaining and even exceeding the efficiency of Old World methods with machinery in every way more simple and less expensive.

Dividing the cost by foot-pounds of duty, or volume and head, the cost of plants to raise from 20,000 to 100,000 gallons per minute in California is not more than two-thirds of what machinery of like capacity costs in Europe.

Some evidence of the skill attained in this branch of engineering on the Pacific coast is seen in the contract lately awarded to the San Francisco Bridge Co. for a pumping plant at New Orleans to raise 18,000 cu. ft., or 135,000 gallons per minute against a head of 12 ft.

The various large plants in the Sacramento and San Joaquin valleys operate at an efficiency that will average between 60 and 70%. In some cases this has been exceeded. Notably in the case of a plant recently erected at Marysville, Cal., on the Feather River, Sacramento Valley, by Messrs. W. T. Garratt & Co., of San Francisco, who sent the accompanying report of a test made in February last.

Test of Centrifugal Pumping Plant, at Marysville, Cal.; Feb. 9, 1896.

One boiler, 60 × 16 ft. Steam pressure, 100 lbs. Compound condensing engine, cylinders 10 and 18 ins. diam., 14 ins. stroke.

Diameter of pump runner.......... ....44 ins.
" " " suction...... ....26 ins.
" " " discharge...... ....24 ins.

Duty guaranteed 15,000 gallons 15 ft. high.

	Test No. 1.	Test No. 2.
Cut off	⅛	1-5
Revolutions per minute	216	250
Vacuum, ins	24½	24
Mean effective pressure, h. p. cyl., lbs	23.8	32
Mean effective pressure, l. p. cyl., lbs	8.3	10.5
HP., h. p. cyl	28.3	44.4
HP., l. p. cyl	31.	47
Total I. HP	59	91
Mean width of canal, ft	14.5	14.5
Mean depth of water in canal, ft	7.3	9.7
Mean velocity of water, ft. per sec	4.69	5.26
Gallons of water pumped	18,600	27,547
Lift in ft	9.5	10
Horse power of water lifted	43.7	69
Efficiency, per cent	74	75
Cords of wood used in two hours	¼	¼

Diagrams of the compound engine used are shown in the accompanying cut, Fig. 1.

The pump was made under a patent granted to the writer in 1887, and operated in the method indicated in the diagram, Fig. 2.

The curves, it will be seen, are natural and easy, while the whole construction lends itself to stability and ready adoption.

Water enters at one side of the pump through the suction or inlet pipe A, and is set in revolution by the vanes B, the number and curves of which are made to suit the head and other working conditions.

By entering the water at one side, it will be seen that curves are more flat and the course of the water is direct in comparison with a double inlet pump; the impeller is balanced the same as if like duty was done on each side of the plate or disk C.

On the back of this disk is a supplementary set of vanes, D, shallower in depth, the function of which is to set up centrifugal action at the back nearly the same as on the front or the working side of the disk C.

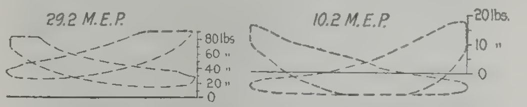


Fig. 1.—Indicator Diagram From Ide Compound Condensing Engine used with Richards' Centrifugal Pump.

As, however, these vanes D are a little shorter than the main ones B, there is a slow circulation over the periphery of the disk C, permitted by the holes E, near the hub of the impeller, so the pump is as completely balanced as though it had a forked or double suction and evades several objections that apply to that type.

The advance in centrifugal pumping in California has not been so much in the adaptation to large volumes, such as have been presented elsewhere, as in operating against high heads or pressures to an extent not attempted in other places.

The Edison Light & Power Co., of San Francisco, has for several years past raised salt water for condensing purposes 70 feet high through pipes 3,000 ft. long. The amount of water thus raised serves for 8,000 HP., and the main pipes are of 24 ins. bore.

In irrigating plants where water is pumped from gravel strata, the heads are from 60 to 100 ft., and in some cases have been more. At first such pumps were made compound, with two or more impellers, so as to avoid the high speed of revolution required with a single impeller or runner, but this method has been abandoned because of the loss of power, and now such pumps are made single in all cases, the water being carried through as much as 600° or even 800° of revolution before it leaves the vanes, without any such loss as computation assigns for this method of operating.

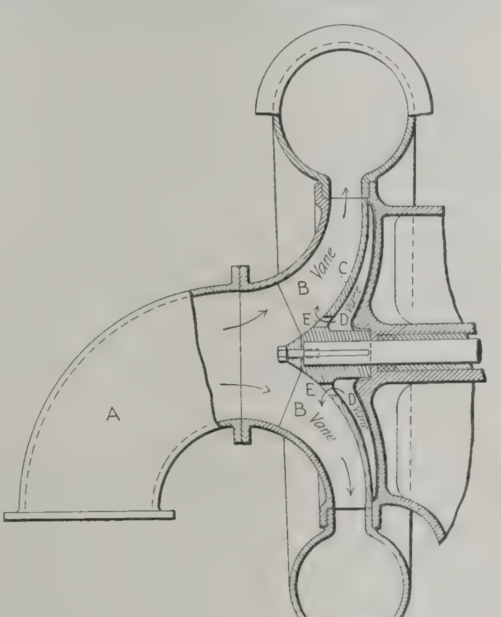


Fig. 2.—Section of Centrifugal Pump Designed by Mr. J. Richards in 1887.

Speaking of the resistances in compound centrifugal pumps due to varying velocity, agitation, deviations in the course of the water, etc., and as an example of "falling back" in the art, the diagrams comprising Fig. 3 are submitted to the readers of Engineering News for analysis.

The scheme can be followed out without the aid of special references. The water is first driven out by fans or impellers revolving in the circular chamber a, then through the apertures e, and its rotation is stopped by the radial vanes f, shown in dotted lines in the same figure. It then passes back to the center and into a second impeller, and is driven out again through a second set of apertures g and so on to discharge at c. The drawing shows but two units or elements, but the machines are made triple.

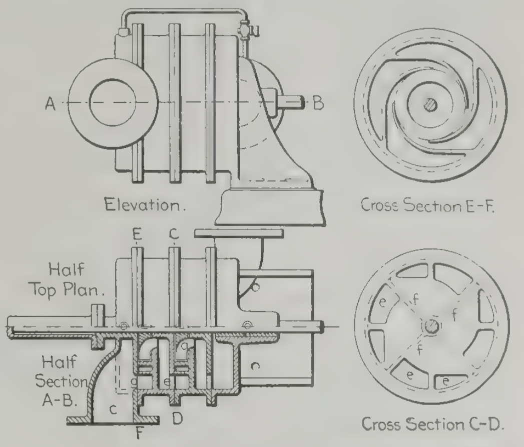


Fig. 3.—A Backward Step in Centrifugal Pump Design.

* * *

OHIO STATE LAW REGULATING THE INTERLOCKING OF RAILWAY GRADE CROSSINGS.

The following is the text of a law just passed by the Ohio State Legislature to regulate and control the protection of railway grade crossings by interlocking signals. In Engineering News of Feb. 6, the operation of a similar law in the state of Illinois was discussed at some length, and in another column of this issue some of the more salient features of the Ohio law are considered.

Section 1. Be it enacted by the General Assembly of the state of Ohio, that when in case two or more railroads, or a railroad and an electric railroad crossing each other at a common grade or any railroad crossing a stream by a swing or drawbridge, shall, by a system of interlocking, or by other works or fixtures, to be erected by them, or either of them, render it safe for engines or trains to pass over such crossing, or bridge, without stopping, and such system of interlocking works or fixtures shall first be approved by the commissioner of railroads and telegraphs, and a plan of such interlocking works or fixtures, for such crossing or bridge, designating the plan of crossing, shall have been filed with such commissioner, then, and in that case, it is hereby made lawful for the engines and trains of such railroad or railroads, to pass over such crossing or bridge without stopping, any law, or the provisions of any law, now in force to the contrary notwithstanding, and all such other provisions of law contrary thereto are hereby declared not to be applicable in such case; provided, that the said commissioner shall have and is hereby given power in case such interlocking system or other fixtures, shall, in his judgment, prove to be unsafe or impracticable, to order the same discontinued, opportunity first being given the persons or company operating the same to be heard before said commissioner as to the propriety of such order. In case such order is made and enforced, the existing statutes relative to stopping at crossings shall apply until such time as a device approved by said commissioner is substituted.

Section 2. That in case where the tracks of two or more railroads, or the tracks of a railroad and an electric railroad cross each other at a common grade in this state, any company owning any one of such tracks, whose managers may desire to unite with others in protecting such crossing with interlocking, or other safety devices, and shall be unable to agree with such others on the matter, may file with the said commissioner a petition stating the facts of the situation and asking said commissioner to order such crossing to be protected by interlocking, or other safety devices; said petition shall be accompanied by a plan showing the location of all tracks and switches, and upon the filing thereof notice shall be given to each company or persons owning or operating any track involved in such crossing, and the said commissioner shall thereupon view the site of such crossing and shall, as soon as practicable, appoint a time and place for the hearing of such petition. At the time and place named for hearing, unless the hearing is for good cause continued, said commissioner shall proceed to try the question of whether or not the crossing shall be protected by interlocking or other safety devices, and shall give all companies and parties interested an opportunity to be fully heard; and after such hearing said commissioner shall enter an order upon a record-book, or docket, to be kept for the purpose, granting or denying such petition; and in case the same is granted, such order shall prescribe the interlocking or other safety devices for such crossing and all other matters which may be deemed proper to the efficient protection of such crossing, and in such order the commissioner shall designate the proportion of the cost of the construction of such plant, and the expense of maintaining and operating the same, which each of the companies or persons concerned shall pay, and shall also fix the time within which such appliance shall be put in, such time, however, not to exceed 90 days from the making of such order.

Section 3. In case, however, one railroad company or an electric railroad campany shall hereafter seek to cross at grade with its track, or tracks, the track, or tracks, of another railroad, the railroad company, or the electric railroad company, seeking to cross at grade shall be compelled to interlock such crossing to the satisfaction of the said commissioner, and to pay all cost of such appliance, together with the expense of putting them in and the future maintenance and operation thereof. Provided, this act shall not apply to crossings of side tracks only.

Section 4. Whenever interlocking or other safety devices are constructed and maintained in compliance with Section 2 or 3 of this act, then and in that case it shall be lawful for the engines and trains of such railroad, or railroads, and the cars of such electric railroad to pass over said crossings without stopping; any law or the provisions of any law now in force to the contrary notwithstanding; and all such other provisions of law contrary thereto are hereby declared not to be applicable in such case.

Section 5. Any person, company or corporation refusing or neglecting to comply with any order made by the said commissioner of railroads and telegraphs in pursuance of this act shall forfeit and pay a penalty of five hundred dollars per week for each week of such refusal and neglect, the same to be recovered in an action of debt in the name of the state of Ohio, and to be paid, when collected, unto the county treasurer of any county in which such suit may be tried.

Section 6. This act shall take effect and be in force from and after its passage.

THE POWER PLANT AT FRESNO, CAL.

The San Joaquin Electric Co. has recently completed the installation of an electrical plant, driven by water power, to furnish light and power to the city of Fresno. The power is derived from water brought from the headwaters of the San Joaquin River. This source of supply is between 40 and 50 miles from Fresno, the generating plant itself being located 35 miles away. The water is taken from the north fork of the San Joaquin River at an elevation of 2,500 ft. above sea level, and is conveyed partly by means of a channel cut in the solid rock and partly by flumes, to a natural reservoir. This reservoir covers eight acres 10 ft. deep, and is intended as a safeguard against occasional repairs to the canal. There are ample sites for other reservoirs should an increased demand for water or extended drought make them necessary. An emergency canal leads from the supply, around the reservoir, to a connection with the pipe down the mountain, so that the reservoir, in case of accident, can be dispensed with entirely. The steel pipe which leads from the reservoir down to the power house is 4,100 ft. long, and gives a difference in level of 1,410 ft.; at the bottom it is 22 ins. diameter, with a ⅝-in. shell. The size is increased until at the reservoir it is 24 ins. in diameter, and the thickness of shell is reduced to ¼-in.; it is anchored to the solid rock of the mountain side by means of wire cables. The San Francisco "Chronicle" states that the pipe was built from both ends, and that it was very difficult to insert the last joint, owing to a variation of six to ten ins. in the length of the pipe. The junction was finally effected at 3 a. m. The outside of the pipe is protected by a coating of asphaltum; after the pipe was completed a workman was let down through its entire length, for the purpose of painting the inside joints.

At the lower end of the pipe is a large steel receiver, from which project the phosphor bronze nozzles for directing the streams against the water wheels. This receiver is 57 ft. long, by 30 ins. diameter of ¾-in. steel with butt-strap joints, and is designed to stand a working pressure of 800 lbs. per sq. in. The power house at the bottom of the hill is built of native granite, with a wooden roof. It is 75 × 30 ft., and is built on bed rock. The receiver and water-wheels are outside the main power house, the shafts passing through a heavy granite wall which keeps all the water and moisture out of the dynamo room.

The water wheels are of the Pelton Water Wheel Co.'s make, 57 ins. diameter, each capable of developing 500 HP., at 600 revolutions per minute, under an effective head of 1,410 ft. The wheels are constructed with steel plate centers and bronze buckets, and are fitted with flywheels 5 ft. diameter. Separate wheels are provided for the exciters.

Pipe Line and Power House of the Water Power and Electric Plant for Fresno, Cal.

The dynamos are of the General Electric pattern, direct connected to the motor shafts, and of 350 K-W. capacity at 600 revolutions per minute. The pressure at the dynamos is 700 volts, and is transformed to 11,200 for transmission to Fresno. A pressure of 10,000 volts is received at the end of the 35-mile line, where it is reduced to a commercial pressure. The entire cost of the plant is said to be only about $200,000. We are indebted to the General Electric Co. for the accompanying cut.

THE CORONER'S VERDICT ON THE VICTORIA BRIDGE DISASTER.

Since our issue of June 18 we have received the report (published in the Victoria "Daily Colonist") of the coroner's jury which investigated the Victoria bridge disaster, in which 55 persons lost their lives. The facts in connection with this accident and the general verdict of the coroner's jury we published on June 18, but the investigation made by the coroner's jury and the full verdict which it rendered reveal so many object lessons with respect to how not to conduct a city's engineering work, that we reprint some extracts.

The following is the report of the testimony of Mr. E. A. Wilmot, the City Engineer, when recalled to the stand on the closing day of the investigation:

> He had not absolute charge of his department. It had been the custom of chairmen of the various city departments to give directions regarding works coming under them; in matters not considered to require particular knowledge of engineering the chairmen have not considered it necessary always to consult him. He had no letter of instructions defining his duties; he had made recommendations, sometimes to the street committee, that had not been carried out. He recalled one instance where his plans were interfered with; he had prepared plans for a bridge on the Lansdowne road and the work was not carried out according to them; the street committee had power to ignore his work. He had no power to carry out work irrespective of the council—the council reserved the right to dismiss his assistants without his consent. This had inconvenienced him sometimes, and he had not the same authority over his subordinates as if he appointed them himself. He had been consulted about the appointment of his subordinates, but not always. Cox, the city carpenter, was in the city's employ before witness became city engineer; streets, sidewalks and bridges all came under Wilson (Street Superintendent) now. Witness's duties were too numerous to allow him time to thoroughly inspect the bridges. There was more work for him to do than he could accomplish in office hours. He had never had a vacation since he had been appointed, not that he had been refused, but he had felt he had not time to take one.

The following is extracted from the Coroner's charge to the jury:

> The jury should consider whether or not any responsibility rested on the tramway company, if, when they increased the size of the cars they took no precautions. The company seemed neither to have consulted the city engineer nor to have tried to find out if the bridge was safe. Then the jury must find out if the bridge was maintained in a state of safety by those responsible for it. There was not the least doubt that the bridge had been utterly neglected from the time that it was built and there had been no proper inspection of it. Whose duty was it to keep the bridge in a state of safety? The mayor and council acted in exactly the same capacity as the government of the country, and so were primarily responsible for the safety of life and property in the city. Their responsibility was generally shifted to the shoulders of the servants under them, but in this particular instance there was quite a difference of opinion—some witnesses held that the responsibility of looking after the bridge fell on the city engineer, others that the city carpenter had it under his charge. It had been stated in evidence that the city engineer never had his duties explained to him or definitely defined, and moreover, it had been shown that he was completely under the thumb of the council and the streets committee, and it was shown that his recommendations to the council have at times been completely ignored. For instance, the probability is that if his advice had been taken about putting in iron floor beams when the bridge was repaired in 1892 there would have been no inquiry like this to-day. Under the circumstances the coroner could not see how the engineer should be held responsible. A man to be responsible must have full control of that for which he was responsible. As to the city carpenter, it was too absurd to hold him responsible for Point Ellice bridge. An ordinary mechanic could not be expected to do the work of a skilled engineer. Then again, had the city council taken any steps to have the bridge inspected? The only thing that could be found in this connection was a report by Cox (the city carpenter) last year stating that the bridge was in good condition; and as the city council seemed to be satisfied with that report, it seems to show that they looked upon Cox as responsible. As to the exact cause of the accident, whether it was a floor beam or a hanger to go first mattered not. The cause of the acident was undoubtedly the neglect to maintain the bridge in an efficient state to do the work put upon it.

The following are the facts of the verdict rendered by the jury of principal interest:

> The accident was the result of the sudden collapse of the eastern Whipple truss of the said bridge, and was caused by the weight of car No. 16 of the Consolidated Electric Ry. Co. and its immense load of passengers. which was in excess of the capacity of the bridge in question as originally constructed, and that the said Consolidated Electric Ry. Co. is guilty of negligence in not having taken proper precautions for the safe conduct of its passengers accordingly. It is the duty of all corporations of this kind to see that all roads and bridges over which it passes are in a safe condition.
>
> That car No. 16 was dangerously overloaded with passengers, and in the interest of public safety it is imperative that restrictions should be imposed upon the traffic of this and similar corporations in the future.
>
> That the city council having assumed control of the said bridge, it was manifestly their duty to the public to maintain it in a proper state of repair and efficiency, and to take steps to restrict the traffic of the said railway company within the limits of safety.
>
> If they do not possess this power legally, it was and is their duty to obtain this power by legislation.
>
> We desire to call attention to and to condemn the system of public works which has been and we believe now is in vogue in the public works department of the city. We find that the city engineer and heads of departments under him who should be held personally responsible for the good and efficient execution of the details of their department, are so hampered and interfered with by untechnical, elective superiors, that they are without au-

thority necessary to carry on their work, and are consequently without responsibility.

We further find occasion, in the interests of public safety, to call attention to the fact that the government department under which this bridge was conducted did not exercise proper supervision over the construction of same, particularly in the matter of ironwork. We find that the specifications call for weldless iron, but that the ironwork is in almost all cases welded, and in many cases of inferior quality, and that the factor of safety provided for in the specifications is an unknown quantity.

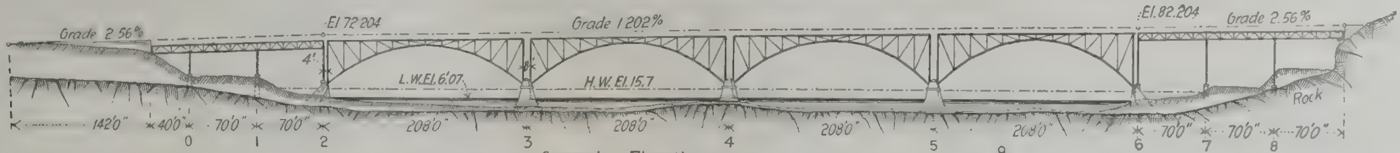
It is quite evident from the evidence produced before us, that the primary cause of the accident was the breaking of one certain iron hanger, resulting finally in the collapse of the bridge; said hanger being part of the original construction.

We find, therefore, that the Consolidated Electric Ry. Co. are primarily responsible for the accident, and that the city council is guilty of contributory negligence.

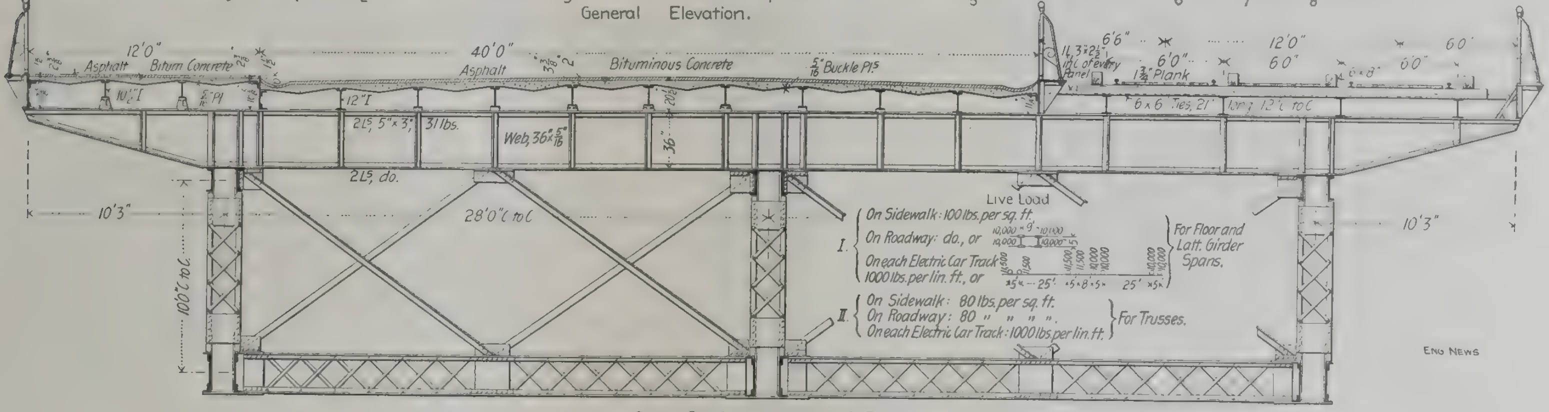
A NEW BRIDGE OVER THE SCHUYLKILL RIVER IN FAIRMOUNT PARK.

We show herewith a general elevation and cross-section of a new bridge which is to be erected across the Schuylkill River in Fairmount Park, Philadelphia, by the Fairmount Park Transportation Co., of which Mr. Russell Thayer, Jr., M. Am. Soc. C. E., is Consulting Engineer. Special attention has been paid in the design of the bridge to secure an artistic effect. The contract for the structure has been awarded to the Phoenix Bridge Co. The weight of metal work in the structure will be about 6,000,000 lbs., and the total cost, including foundations, is estimated at $375,000. It will be seen that the electric car tracks are entirely separated from the roadway, and that guard rails are provided beside each track. These features, and the manner in which the bridge is proportioned for its live loads, are of interest in connection with our editorial remarks on the Victoria bridge disaster in our issue of June 18.

We are indebted to Mr. John Stirling Deans, Chief Engineer of the Phoenix Bridge Co., for the drawing from which our illustration is reproduced.



General Elevation.



Cross Section at Center of Span.

NEW BRIDGE OVER THE SCHUYLKILL RIVER IN FAIRMOUNT PARK, PHILADELPHIA.

LOCOMOTIVE COUNTER-BALANCING.*

The purpose of adding counter-balance weights to the driving wheels of locomotives is to prevent or minimize the strains and vibrations caused by the momentum or inertia of the moving parts attached directly or indirectly to them. These are of two kinds, revolving parts and reciprocating parts. The revolving parts can be counter-balanced by weights attached to the wheel to which they belong. The reciprocating weights can only be balanced in one direction by adding weights to the driving wheels, as all weights added after the revolving parts are balanced over-balance the wheel vertically, exactly to the same extent that they tend to balance the recoprocating parts horizontally. This over-balance exerts a pressure upon the rail directly proportional to its weight and to the square of its velocity. At high speeds this pressure, which is added to the weight of the driver on the rail, may become great enough to injure track and bridges.

In consideration of the above, your committee have formed the rules which follow after full consideration of the following fundamental principles:

1. The weight of the reciprocating parts that are left unbalanced should be as great as possible, consistent with a good riding and smooth working engine.

2. The unbalanced weight of the reciprocating parts of all engines for similar service should be proportional to the total weight of the engine in working order.

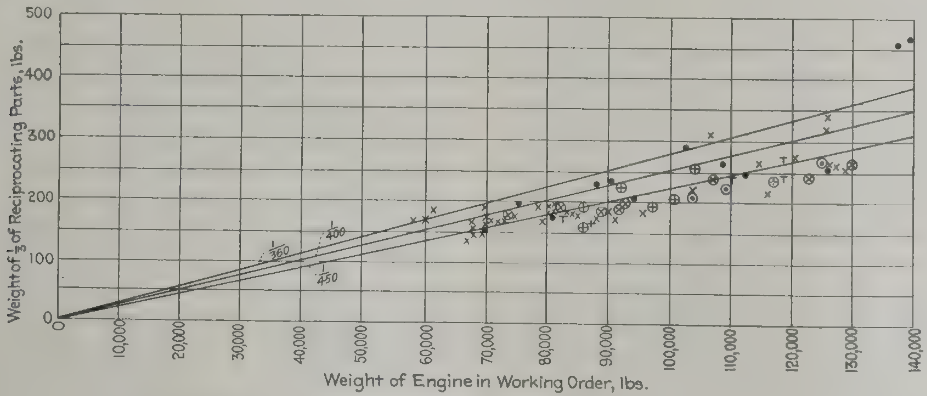
3. Total pressure of the wheel upon the rail at maximum speed when counter-balance is down must not exceed an amount depending upon the construction of bridges, weight of rail, etc., and when counter-balance is up the centrifugal force must never be sufficient to lift the wheel from the rail.

A majority of railways answering the committee's circular leave unbalanced one-third of the reciprocating parts. In order to see how nearly this method makes the unbalanced weight of the reciprocating parts proportional to the total weight of the engine, we have plotted on the accompanying diagram the relation between the unbalanced reciprocating weight on one side, and the total weight of 75 road engines in actual satisfactory service on seven different roads. On the same diagram are drawn lines, all the points in which are proportional to the total engine weights laid off on the horizontal. The first line marked 1-450 is drawn through about the average of all the points plotted, and indicates that the average unbalanced weight of the reciprocating parts on one side of engine as balanced on these roads is 1-450 of their total weight. The upper line marked 1-360 represents the ratio of unbalanced reciprocating parts on one side to the total engine weight, recommended by Mr. G. R. Henderson, Mechanical Engineer of the Norfolk & Western R. R., in an admirable report on this subject, made to Mr. R. H. Soule, about a year ago, and to which your committee is indebted for valuable data and suggestions. Mr. Henderson proposes the following formula for expressing the relation between the unbalanced reciprocating parts and the total weight of the engine:

$$Wr = \frac{Wt}{360}$$

Wr = the weight of the unbalanced reciprocating parts on one side:

Wt = the total weight of the locomotive in working order.



RELATION BETWEEN WEIGHT OF LOCOMOTIVE AND WEIGHT OF ITS UNBALANCED RECIPROCATING PARTS.

From the data obtainable, we believe this formula allows a greater proportion of the reciprocating parts to remain unbalanced than present good practice will warrant.

The intermediate line marked 1-400 on the diagram indicates the average maximum of unbalanced weight of reciprocating parts in locomotives now in service on various roads. From actual tests of locomotives so balanced in fast passenger service, we recommend it as a safe formula for the maximum limit of the weight of the unbalanced proportion of the reciprocating parts on one side.

In formulating the following rules it is assumed that the driving wheels are finished and mounted on their axles with pins in place.

In designing new locomotives the proper counter-balance weight should be calculated and cast into the wheel centers as follows: Place the center of gravity of counter weight opposite the crank pin as far from the center as possible, and have it come as near the plane in which the rods move as proper clearance will allow. To obtain weight of the reciprocating parts and detachable revolving parts, proceed as follows:

Reciprocating Parts.—Take the sum of the weights of piston complete, with packing ring, piston rod, crosshead complete, and the weight of the front end of the main rod complete. Weigh each end of rod separately supported.

Revolving Parts.—Weigh the back end of the main or connecting rod, and each end of each side rod complete, separately supported. The sum of the weights so found which are attached to each crank pin are the revolving weights for that pin.

Rules for Counter-Balancing Locomotive Driving Wheels.—1. Divide the total weight of the engine by 400; subtract the quotient from the weight of the reciprocating parts on one side as found above, including the front end of the main rod.

2. Distribute the remainder equally among all driving wheels, adding to it the weight of the revolving parts for each wheel. The sum will be the counter-balance required if placed at a distance from the wheel center equal to the length of the crank.

Counter-balance weights added to old wheels should be generally cast in two parts, fitted between spokes and securely bolted with the ends of bolts riveted over the nuts. Increased weight of counter-balance can be obtained when necessary by coring out cast iron and substituting lead, or in other ways replacing cast iron with a denser material.

Cautions and Limitations.—If we assume that the maximum speed in miles per hour of the driving wheel of a locomotive equals its diameter in inches, it can easily be shown (see Appendix) that if such wheel is over-balanced by an amount W, at its maximum speed, this over-balance will increase and decrease the wheel pressure on the rail each revolution 38.4 times W. Or if we denote such increase pressure by P, then P = 38.4 times W, or P = 40 W (nearly). Therefore, in order that the wheel shall never leave the rail, 40 times the portion of the weight of the reciprocating parts added to each wheel must not exceed its static pressure on the rail. To insure safety it should not exceed 75% of such pressure. Nor should this amount, when added to the static wheel pressure, exceed the safe maximum pressure allowed on track and bridges. Locomotives with rods disconnected and removed should not be hauled at high rates of speed.

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*From a committee report presented at the annual convention of the American Railway Master Mechanics' Association.

Make reciprocating parts as light as possible.

Spread cylinders as little as possible.

E. M. Herr, W. H. Lewis, C. H. Quereau, S. P. Bush,
Committee.

Appendix.

We take the following from Mr. Henderson's report:

"To determine the centrifugal force, we have from Weisbach, Vol. I., page 609, the following formula:

$P = .00034\ U^2\ G\ R$

U = revolutions per minute,

G = weight in lbs.,

R = radius in ft.

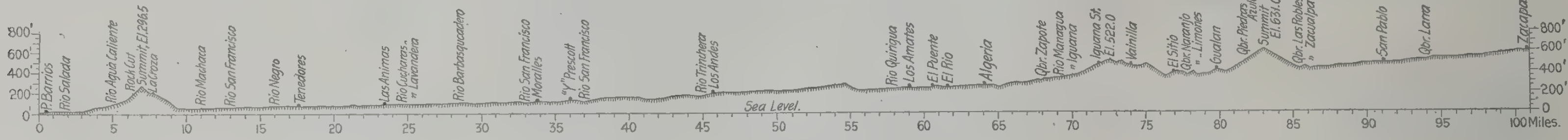

FIG 2.—PROFILE OF GUATEMALA NORTHERN RY.

Now let

s = speed in miles per hour,

d = diameter of wheel in ins.,

then

$$U = \frac{s \times 5{,}280 \times 12}{3.1416 \times d \times 60} = \frac{s \times 1{,}056}{d \times 3.1416} = 336\ \frac{s}{d}$$

and

$$U^2 = 112{,}896\ \frac{s^2}{d^2}$$

and, substituting, we have,

$$P = 38.4\ \frac{s^2}{d^2}\ G\ R,$$

and where

$$R = 1,$$

$$P = 38.4\ \frac{s^2}{d^2}\ G.$$

If we assume that the speed in miles per hour at its maximum equals the diameter of the wheel in inches, we have simply

$$P = 38.4\ G,$$

or say,

$$P = 40\ G."$$

* * *

SEWAGE DISPOSAL BY INTERMITTENT FILTRATION AND BROAD IRRIGATION AT BRISTOL, CONN.

The third town in Connecticut which has thus far made any attempt to treat its sewage before discharging it into some stream or other body of water is Bristol, Conn. Meriden led off with an intermittent filtration and broad irrigation scheme, and later Bristol has followed its example. Between the dates of putting these plants in operation a station for the manufacture of sodium hypochlorite by the Woolf electrical process was installed at Danbury, Conn., and this has been used to disinfect the sewage before it discharges into the river. The city has been ordered by the courts to keep the sewage out of the river after May 1, 1897.*

The work at Bristol has been done by the borough, the population of which was not separately returned by the last census. In 1890 the whole town had 7,382 inhabitants, against 5,347 in 1880. A gravity water supply was introduecd by a private company in 1895.

Early in 1892 riparian owners began to bring suits to restrain the discharge of crude sewage into a stream flowing through the town. The suits were withdrawn, on agreement that a sewerage and sewage disposal system should be built. During the year 1892, Mr. T. H. McKenzie, M. Am. Soc. C. E., now of Hartford, Conn., was engaged to make preliminary plans and estimates for a sewerage system, with recommendations as to the best methods of sewage disposal. This he at once did, but delays in securing legislation and preparing detailed plans prevented the execution of the work for about three years.

During 1895 there were constructed 9½ of the proposed 15 miles of sewers, and part of the land was prepared, the latter being put in use on Dec. 20. The separate system of sewerage was put in, with underdrains for collecting the ground water and discharging it into the nearest water courses. The sewer pipes have deep and wide sockets, and are in 3-ft. lengths. The joints were calked with oakum and then cemented. Mr. McKenzie states that as a result of this course but little ground water finds its way into the sewers, a matter of great importance where sewage is to be purified, as was discussed at length in our issue of Aug. 25, 1892.

The borough bought 80 acres of land, recommended by Mr. McKenzie, paying $35 an acre, or $2,800 for it. Six acres of land have been made into filter beds, and a portion of the irrigation area has been cleared of bushes and plowed.

The filter beds are composed of coarse sand and gravel. The sewage is distributed to them by means of 15 and 12-in. main carriers. Only a part of the underdrains have been put in, but these will be 8 and 6 ins. in diameter and 25 ft. apart. The irrigation area will not be underdrained. The six acres of filter beds and appurtenances, Mr. McKenzie states, will cost about $9,000.

Up to April 1, 1896, about 100 connections had been made with the sewers. It is expected that a portion of the irrigation area will be graded during the summer of 1896. Mr. Albert Munson is superintendent of sewers.

We are indebted to Mr. McKenzie for the greater part of the above information, some of it being taken from a paper by him in the last report of the Connecticut State Board of Health. Mr. McKenzie and Prof. Herbert E. Smith, Chemist of the Board, have been authorized to make studies of the work of the Bristol disposal area. Mr. McKenzie is the engineer member of the State Board of Health.

* * *

THE GUATEMALA NORTHERN RAILWAY.

One of the important railway projects now being carried out in Central America is the Guatemala Northern Ry., which extends inland from the port of Puerto Barrios, on the Atlantic coast (Gulf of Honduras), following the valley of the Motagua River, and being practically parallel with the Honduras frontier. This line was commenced by the government in 1883, when Gen. Rufino Barrios was President. After his death, in 1884, work was suspended, with only three miles of track laid. The enterprise remained dormant until 1893, when President Reyna Barrios entered into a contract with Mr. Silvanus Miller, M. Am. Soc. C. E., for the completion of the first 20 miles. Since then, by several contracts with Mr. Miller, the construction has been steadily continued, and the line is now open for traffic from Puerto Barrios to Gualan, 80 miles. In July it will be opened to Zacapa, 101 miles, and by October it is expected to be in operation to "El Rancho," 134 miles from Puerto Barrios. The road is intended to form a part of a transcontinental route, and will probably be completed to Guatemala City, about 200 miles, in 1898, connecting there with the Guatemala Central Ry., which is now in operation from that city to the port of San Jose, on the Pacific coast, a distance of 75 miles.

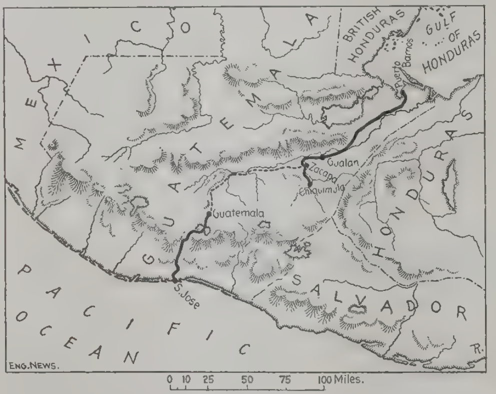

Fig. 4.—Map Showing the Guatemala Northern Ry. and Guatemala Central Ry.

The line has a gage of 3 ft. The track has 40-lb. rails for the first 18 miles, and 56-lb. rails for the rest of the distance, while the 40-lb. will soon be replaced with 56-lb. rails. There are turntables at Puerto Barrios, Los Amates, Gualan and Zacapa; also well equipped shops at Gualan, and a small shop at Puerto Barrios. A fine wharf has been built at this latter place, where ships of 5,000 tons have discharged their cargoes. The equipment includes 8 Baldwin locomotives, 1 parlor car, 13 passenger cars (including baggage cars), 30 box cars, 115 flat cars and 2 wrecking cars. The road is being built and operated by Mr. Miller, aided by the following staff: General Manager, Miller A. Smith, M. Am. Soc. C. E.; Superintendent, Wm. F. Sharp; Master Mechanic, Wm. Holland; Auditor, W. Bundy Cole. The inspector for the government is Mr. L. P. Pennypacker, Assoc. M. Am. Soc. C. E.

We are indebted to Mr. Miller A. Smith for the accompanying profile of the road, and for a copy of the schedule of train service between Puerto Barrios and Gualan, 79.8 miles. There are 11 intermediate stations, with from 370 to 2,300 ft. of sidetrack at all but the last three stations. There is a mixed train daily each way. The train from Gualan leaves at 6 a. m., and reaches Puerto Barrios at 11.10 a. m.; the return train leaves at 1 p. m. and reaches Gualan at 6.10 p. m. The average rate of speed is, therefore, about 15 miles per hour. On Tuesdays a mail train leaves Puerto Barrios at 6 p. m., reaching Gualan at 11.10 p. m., and on Wednesday it leaves at 12.30 a. m., reaching Puerto Barios at 5.40 a. m. The grades are in general easy, with the exception of summit grades of about 3% near the coast, and about 1.6% towards the inland range.

The Guatemala Central Ry. is 75 miles long, with maximum grades of 3% and minimum curves of 15°. The track has 54-lb. rails, laid on wooden ties, 24 ins. c. to c., in stone and blue gravel ballast. The rails are laid with broken, suspended joints, spliced by 20-in. angle bars. The ties are partly of California redwood, 7×8 ins., 8 ft. long, and 7×7 ins., 6 ft. long; and partly of native hardwood, 6×8 and 6×7 ins., 6 ft. long. The locomotives weigh about 45 tons.

* * *

THE SUEZ CANAL TRAFFIC in 1895 was very prosperous, and the earnings amounted to $15,685,222, an increase of $859,810 over those of 1894. The total receipts were about $16,140,000, and the total expenditures about $7,500,000; the cost of widening and deepening having been $782,000. The number of vessels was 3,434, with an aggregate tonnage of 8,448,383 tons, while 95% of these vessels used the electric light to enable them to continue their passage at night. The average length of trip was 19 h. 18 min., of which 16 h. 18 min. were occupied in steaming through the canal. Of the 3,434 vessels, 1,250 had a draft of over 23 ft., and of these 228 had a draft of 24 ft. 8 ins. to 25 ft. 8 ins., the latter being the maximum draft allowed by the navigation rules.

◆

THE WATER POWER CANAL at Sault Ste. Marie, Mich., is now projected on a smaller scale, and it is said that the Lake Superior Power Co. has abandoned its plans for a 400-ft. canal in favor of a canal 250 ft. wide, the right of way for which has been nearly all acquired.

◆

A BOILER EXPLOSION occurred on June 29 at Houston, Tex., which killed three persons and injured a fourth. The main shell of the boiler, which was a small one, used in a newspaper office, is stated to have been thrown 300 ft. from the boiler house through the brick wall of the office of the Southern Pacific Ry. Co. W. G. Van Vleck, Manager of the Atlantic System, was seriously injured. The accident is supposed to have been caused by low water in the boiler.——On June 25, at Hazelton, Pa., three of a battery of six boilers exploded simultaneously. The boiler house is reported as totally destroyed and the remaining boilers were twisted and distorted. The engineer was only slightly injured.

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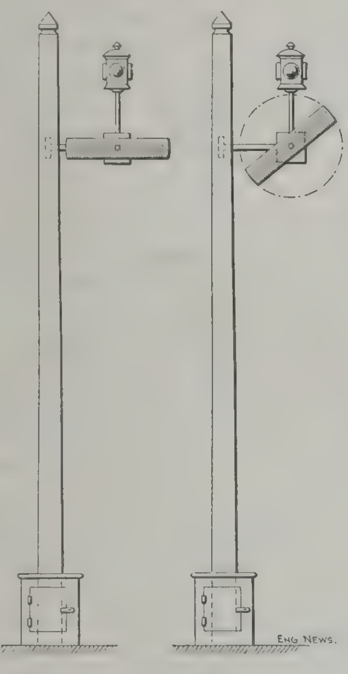
*The Meriden plant was described in Engineering News for July 18, 1895, and a small Woolf plant at Brewsters, N. Y., a few miles from Danbury, was described in our issue of July 13, 1893.

A REVOLVING SEMAPHORE SIGNAL.

One of the latest novelties in railway signals is the Bezer revolving signal, the principle of which is that if the signal is moving the train may move, while if the signal is stationary the train must come to a stop. The signal post carries a horizontal arm which supports a box containing the mechanism. On the front of the box is a signal arm pivoted at its center (like the semaphore blades on some of the English railways), while from the top of the box projects a spindle carrying the lamp. The mechanism is operated by electric batteries of the Gordon & Burnham make, placed in a box at the foot of the post, and which are being continually charged from a primary battery, which is in turn charged from chloride storage batteries in a well near the track. A track circuit effects the connection between the batteries of each signal, and only one line wire is required. As the train passes a signal the arm ceases to revolve, while the arm on the next signal ahead (the block being clear) begins to revolve, making about ten revolutions per minute. The lamp has four bulls-eyes, two red and two white, and forms an intermittent flashing signal. The arrangement of the gearing and mechanism is such that the arm will always stop in a horizontal position, with the lamp showing a fixed red light. Should any failure, however, cause the arm to stop in any other position and the lamp to show a white light, the signal would still indicate danger from the fact of the arm and lamp being stationary. No spectacle is required, the only glass in the signal being the bulls-eyes of the lamp.

There are three of the signals now in service on the Delaware, Lackawanna & Western R. R., near Kingsland, N. J., and they were inspected a few days ago by a party of engineers and railway men. At the drawbridge is a mechanical or manual signal, and as soon as this has been set at "track blocked" by the passage of a train, the first automatic signal, ¾-mile in advance, begins to revolve (indicating "track clear"). As the train passes this signal, the motion ceases (indicating "track blocked"), while the second signal begins to revolve. The block sections are ¾-mile long. The normal condition of the signals is at rest, fulfilling one of the cardinal principles in signaling; namely, that the signals should normally indicate danger. Any failure of the wires, batteries, connections, etc., also cause the signal to stop and indicate danger.



Bezer's Revolving Semaphore Signal.

The system is simple and inexpensive, and the signals above mentioned have been in service through the past winter. The system may be worked automatically, as above described, or may be operated from a signal tower; the inventor is in favor of having tower men at intervals, the semaphore arm working automatically in all cases. The system is claimed to have the advantage of the electric slot, without the electrical joint or connection which may introduce an element of uncertainty in an electrically slotted position signal. On a four-track road, the signals might be placed on opposite sides of the two posts, thus avoiding the expense of bracket posts, while the fact of the lamps being thus 6 ft. apart would preclude any liability to a confusion of signals. The mechanical part of each signal (as distinguished from the electrical part) is interlocked with the next signal beyond, so that in case of a failure of any signal to indicate "track blocked" no two consecutive signals will indicate "track clear." If an engineman finds a signal (1) at "track blocked" he waits the time limit or gets a clearance card and then proceeds. If he finds the next signal (2) at "track clear," however, he regards this only as a "caution" signal, as it may have failed in action, and have thereby set Nos. (1) and (3) at danger, in which case he may find a train standing at (3).

This system is the invention of Mr. Henry Bezer, Signal Engineer, of New Rochelle, N. Y., whose address for the present is at Kingsland, N. J.

DIAGRAM OF FROG AND SWITCH VALUES.

The formulas involved in frog and switch work, though not complicated in themselves, are very often a trouble to engineers and involve the expenditure of considerable time in getting at and working out the formulas for each particular case. We publish herewith a useful and practical diagram, prepared by Prof. Malverd A. Howe, of the Rose Polytechnic Institute, Terre Haute. Ind., giving at a glance the values of the various lengths, etc., for any given number of frog, and no "mathematics" are required beyond a few simple multiplications. If the frog number is not known it can be ascertained by measuring l and b and dividing the former by the latter. The results are exact enough for all practical purposes, as shown by the following comparison between the formulas given on the diagram and Parson's formulas:

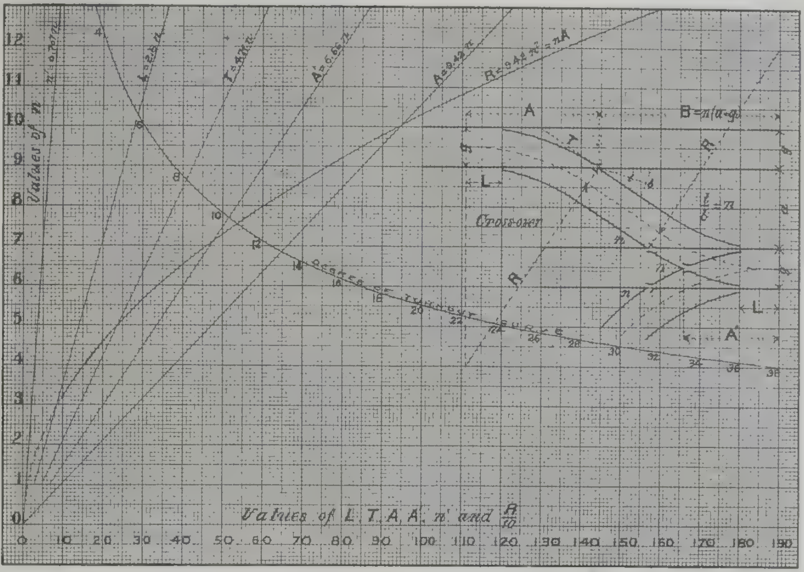


DIAGRAM OF FROG AND SWITCH VALUES.

	Howe and Trautwine. Frog number =n. No. 5.	Howe and Trautwine. Frog number =n. No. 10.	Parsons. Frog number =n. No. 5.	Parsons. Frog number =n. No. 10.
	ft.	ft.	ft.	ft.
A (=9.42 n)..	47.10	94.20	47.08	94.16
T (=4.71 n)..	23.55	47.10	23.78	47.20
L (=2.8 n)..	14.00	28.00	14.00	28.00
A' (=6.66 n)..	33.33	66.66	33.37	66.62
R (=9.42 n²)..	235.50	942.00	235.42	941.67

WEATHER TABLE FOR MAY, 1896. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.)				Wind. Velocity in miles per hour.		Wind. Direction at time of max. velocity.	Precipitation—rain or melted snow—inches.		
		Average.	Max.	Min.	Range.	Average.	Max.		Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities	Northfield, Vt........	56.2	88	29	59	9.5	38	S	1.44	0.30	11
	Portland, Me.........	55.0	92	35	57	7.2	27	W	3.21	1.51	9
	New York City.......	63.8	91	43	48	12.9	52	SW	2 01	0.58	11
	Pittsburg, Pa....	69.2	90	50	40	6.1	27	W	3.91	1.02	17
	Chicago, Ill....	65.5	89	46	43	18.5	62	S	4.16	1.47	10
	Omaha, Neb.	66.9	88	48	40	8.9	36	NW	9.51	1.82	18
	St. Paul, Minn.	63.4	87	41	46	9.0	36	W	4.67	1.52	15
	Duluth, Minn.........	53.3	88	38	50	11.0	42	SW	5.18	1.43	17
	Bismarck, N. Dak....	57.3	92	34	58	12.1	44	NW	1.98	0.88	17
	Average............	61.2	89	40	49	10.6	40		4.01	1.17	14
Southern Cities.	Washington. D. C....	68.8	94	42	52	6.1	54	SW	2.26	0.87	14
	Louisville, Ky........	72.6	94	54	40	7.1	36	W	4.32	1.29	15
	St Louis, Mo.........	73.0	91	56	35	10.6	80	NW	9.12	3.08	15
	Savannah, Ga........	77.6	97	55	42	7.3	22	NE	4.30	1.59	8
	Kansas City, Mo.....	69.6	89	48	41	9.5	32	NW	5.81	1.90	14
	Jacksonville, Fla	77.7	95	53	42	7.4	29	SE	1.24	0.63	7
	Chattanooga, Tenn..	74.0	92	55	37	5.7	46	W	3.76	1.14	8
	New Orleans. La.....	77 8	92	65	27	6.8	25	N	2.80	0.85	11
	Memphis, Tenn......	76.4	92	58	34	8.6	42	SW	2.49	1.12	8
	Palestine, Tex.	76.6	93	59	34	7.8	39	SW	1.13	1.81	6
	Average............	74.4	93	54	38	7.7	40		4.02	1.43	11
Western Cities.	Helena, Mont........	46.6	75	29	46	9.1	36	SW	2.25	0.91	14
	Port Angeles, Wash..	49 0	69	33	36	6.7	38	W	0.72	0.20	12
	San Francisco, Cal ..	56.3	91	45	46	12.4	41	W	0.73	0.34	5
	Salt Lake City, Utah.	51.4	88	30	58	6.7	48	W	3.67	1.35	15
	Santa Fe. N. Mex....	58.0	86	31	55	8 9	39	SW	0.27	0.20	3
	Denver, Colo.........	58.8	86	32	54	9.3	42	E	1.27	0.67	8
	Yuma, Ariz	76.8	112	49	63	8 4	38	NW	Trace.	Trace	0
	Average............	56.7	87	36	51	8.8	40		1.27	0.52	8

THE ANNUAL CONVENTION OF THE AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

We gave on pages 420, 421 of our last issue the report of the first two days' sessions of the 29th annual convention of this association, held at Saratoga, N. Y., June 22, 23 and 24. On the concluding day of the convention the special committee on the Stevens Institute scholarships reported proposed amendments to the constitution, making these open first to the sons of members or deceased members of the association, and if there are not enough of these to fill the vacancies then the scholarships will be open to other railway employes or their sons. This amendment will be voted on next year.

On motion of Secretary Sinclair the by-laws were amended so that the meeting next year will begin on the third Tuesday in June. It has opened for some years past on the Monday following the Master Car Builders' convention.

The Apprentice Boy.

The committee on this subject was instructed to report on the best method of training apprentice boys and on what means can be adopted to improve their technical education. The committee sent out circular letters inquiring concerning the system in use for training apprentice boys, and received over 300 answers, indicating that the topic is one in which the members generally are more interested than in almost any of the mechanical subjects which are commonly considered by the association's committees. The report opened as follows:

> Your committee believe the necessity of the times change the environment of the apprentice as well as the mechanic. With the passing of the small shop with a few boys, bound under written agreements and bonds signed with legal formality, there must be a new era for the apprentice.
>
> We see with the modern corporations a breaking down of the old method of shop organization, suitable for the fathers and grandfathers, but no longer suitable for progressive organization. While in the past it may have been possible to hold a boy bound under agreements, such methods do not answer with great corporations, such as our railroads are fast becoming, extending through several states, with their aggregation of shop employees gathered from the heart of great cities, from the suburban districts, and sometimes from small villages which are almost dependent on the corporation for their existence, the bond gives way to a comity. The boy is taught fidelity and is given examples in the principles of loyalty, and the time is fast approaching when the young man will feel a loyalty to the corporation second only to the state or church. To bring about this is the duty of men handling large bodies of workmen.

Concerning the ratio of apprentices to mechanics, the replies received by the committee varied widely. On the whole the committee was of the opinion that in the ordinary railroad shop the best results are obtained by the employment of one apprentice to five able mechanics. To the question: "Have you a system of technical instruction for apprentices?" the replies showed a gratifying number of evening schools in mechanical drawing and mathematics. With most of these schools, however, no effort is made to the further advancement of the pupils after completion of the school work.

The committee then submitted schemes for the technical instruction of railway shopmen and apprentices proposed by Prof. W. F. M. Goss, of Purdue University, and Mr. I. H. Howerth, Class-Study Secretary of the University Extension Department of the University of Chicago. It also called special attention to the advantages offered by Railroad Y. M. C. associations, to the lecture study course of the University of Chicago, and to the proposed organization of the Purdue Mechanics' Institute. In the discussion President Smart, of Purdue, who was present, explained in some detail these mechanic's lecture courses which Purdue is about to organize.

Mr. Forsyth (C. B. & Q.) criticized the committee for not preparing and submitting a system of instruction for apprentices. On his motion it was voted that the subject be continued with instructions to the committee to recommend a course of shop training for machinists' apprentices or other apprentices in locomotive shops, and also to make definite recommendations for the technical education of shop apprentices.

The discussion continued for some time, bringing out among other things the value of the work being done by the correspondence schools, the fact that mathematics and drawing are of much less importance than instruction in physics, and that lectures to young apprentices cannot take the place of systematic personal instruction.

Subjects for Committee Reports in 1897.

The committee reported the following list of subjects for consideration at the convention of 1897:

1. What kind of metal should be used in locomotive cylinder valve seats and slide valves; as hard as can be worked, medium, or soft? and should the hardness of the metal for valves and seats be the same? or should one be harder than the other?
2. Which is the most economical, a planished iron boiler jacket, or a boiler jacket made of common sheet iron, or sheet steel, painted? The general appearance, first cost, and cost of maintenance to be considered.
3. For anthracite and bituminous burning engines engaged in passenger and freight service, what should be the ratio of grate area to total heating surface, and to cylinder volume? For such engines, what is the best ratio between the diameter of cylinder, and length of steam port?
4. What is the best method of securing crank pin collars used in connection with solid rods.
5. Committee to report as to whether it would be advisable and practicable to introduce piece work in connection with locomotive repairs. Also best method of arriving at prices for the different operations.
6. Have cast steel driving wheel centers any advantage over cast iron, other than the reduction in weight?
7. What classes of work in an ordinary locomotive repair shop can best be performed with air motors, and what is the relative convenience and economy of air motors for such work, as compared with motors driven by electricity, or steam? When air motors are used, should the shape of the cutting edge of drills, reamers, etc., be changed from the ordinary practice?
8. Is it desirable or economical to use extended piston rods for cylinders more than 18 ins. in diameter in the simple American type of locomotive? How should such rods be carried through the front cylinder head, and what means should be provided for supporting the weight? What provision should be made for keeping dirt and dust from this piston rod?
9. What is the best material for piston rods, iron or steel?
10. Can cast steel be used successfully for eccentric straps, and is it superior to cast iron for this purpose?
11. Best construction and material for a locomotive pilot, to be used in connection with M. C. B. coupler.
12. A revision of the air brake instruction rules. The committee to work with a similar committee appointed by the Master Car Builders' Association and to make a joint report to both associations.

Driving Box Wedges.

From the report and discussion upon this subject, it appears that practice is tending toward the disuse of the old-fashioned wedges for driving boxes, and toward the use of fixed jaws with liners between the jaws and the box to take up the wear. With narrow bearing surface, however, frequent adjustment of the liners are necessary to keep the locomotive in good condition.

Steps and Handholds.

The gist of this report was that from the investigations made by the committee, it appeared that the majority favor the placing of steps on the front corners of the tender, but not on the rear corners of the engine as well. This tender step should be a wide double step, to accord with the practice of the majority of roads. Various other standard locations for steps were proposed and finally the committee recommended that to insure comparative safety the form and location of locomotive steps and handholds should be so nearly uniform that in mounting or alighting one could, even in the dark, readily locate with his feet and hands, all the steps and handholds of any locomotive.

Miscellaneous.

The report of the committee appointed to advise the proper angle for swing-beam hangers in locomotive trucks was read by Mr. Mackenzie. On motion the committee was continued another year with instructions to have railways make experiments during the year and report results to the committee. Practically the same course was taken with the report of the committee on locomotive grates. Neither this nor the preceding paper were in type, hence discussion of them was practically impossible. The report on standard thickness for engine truck wheel flanges was then presented, and the common sense of the report so commended it to the members that the changes recommended were at once made.

The committee on standard sizes for locomotive boiler tubes then presented its report that the association's standard specification for locomotive iron boiler tubes be changed to read as follows:

> Tubes 2 ins. Outside Diameter.—.095-in. thick and weight at least 1.91 lbs. per ft.; .110-in. thick and weight at least 2.19 lbs. per ft.; .125-in. thick and weight at least 2.47 lbs. per ft.; .135-in. thick and weight at least 2.65 lbs. per ft.
>
> Tubes 2¼ ins. Outside Diameter.—.095-in. thick and weight at least 2.16 lbs. per ft.; .110-in. thick and weight at least 2.48 lbs. per ft.; .125-in. thick and weight at least 2.80 lbs. per ft.; .135-in. thick and weight at least 3.01 lbs. per ft.
>
> Under the heading of "Surface and Inspection," "And must be of uniform thickness throughout, except at the weld, where one gage number additional thickness will be allowed" be changed to read "where .015-in. additional thickness will be allowed."

These modifications in the standard specifications were adopted.

The following was presented by Mr. W. H. Lewis and adopted:

> Resolved, That it is the sense of this association that the statement of performance of locomotives should be made on the basis of ton-miles of train load in lieu of train-miles or of loaded car-miles, as is the prevailing practice at present.

Officers were then elected for the ensuing year as follows:

President, R. H. Soule; First Vice-President, Pulaski Leeds; Second Vice-President, Robert Quayle; Treasurer, O. Stewart.

Messrs. John McKenna and Alexander Galloway were elected honorary members of the association.

After discussing the place for holding the next convention an informal ballot was taken with the result that Colorado Springs had 40 votes to 24 for all other places combined.

The final adjournment was then taken.

* * *

A FLYING MACHINE is reported as being tested at Miller, Ind., by Octave Chanute, Past-Prest. Am. Soc. C. E. The machine is fastened to the body with straps, leaving the legs free, for starting, which is done by running against the wind. It is reported that a number of successful trials have been made, the machine rising to a height of 15 ft. and sailing for a distance of 200 ft.

BOOK REVIEWS.

A TREATISE ON LAND SURVEYING.—Comprising the Theory and the Practice. By William L. Gillespie, L. L. D., formerly Professor of Civil Engineering in Union College. Revised and Enlarged by Cady Staley, Ph. D., President of Case School of Applied Science. Part I., Land Surveying and Direct Leveling. New York: D. Appleton & Co. 8vo.; cloth; pp. 424 + 127; with 427 illustrations and many tables; $2.50.

We doubt not that to many of our readers Gillespie's "Land Surveying" was one of the earliest and most diligently studied of their engineering text-books, and that they feel for it still the same familiar respect and friendly prejudice that one always feels for a good text-book from which he learns the rudiments of any science and to which he often refers in after years.

We learn from the preface to this work that Part II., on Leveling and Higher Surveying, was only partly completed at the time of Prof. Gillespie's death, in 1868. This work was then taken up and completed by Prof. Staley, and was published in 1870. Seventeen years later the two parts were revised and united in one volume; but it has been found that the class of readers who desire the matter contained in Part I., have seldom use for the geodetic work, topographic work, etc., which is discussed in Part II. It has therefore been decided to again separate the parts, and the volume before us is the new and revised edition of Part I. We believe it will be received with much favor by teachers in engineering schools, and will be appreciated also as a manual for daily use by practical surveyors. The publishers deserve high praise for the mechanical work upon the volume. The type is remarkably clear; the illustrations are excellent; the tables in the last 125 pages are printed on a special paper with a rough surface and a cream tint, so that the leaves turn readily and do not show soil like the smooth calendered and dead white paper in the other part of the book. The cover of the book, however, is a green cloth, the color of which comes off when wet, and this is a serious defect in a book which will often be desired for use in the field and often will be carried in moist hands. We advise the publishers to change the style of their binding for books of this sort.

STATE RAILROAD CONTROL.—A History of Its Development in Iowa. By Frank H. Dixon, Ph. D., Assistant in Political Economy, University of Michigan. New York; Thos. Y. Crowell & Co. 8vo.; cloth; pp. 250; map and tables; $1.75.

The future development of railway regulation in this country is possible along two lines; either government ownership and government management must be adopted, or else the policy of state and national commissions must be elaborated and codified so as to make their influence practical and useful. It is not our purpose to elaborate this statement here, but its truth must be admitted unless we are to return to the old evils of private control alone. Dr. Dixon's book is a useful one to the man who realizes these facts, for it presents in a clear and concise form the history—the successes and failures—of the veritable struggles made by one of our great commonwealths in its efforts to evolve a just and efficient system for controlling the operations of the railways within its borders. Iowa is the state selected, and perhaps no more happy selection was possible. In that state trial has been made of both types of railway commissions now existing in this country, and an opportunity is had to compare their workings under nearly the same conditions. Space will permit only the author's general conclusions from this study, which are briefly: The success of a particular form of commission is dependent upon the character of the population, the industrial conditions and the geographical location, and the multiplication of state commissions is not a solution of the problem of control, but it must be worked out through a division of powers between state and national commissions.

* * *

SUBMARINE TORPEDO BOAT DESIGN is to be encouraged by the French navy department, the Minister of Marine having offered a prize of $2,000 for the best design of a submarine torpedo boat. The minimum requirements are a speed of 12 knots on the surface, with a radius of action of 100 miles; a speed of 8 knots when submerged, with a radius of action of 10 miles; two torpedoes, ready for launching, to be carried, and the total displacement not to exceed 200 tons. If there should be several good designs submitted, additional prizes of less amount may be given.

* * *

THE ARCHITECTURAL COMPETITION for plans for a block of model tenement houses in New York city, has resulted in the award of the prizes to Messrs. James E. Ware, Ernest Flagg and A. W. Ross. The competition was instituted by the New York Commission on the Improved Housing of the Poor, of which Mr. Richard Watson Gilder is the Chairman.

* * *

A TEST OF A 24-IN. submerged cast-iron water intake, at Burlington, Vt., showed it to be as tight as when accepted, about two years ago. The pipe is nearly three miles long and was laid on the bed of Lake Champlain, by Mr. J. G. Falcon, of Evanston, Ill. The intake was described in our issue of June 21, 1894. We are indebted to Mr. F. H. Crandall, Superintendent of the Water-Works of Burlington, for the above information.

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A NEW SITE FOR THE 20,000,000-gallon driven well plant for Camden, N. J., has been selected at a point much nearer the city than the original location. This will save 16,000 ft. of 36-in. cast-iron pipe, for which the contractor allows $105,000, making the price for the new supply $420,000. The new location is near the present reservoir in the town of Stockton, N. J., and the land comprises 56 acres of meadow ground, triangular in shape, with a frontage of about 1,000 ft. on the New Jersey channel of the Delaware River. Work will be started at once. The contractor, Mr. Geo. Pfeiffer, Jr., has sublet parts of the work as follows: Driven wells, Kisner & Bennett, Belmar, N. J.; two 10,000,000-gallon horizontal compound pumping engines, Holly Manufacturing Co., Lockport, N. Y.; stand-pipe, Tippett & Wood, Phillipsburg, N. J. It is expected that the driven wells will be about 90 ft. deep. A bond of $200,000, guaranteeing quantity and quality of supply for ten years, has been given by the contractor.

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BIDS FOR LAKE TUNNELS AT CLEVELAND, O., are wanted until July 31, as stated in detail in our advertising columns. It is proposed to build a brick-lined tunnel 9 ft. in diameter and 26,000 ft. long, terminating four miles from the shore of Lake Erie. Bids are also desired for an 8½-ft. brick-lined tunnel 15,000 ft. long, extending from the present intake crib. Mr. D. E. Wright is director of public works.

◆

TESTS OF TWO 30,000,000-GALLON Holly triple expansion vertical pumping engines for the Philadelphia Water-Works were recently made by Prof. H. W. Spangler, M. Am. Soc. M. E., and Mr. D. A. Decrow, M. Am. Soc. M. E. From a report of the test sent us by Mr. John C. Trautwine, Jr., Assoc. Am. Soc. C. E., Chief of the Bureau of Water, it appears that the engines exceeded the duty guarantee of 120,000,000 ft.-lbs., one by 8.5 and the other by 4.5%.

◆

A WATER FILTRATION COMMITTEE has been appointed at Pittsburg, Pa., by the mayor, Mr. Henry P. Ford. Among the eight members are Messrs. Robt. Pitcairn, Superintendent Pittsburg Division and General Agent of the Pennsylvania Railroad Co.; E. M. Bigelow, Director Public Works; and Dr. J. Guy McCandless. The advisability of filtering the present water supply from the Allegheny River will be considered.

◆

SLOW SAND FILTRATION FOR INDIANAPOLIS has been formally adopted by the Indianapolis Water Co., and Mr. Allen Hazen, of Noyes & Hazen, Boston, has been invited to prepare the necessary plans for the construction of filter beds. This will be supplementary to the present supply from infiltration galleries, driven and deep drilled wells. Mr. T. A. Morris is president, and Mr. F. A. W. Davis is treasurer of the Indianapolis Water Co.

◆

A CHEMICAL PRECIPITATION PLANT for treating the sewage of the Wayne County poor farm buildings, near Detroit, Mich., has just been completed. The engineer for the work was Mr. Geo. Y. Wisner, Sanitary Engineer for the Detroit Board of Health. The sewage first passes through a 30-ft. mixing channel, where it receives lime and alum. It then goes through three precipitating tanks placed side by side, each 4½ × 75 ft., giving a total flow of 225 ft. The effluent falls 4 ft. over a series of steps for aeration and finally discharges through an iron pipe into a small brook leading to the River Rouge. The plant cost about $10,000. Heretofore crude sewage has been discharged into the river, but complaints were made before the court, it is said, and the practice was ordered stopped.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred June 27, on The Union Pacific, Denver & Gulf Ry., near Bierstadt, Colo. An express train consisting of engine, baggage car and two coaches ran into an engine which was taking water. Both engines were wrecked, and one engineman was killed and several persons were injured. The express was 15 minutes late.

◆

A NEW BRIDGE FELL under an electric car near Carrollton, O., July 1. The accident was caused by the derailment of the car, wreching one of the trusses of the bridge. The line on which the accident occurred is owned by the Dayton Traction Co., and was opened for traffic on the day of the accident. Two cars containing invited guests were run over the line, and as one of these entered a bridge over a canal between Alexandersville and Carrollton, the front truck left the rails and struck the side of the bridge. The car was going very slowly and, according to the account in a Dayton newspaper, the bridge broke in two at the center and sank down so gradually that no panic was caused among the passengers, and the car remained right side up, but with one end tilted down to the break at the center of the span. No one on the car was injured. From a rough newspaper sketch, we judge the bridge was a pony truss structure of wooden or composite construction.

◆

A WOODEN HIGHWAY BRIDGE COLLAPSED at Hancock, Md., June 29. A four-horse team with a load of bark was crossing it. One driver was killed and another seriously injured. The bridge was built in 1889. It had been considered dangerous, and props had been placed under it, running up from the bed of the creek.

◆

THE TIDAL WAVE which followed the earthquake in Japan on June 18 is stated to have devastated the northern shores for 170 miles; many sea coast villages were totally destroyed and several thousand people are estimated to have lost their lives.

◆

A LOCOMOTIVE BOILER EXPLODED, July 2, on the Louisville & Nashville Ry., 27 miles north of Birmingham, Ala. Three men were killed and 18 cars were wrecked. The engine is said to have been in good condition at the beginning of the trip.

◆

A RIOT was precipitated at Cleveland, O., last week by a student from one of the scientific schools, who, in company with several others, had been conducting a series of tests at the works of the Brown Hoisting & Conveying Machine Co. Upon emerging from the works he was threatened by a crowd of strikers and shot one of them in self defense. In the fight that followed between the strikers and police a number of people were injured. The strike is occasioned by the workmen's objection to the employment of non-union men.

◆

A PHOTOGRAPH OF A TORNADO has been sent us by Mr. K. E. Hilgard, M. Am. Soc. C. E., Engineer of Bridges, Northern Pacific R. R., in response to the statement made in our issue of June 11, that so far as we knew only two such photographs had ever been taken. This photograph was taken by Fredericks & Koester, of St. Paul, Minn., and shows the so-called Lake Gervais cyclone, which occurred July 13, 1890. Owing to the blackness of the sky and the faint outlines of the funnel-shaped cloud, the possibility of a successful engraving is doubtful, and we do not reproduce the photograph, but refer to it here as a matter of record in connection with the Oklahoma tornado illustrated in Engineering News of June 11.

◆

THE PASSENGER DEPOT of the Baltimore & Ohio R. R. at Wheeling, W. Va., was carried away by a flood on July 6. The depot was built at the mouth of Wheeling Creek.

◆

FATAL ACCIDENTS FROM ELECTRIC CARS in Brooklyn now number 156 since the first introduction of the trolley, according to the records of the daily newspapers. The 156th victim was killed on July 8, and on the same day two collisions occurred, one at a crossing and one a rear collision. In the latter, two persons were injured.

◆

THE TRANSMISSION OF ELECTRIC POWER has made it possible to operate, profitably, the Virginius mines of the Caroline Mining Co. at Ouray, Colo. These are situated near the summit of Mount Sneffles, in a region of perpetual snow, some 12,700 ft. above the level of the sea, or 5,000 ft. above timber line. Access to the mines in winter is impossible and in summer extremely difficult. Before the introduction of electricity in 1891, fuel, delivered at the mines, cost $18 per ton. The electric power now used is derived from water which passes through a pipe line 4,000 ft. long to Pelton water wheels driving General Electric dynamos located at the foot of the mountain. The transmission line for the electric current passes first through dense timber, then over rocks and chasms and heavy snow drifts until it reaches the mine four miles away from the power house. The current is direct and the potential 800 volts. The amount of power now used is double that supplied by the superseded steam plant, and it is estimated that the saving pays, each year, the entire cost of the plant.

◆

A MAIL TUBE is under consideration for carrying mail between the New York and Brooklyn post-offices. If built it will cross the bridge and be operated by electricity or pneumatic pressure. The bridge trustees ask a rental of $8,000 for the first two years and $6,000 a year thereafter. It is stated that the post-office department is willing to pay from $14,000 to $15,000 a year to a company that will transport the mail by tube. The plan would greatly expedite the interchange of letters between the two cities and it is to be hoped that it may be carried out.

◆

MAIL COLLECTING AND SORTING WAGONS are reported as the latest proposed improvement in the United States Postal Service. These wagons would run in outlying districts and by having the mail sorted on them and placed in separate pouches according to destination much time could be saved that is now lost in sending mail to central stations, besides the saving in time of collection. Motor wagons are talked of for this service.

◆

ACETYLENE GAS FOR CAR LIGHTING is reported as having been tried on the Eastern Railway of France. The acetylene was compressed in a tank similar to that used for the gas ordinarily used in lighting on the road in question. A special Manchester burner, with a very small slit, was used.

◆

EXPERIMENTAL HOT WATER MOTORS are to be tried on the New York and Putnam Branch of the New York Central Railway, between New York and Yonkers, it is reported. The motor was invented by Mr. W. E. Prall.

◆

A NEW STEEL PLANT is being built at North Birmingham, Ala., by the Jefferson Steel & Manufacturing Co. A 15-ton Hawkins furnace will be put in operation July 10, it is expected, and nine more of the same style and size as soon as they can be completed. Mr. F. W. Hawkins, the patentee of the furnace to be used, is superintending the construction of the plant.

◆

A NEW OIL PIPE LINE TO TIDEWATER will be completed soon by the United States Pipe Line Co. The company has been delayed by an injunction against crossing under the tracks of the Pennsylvania and Delaware, Lackawanna & Western Railway companies' tracks in New Jersey.

◆

A DISINFECTING SHIP is nearly completed at the port of New York and will be used by the health officers in charge of disinfecting and fumigating vessels arriving from infected foreign ports. By its use it is hoped to reduce the time required to disinfect a vessel to one hour. Arriving vessels will be met and passengers transferred to the quarantine ship. All their wearing apparel will be subjected to a steam bath at 230° F.; and the passengers themselves will be obliged to take antiseptic baths.

◆

FIVE NEW PIERS, capable of accommodating the largest steamships afloat, will be built on the North River water front of New York city within a year by the Dock Department. The piers will be 100 ft. wide and 675 to 730 ft. long. Two of the piers have been applied for by the Cunard line and two by the White Star line.

◆

PROPOSALS FOR ORDNANCE MATERIAL are called for by the Ordnance office of the War Department until Aug. 3. The material desired includes 18 sets of forgings for 10-in. and 12-in. guns, and one set for a 16-in. gun, which will be the largest caliber yet attempted in this country. Proposals for 30 disappearing gun carriages, for 60 sets of steel mortar forgings, for finishing and assembling them, and for spring return carriages for mounting them are also asked.

◆

THE THREE 30-KNOT TORPEDO CRUISERS authorized at the last session of Congress promise to be the subject of more competition than was expected. Besides the Herreshoff Bros. the Columbian Iron Works, of Baltimore, has announced its intention to submit bids, and it is thought that the Cramps and one or two other firms will also submit figures.

A NEW SOLID FLOOR FOR HIGHWAY BRIDGES.

Solid floors are very desirable for highway bridges, but in many cases the increased cost has prevented the adoption of such a floor. To meet the objections as to cost, and at the same time to provide sufficient strength and durability in the cheaper floor, Mr. John O. Pew, General Manager of the Youngstown Iron & Steel Roofing Co., has designed and patented the system shown in the accompanying cuts.

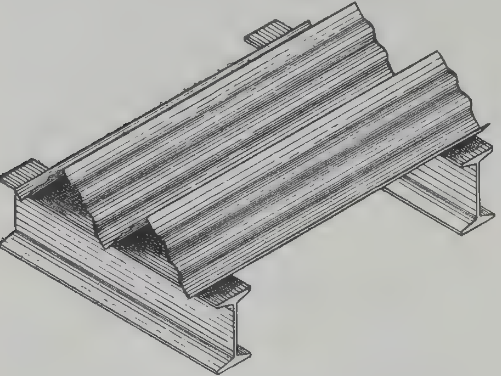

Fig. 1.—Galvanized Steel Troughs for Bridge Floor.

It consists of a series of galvanized iron troughs, 5½ ins. deep and 9¾ ins. wide, each trough having one or more corrugations along its faces to stiffen it and bind the trough more firmly to the concrete filling. The general form of the trough is shown in Fig. 1. The metal varies from No. 20 to No. 10 gage in thickness; No. 20 is for bridge sidewalks, No. 18 for country bridge roadways, and No. 16 for city bridge roadways. The metal is galvanized to protect it from corrosion. In order to get sufficient bearing on the floor beams the lower edges of the trough rest in wrought-iron or cast-iron chairs on the beams. The concrete filling is made with Portland cement concrete, and is finished off to an even surface for the paving, the concrete being 3 ins. thick over the tops of the troughs, as shown in Fig. 2.

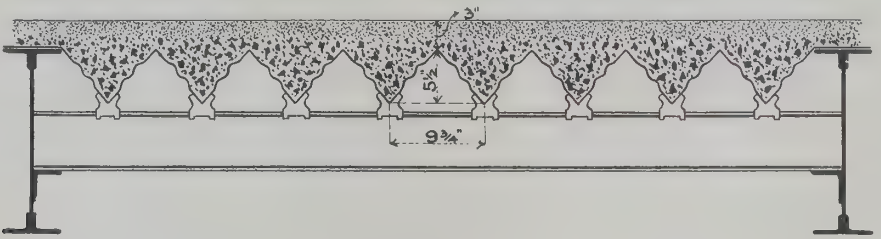

Fig. 2.—Cross Section of Solid Floor Roadway for City Bridges Showing Concrete Filling.

A section of floor having troughs of No. 18 steel, with a span of 3 ft. 10 ins., was loaded with pig iron, as shown in Fig. 3, the total load amounting to 16,534 lbs., or 1,016 lbs. per sq. ft. The load was not increased beyond this, as the pig iron could not be piled any higher. No appreciable deflection was noted, and the floor was in no way injured. This section of floor had concrete paving, 3 ins. above the tops of the troughs. Another test was made with a section of 7 ft. 10 ins. span, the troughs being of No. 16 galvanized steel, and the concrete being filled in to the tops of the troughs. This section carried without injury a load of 1,300 lbs. per sq. ft., the loading being then stopped on account of the height of the pile of pig iron.

The Youngstown Iron & Steel Roofing Co., of Youngstown, O., controls the patents, and we are informed that this floor has been adopted for heavy city bridges at several different places.

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ROCK RIVER AND MERRIMAC BRIDGES, CHICAGO & NORTHWESTERN RY.

(With inset.)

In its gradual work of replacing by new and heavier structures the old bridges along its lines, the Chicago & Northwestern Ry. Co. has recently completed two bridges, which for different reasons are of interest to engineers, and through the courtesy of Mr. J. E. Blunt, Chief Engineer, and Mr. W. H. Finley, Bridge Engineer of that company, we are able to present illustrations showing the essential features of these structures. The first bridge illustrated—that across Rock River, at Rockford, Ill.,—is of interest for its family history, the general characteristics of which engineers will recognize as typical of the history of many other American railway bridges. The second bridge is interesting on account of the method adopted in erecting it without disturbing traffic.

Rock River Bridge.—The first bridge built to carry the Chicago & Northwestern Ry. across the Rock River, at Rockford, Ill., was completed in 1852, a date at which iron bridges had been used in only a few isolated cases. Indeed, only five years before, in 1847, Squire Whipple, under the title of "A Work on Bridge Building," had presented the first rational discussion of the determination of stresses and proportioning of cross sections of truss members as the science is known to-day. The Howe truss had been known for twelve years and the Pratt truss for eight years, and many important combination wood and iron structures of these two types had been erected, but the era of iron bridges had hardly begun. Located in the West, far from the then existing centers of iron production and with the precedent of past experiences in favor of wooden structures, it was natural that a wooden bridge should have been erected at Rockford. It is not quite so easy to see, however, why a type of wooden structure which even at that early date was becoming obsolete, should have been chosen, for we find this first bridge to have consisted of five 116-ft. and two 106-ft. Burr truss spans with their clumsy trussing and reinforcing arches of wood.

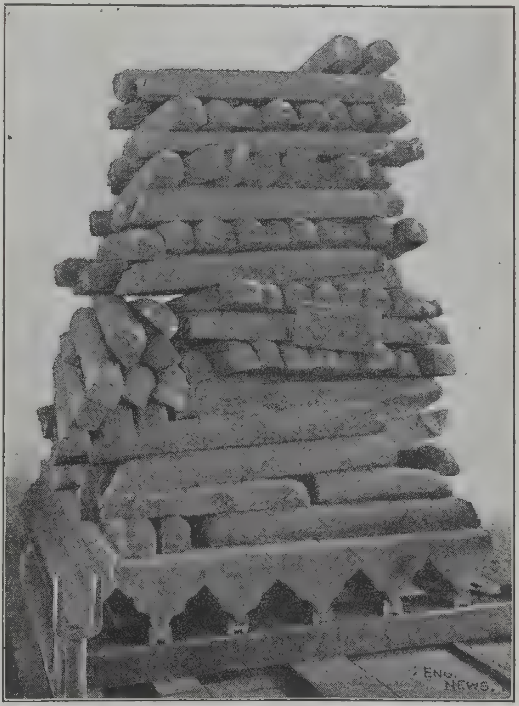


Fig. 3.—Test of Concreted Trough Floors for Bridges.

Whatever the considerations determining their selection may have been, these Burr trusses served their purpose for 17 years, when, in 1869, they were replaced by an equal number of Howe truss spans resting on the same foundations. Fig. 1, reproduced from a yellow old photograph taken in 1869, shows this work of reconstruction in progress. At the near end of the bridge is seen one of the old Burr truss spans undisturbed and just beyond is a second truss of the same type but with the arch timbers removed in the process of reconstruction. The far end of the bridge shows a number of the new Howe truss spans. This illustration will be found not uninteresting, too, on account of the single-driver inclined cylinder locomotive and the derrick car being used in the reconstruction work. It may be noted here, also, that this work was done under the immediate direction of Mr. J. E. Blunt, the present Chief Engineer of the Chicago & Northwestern Ry., who was at that time Division Engineer of the Galena Division of that railway.

The second generation of this bridge, the Howe truss, continued in use until the winter of 1895-6, or altogether 27 years, when it was replaced by the riveted triangular truss deck bridge shown by Fig. 2. This new bridge was placed on the same piers which carried the old Burr trusses of 1852, the only change necessary being the removal of the old capstones and some necessary modifications of the seats. A comparison of the old and new structures shown by Figs. 1 and 2 will suggest many things of interest to the bridge engineer, but with this brief historical introduction we proceed here to the construction of the new wrought iron structure, the grandchild of Rockford bridges. It may be noted here in reference to the use of wrought iron instead of steel that the managers of the Chicago & Northwestern Ry. Co. much prefer wrought iron to steel for bridge work, and state that up to this time they have succeeded in getting it as cheap or cheaper than steel.

The new iron bridge at Rockford is a single-track riveted truss deck bridge consisting of five 120-ft. spans and two 100-ft. spans. Fig 3 shows the general details of one of the 120-ft. spans—actually these spans are 114 ft. 3¼ ins., c. to c. of end pins—and as all shapes and dimensions are given they need not be discussed here. The manner of erecting the bridge deserves, however, brief mention, and to explain it the partial drawings of the falseworks, Fig. 4, are given.

A number of bents were constructed, as shown by the end elevation, Fig. 4. It will be noticed that the top story of this bent passes up inside of the trusses of both the old bridge (shown by dotted lines) and the new iron bridge. For each span the requisite number of these bents, generally seven or eight, were placed and then braced together longitudinally by means of horizontal and diagonal timbers held by bolts. This construction allowed the falsework to be taken to pieces and built up again quickly and easily. Enough falsework was built for three spans and after the completion of the ironwork for these spans the falsework was removed and re-erected under three other spans.

Turning now to the end elevation of the falsework shown in Fig. 4, the method of erection may be explained. After the erection of the bents and their bracing complete, the old Howe truss floor was removed and the track temporarily laid on the bents. The Howe trusses were then torn down and removed with the exception of the bottom chords, which were slid out on the first story cap of the bents and formed a track for the traveler used in erecting the ironwork. The iron trusses being erected with floor beams complete, the temporary floor on the bents was replaced by the permanent floor and track of the new bridge. All the erection was carried on without interruption to traffic. The railway company erected the falsework and tore out the old Howe trusses, Mr. R. C. Sattley, Superintendent of Bridges, Galena Division, having charge of the work. The Wisconsin Bridge & Iron Works, Milwaukee, Wis., built and erected the new iron bridge.

Merrimac Bridge.—The Merrimac Bridge crosses the Wisconsin River at Merrimac, Wis., and the work here described consisted in erecting twelve plate girder deck spans to replace the same number of riveted truss deck spans without delaying traffic, which averaged 18 trains between 7 a. m. and 6 p. m. o'clock during its prosecution. As will be seen from Fig. 5, the supports for these spans were iron towers and as the old truss spans were deeper than the new plate girder spans the towers had to be increased in height. This increased height was secured by the construction shown in Fig. 6, which also shows other details of the plate girder work, floor construction, etc.

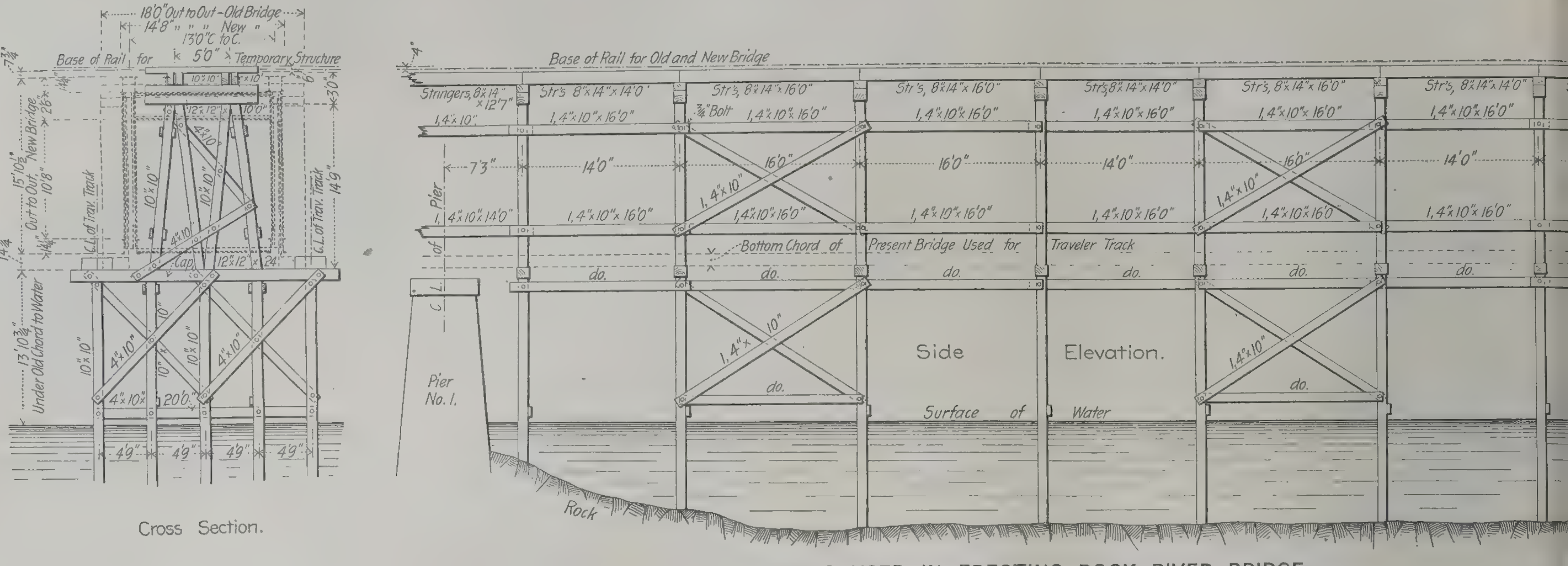
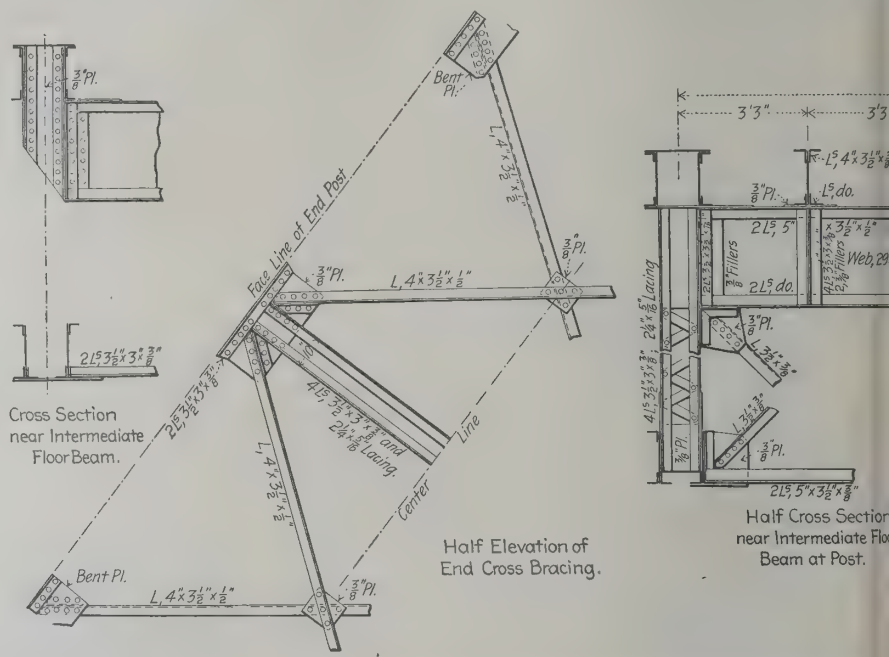


FIG. 4.—DETAILS OF FALSEWORKS USED IN ERECTING ROCK RIVER BRIDGE.


3/8" Pl.
2 L5 3 1/2" x 3" x 3/8"
Cross Section near Intermediate Floor Beam.
Bent Pl.
Face Line of End Post
L, 4" x 3 1/2" x 1/2"
4 L5 3 1/2" x 3" x 3/8" and 2 1/4" x 5/16" Lacing.
Center Line
Half Elevation of End Cross Bracing.
3'3"
2 L5 5"
Fillers
Web
Lacing
2 L5 5" x 3 1/2" x 3/8"
Half Cross Section near Intermediate Floor Beam at Post.

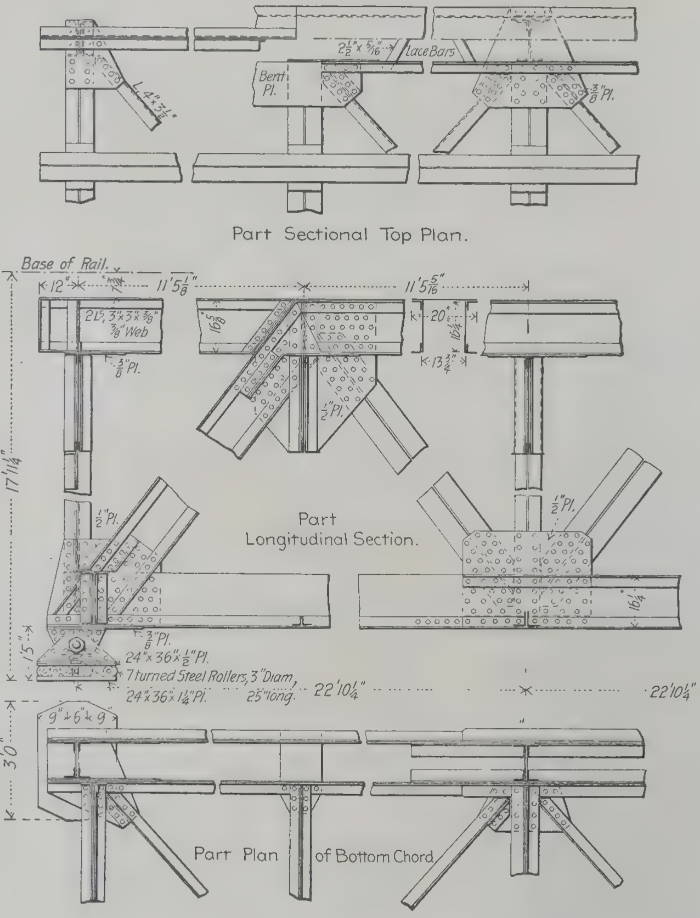


FIG. 3.—DETAILS OF RIVETED TRIANGULAR TRUSS FOR NEW ROCK RIVER BRIDGE.

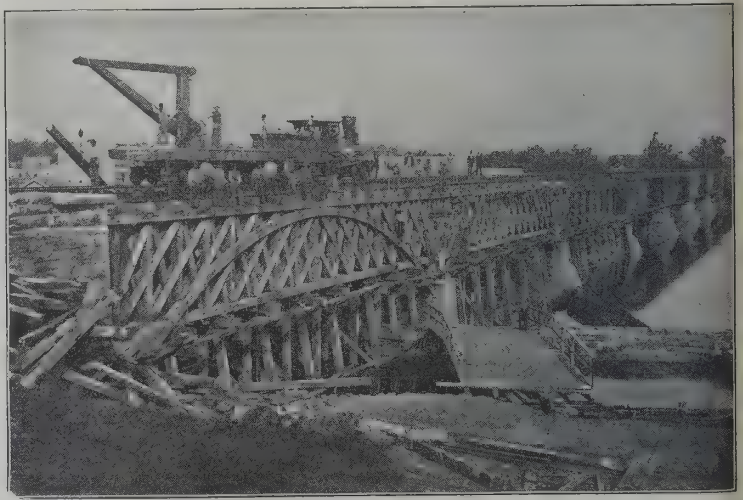


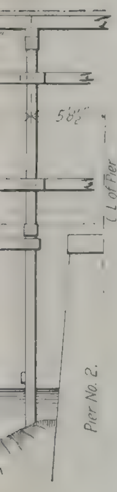
FIG 1.—VIEW OF ROCK RIVER BRIDGE, CHICAGO & NORTHWESTERN RY DURING RECONSTRUCTION IN 1869.

(At the Near End of the Bridge are Shown the Burr Trusses Built in 185 and at the Far End the Howe Truss Spans Being Erected in 1869.)

ROCK RIVER AND MERRIMAC BRI

J. E. Blunt, Chief Engineer. Wm. H. Fin

Wisconsin Bridge & Iron Co., Milwaukee, Wis., Contractors for Rock River Bridge.



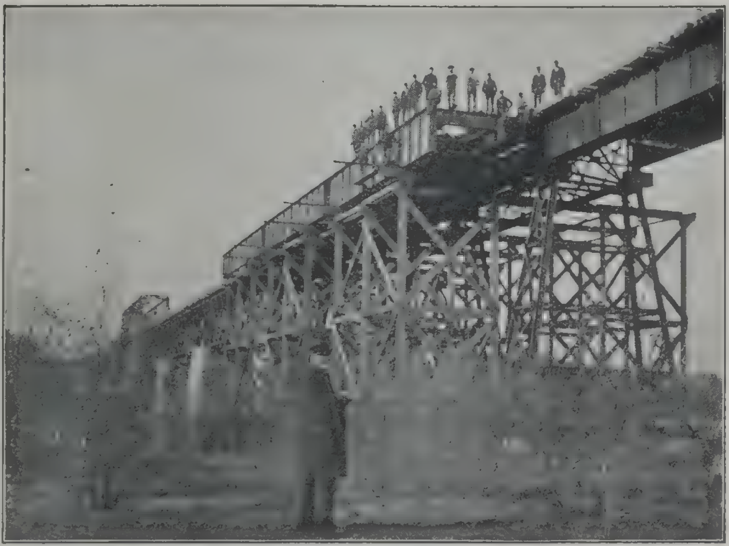


FIG. 8.—VIEW OF MERRIMAC RIVER BRIDGE SHOWING METHOD OF ERECTION.

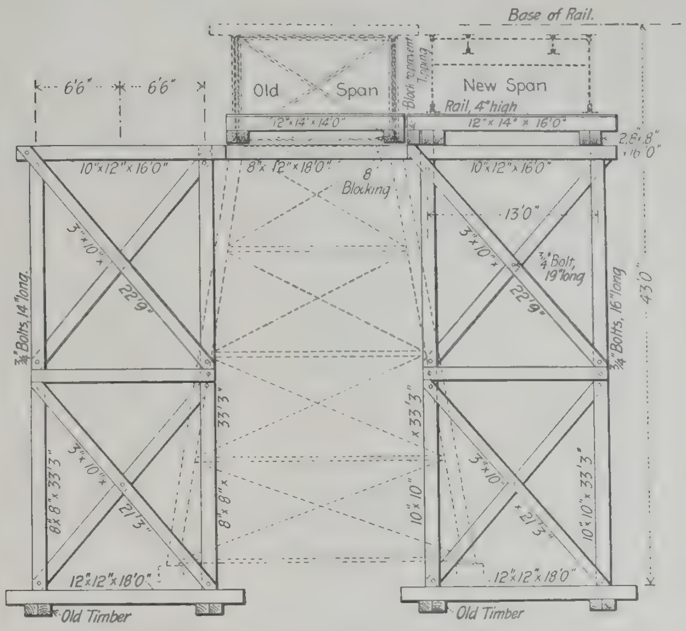
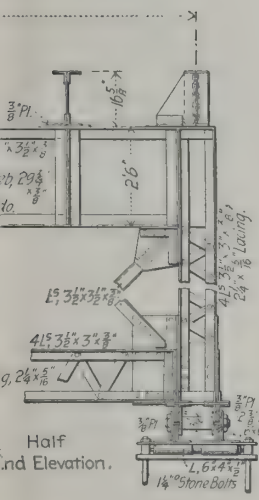


FIG. 7.—DETAILS OF FALSEWORKS USED TO ERECT MERRIMAC BRIDGE.



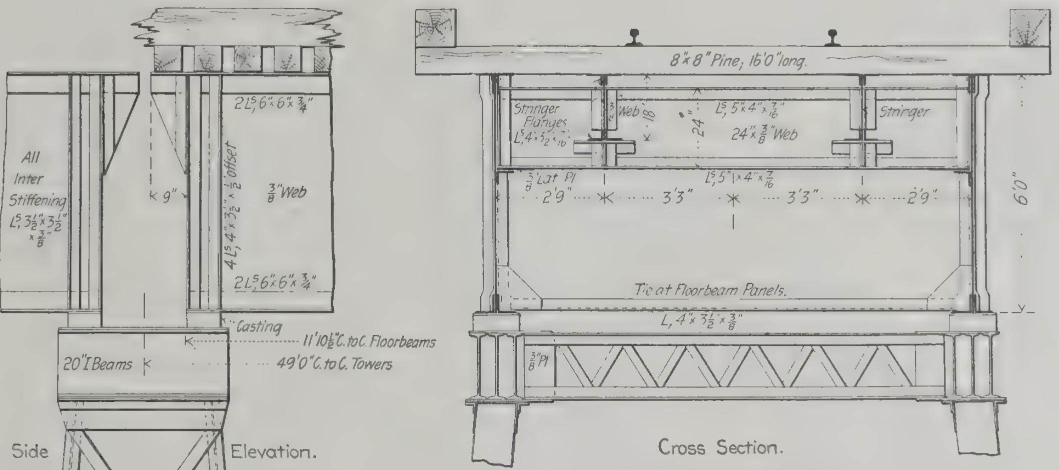


FIG. 6.—CROSS SECTION OF PLATE GIRDER SPANS SHOWING SUPPORTS ON TOWERS, MERRIMAC BRIDGE.

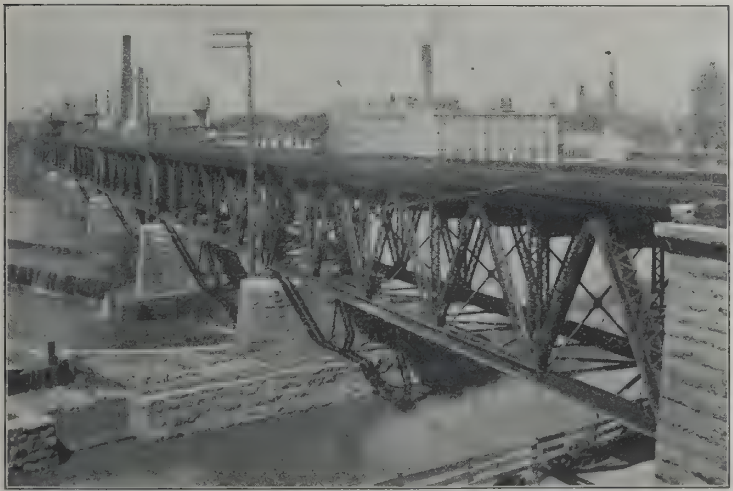


FIG. 2.—WROUGHT IRON BRIDGE AT ROCK RIVER, CHICAGO & NORTHWESTERN RY., BUILT IN 1895-6, TO REPLACE HOWE TRUSS BUILT IN 1869.

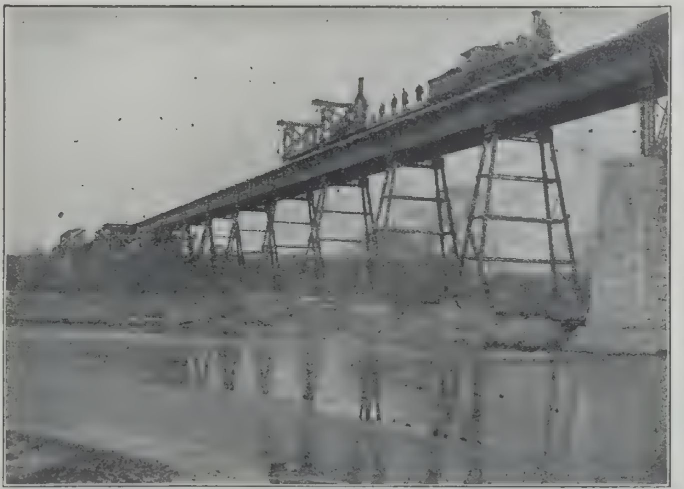


FIG. 5.—MERRIMAC BRIDGE, CHICAGO & NORTHWESTERN RY., SHOWING CHARACTER OF CONSTRUCTION AND METHOD OF ERECTION.

HICAGO & NORTHWESTERN RY.

ge Engineer, Chicago & Northwestern Ry.

Lassig Bridge Works, Chicago, Ill., Contractors for Merrimac Bridge.

To erect the bridge a falsework was erected on each side of three spans, as shown by Figs. 7 and 8. This falsework was so arranged that as soon as three spans of the new structure had been completed it could be removed and set up beside three more spans. On the falsework on one side the new plate girder span was assembled complete. This being done the old span was slid sideways onto the opposite falsework and the new span put in its place. The illustrations show the method of operation in a general way, but further details are given by Mr. M. Riney, Superintendent of Bridges and Buildings, Chicago & Northwestern Ry., in a report of the work to Mr. Wm. H. Finley, Engineer of Bridges for the same company. This report was as follows:

During the erection of the twelve plate girder spans over the Wisconsin River at Merrimac, Wis., the number of trains that crossed the bridge daily between 7 a. m. and 6 p. m. was 18. Work was begun unloading the falsework the last week in September, 1895, and on Oct. 3, 4 and 5, three spans of falsework on both sides of the bridge were raised. On Oct. 5 the iron crew lowered the first girder onto the falsework, and by Oct. 7 the remaining girders and connections for all three spans had been lowered and the floor beams, laterals and stringers put in place. On Oct. 9 the first set of girders was moved onto their permanent position. To allow of this shift the running of trains was so arranged that the time between 2 p. m. and 4 p. m. o'clock was left free from trains. In making the shift the first thing done was to remove the ties from the old bridge. A block and tackle was then hitched to the old span and it was slid bodily out onto the falsework by means of a hoisting engine. The time occupied in doing this was three minutes. The hitches were then changed to the new girder span, blocking meanwhile being placed on the towers to provide for the less depth of the girder span. The new span was then slid into place in about five minutes. The old span was moved about 14 ft. and the new span about 15 ft. from their original positions. Before starting to move the new span the ties had been placed so that all that remained to be done was to put the rails into place. The procedure with the remaining spans was exactly similar and the following statement shows the time occupied in placing each new span complete:

No. span.	Hrs.	Mins.	No. span.	Hrs.	Mins.
1.	2	30	7.	1	10
2.	2	00	8.	1	30
3.	2	05	9.	1	40
4.	1	15	10.	1	30
5.	2	00	11.	1	40
6.	1	45	12.	1	30

Only one train was delayed and that during the change of the first span when the men were new to the work and over careful.

When the three new spans had been set, the next task was to remove the old spans so as to get at the falsework to move it to a new position. Two long pine timbers were placed on timber horses transversely across the car with their ends overhanging on each side of the bridge, Fig. 7. By means of block and tackle operated by a hoisting engine, also on the car, two bents of the falsework on each side of the bridge were picked up and the cars moved along the bridge to the points where the bents were to be set again. Everything possible was handled by a locomotive, hoisting engines, and a wrecking car. The first span was set in place Oct. 9, and the last Oct. 31.

The designs for both this bridge and the Rockford Bridge and also the methods of erection were the work of Mr. Wm. H. Finley, Engineer of Bridges, Chicago & Northwestern Ry. The Merrimac Bridge was built by the Lassig Bridge Works, of Chicago, Ill., and it was erected by Mr. A. B. Carson. The forces of the railway company put in the falseworks and handled them during the work.

THE SAFE THICKNESS FOR ENGINE TRUCK WHEEL FLANGES.*

Your committee is asked to report on the thickness of engine truck wheel flanges, recommending the minimum thickness at which it is safe to allow the leading truck wheels to run.

At the last convention, at Alexandria Bay, a communication was received from Mr. T. J. Hatswell, master mechanic of the Flint & Pere Marquette R. R., asking that this matter of the thickness of engine truck wheel flanges be discussed. It appears that Mr. Hatswell had had a difference of opinion with the Railroad Commissioner of the state of Michigan, arising from an accident on his line by the derailment of an engine at a frog on a perfectly straight track, which was attributed to a thin flange on the engine truck wheel. The wheel in question was steel-tired. The flange of the wheel, measuring by the gage, was 13-16-in., which Mr. Hatswell considered perfectly safe in running. The commissioners fell back on the M. C. B. rules, claiming that they recommended wheels to be condemned with a flange 1 in. in thickness, and that a steel-tired wheel ought not to be rated with a flange thinner than a cast-iron wheel.

We have made rather extended investigations, and find a considerable variance in practice. We find the allowable thickness to vary from ¾ to 1⅛-ins. in steel wheels, and from ⅞ to 1 and 3-16-ins. in cast-iron wheels, a range for which there seems to be no good reason. There is a considerable number of mechanics who follow the practice of permitting a thinner flange in steel wheels than on cast-iron wheels, and we confess that your committee started its work of investigation with a bias in favor of this practice. It seemed at first that a steel-tired flange could be worn thinner than a cast-iron flange, inasmuch as in condemning one the reasons were entirely different; that is to say, a cast-iron flange ought to be condemned when it developed wear, on account of its liability to break, whereas a steel-tired flange ought to be condemned when it showed wear, not on account of its liability to break, but on account of its liability to climb the rail through being sharp. We very shortly changed our views of this matter, however, and now think it can be demonstrated very clearly that there should be but one thickness as a minimum for a leading engine truck flange, whether the material is cast iron or steel. In support of this view, we submit tracings that show that by allowing even moderate wear to a steel flange, the life of the wheel will give out much more rapidly, owing to the quantity of tread surface that subsequently has to be turned off and thrown away, in order to produce a standard thickness of flange.

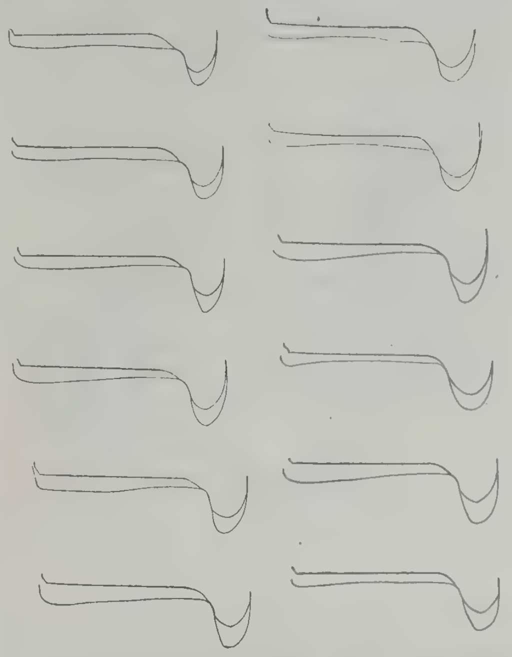


Fig. 1.—Contours of Engine Truck Wheel Tires With Flanges Worn Thin, and Standard Section after Turning, Showing Amount of Metal Required to be Removed.

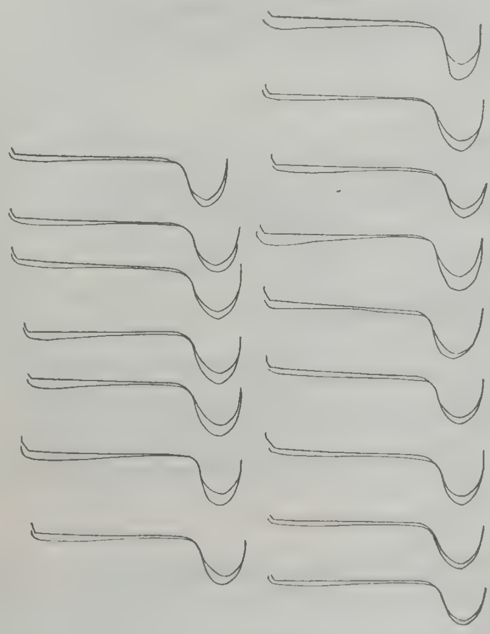


Fig. 2.—Sections Showing Economical Limit of Flange Wear on Engine Truck Wheels.

These tracings show the outlines of a number of coach tires which were taken on the C. B. & Q. Ry. several years ago by Mr. A. Forsyth, master mechanic of that road. We append a letter from Mr. Forsyth, which, with the accompanying drawings, we believe fully demonstrates the correctness of our position.

To sum up, your committee would definitely recommend:

1. That the minimum thickness of leading engine truck wheel flanges should be the same for both iron and steel wheels.

(Note.—In recommending that the steel flange limit be the same as in cast iron, the fact that the strength of steel admits, with perfect security, of a thinner flange has not been lost sight of by your committee. Our recommendation is based purely upon economical considerations as to tire wear.)

2. That the minimum thickness be 1 in., measured at a point ¾ in. from the top of flange, as shown on the appended diagram, Fig. 3.

Pulaski Leeds, G. W. Rhodes, R. M. Galbraith, A. F. Stewart and W. D. Crosman, Committee.

Appendix.

Aurora, Ill., May 18, 1896.

Mr. G. W. Rhodes, Supt. M. P., C., B. & Q. Ry., Aurora:

Dear Sir: Replying to Mr. Crosman's communication attached. Up to 1890 it was our practice on the C., B. & Q. to run steel-tired wheels as long as they could possibly run with safety. This was done with the idea that we were getting more mileage out of the steel tires by so doing. During the year 1889, I took contour lines from every steel-tired wheel that came to the shop for tire turning, and in April, 1890, the matter was brought to the attention of the C., B. & Q. Master Mechanics' Association, and blue prints of 171 tires as they arrived at the shop, and the amount of metal that had to be turned off the tread in order to make a good flange, were presented at that time.

In order to illustrate this, I have selected from these contour lines (Fig. 1), and present on the enclosed drawing twelve extreme cases which show the enormous amount of metal wasted from the tread of the steel-tired wheels by allowing the wheel to run until it has a very thin flange.

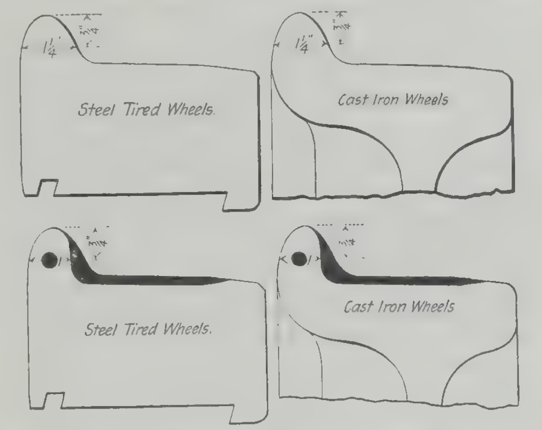


Fig. 3.—Standard Flange and Minimum Flange Thickness Recommended for Engine Truck Wheels.

On the second drawing (Fig. 2) I have shown selected contour lines of sixteen steel-tired flanges that had commenced to develop flange wear. At our Master Mechanics' meeting it was decided that it was not economical to allow flange wear on steel-tired wheels to get any worse than is shown on this drawing.

A. Forsyth, Division M. M., C., B. & Q. Ry.

THE COSTA RICA RAILWAY.

From a report by Mr. George E. Church, M. Am. Soc. C. E., one of the directors of the Costa Rica Ry. Co., of London, we take the following brief description: The line extends from Limon, on the Atlantic coast, to Alajuela, 117 miles, with a branch 20 miles long to Guapiles. The grades are from 1½ to 4%, the latter being at the summit of the range, and the curves are from 12 to 20°. There are 143 bridges, with an aggregate length of 10,702 ft., which is an indication of the great amount of waterway to be provided for floods, etc. All the bridges are of iron, with a minimum span of 20 ft., and there are 25 bridges with lengths of 129 to 620 ft. Floods and landslides cause much damage to the railway and its structures.

The line has a gage of 3 ft. 6 ins., and is laid with 50-lb. rails on the main line and 40-lb. rails on the branch. Between Limon and San Jose (the capital city) there are 99,500 wooden ties, of which 27,500 are of lignum vitae (estimated to have a life of 15 years on the Panama R. R.), the remainder being of Colombian and native hard wood, which requires renewal in a few years. All the other ties are of steel, of which 20,130 were on hand for renewals in June last. It is recommended that all renewals should be made with steel ties, except that lignum vitae should be used on the first 12 miles, as the action of the climate and the sea air is very destructive. The steel ties, after 7 years' use, show a wear of about ⅛-in., under the outer flange of the rail.

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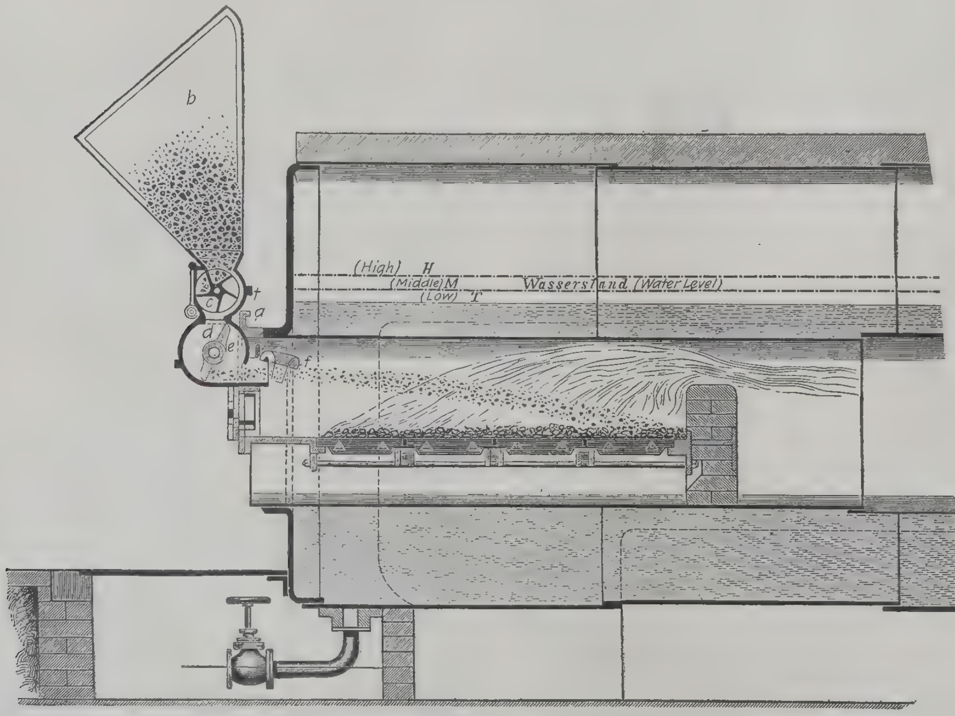
*A committee report presented at the annual meeting of the American Railway Master Mechanics' Association.

There are 22 locomotives, of six or seven different types, and it is considered that 16 mogul engines and 2 six-wheel switching engines could more economically handle the traffic. At present large American engines (from the Baldwin Locomotive Works) are used on the heavy divisions, hauling the same trainloads which the smaller English engines haul on the other divisions. There are 37 passenger cars, of various types, and the small English cars are considered inferior to the American cars on account of their greater proportion of dead load. The freight equipment aggregates 284 cars, and here again the American cars, with a capacity of 20 tons and over, are considered to give more economical service than the small English cars of 8 and 10 tons capacity. These latter, however, are at present preferred for certain traffic. It is recommended that all new cars should have iron or steel sills, as wood has so short a life in this climate. At Limon there is a wooden pier 930 ft. long, 50 to 70 ft. wide, along which two tracks are laid. The piles are subject to rapid destruction by the teredo navalis, and a new iron pier, at a different location, is proposed. Some particulars of the early history of this railway will be found in our issue of Feb. 16, 1889.

A GERMAN MECHANICAL STOKER.

That our readers interested in mechanical stokers may see what is being done in that line on the other side of the water, we reproduce herewith illustrations of a mechanical stoker which is being placed on the market by the "Sachsische Maschinenfabrik zu Chemnitz." We venture to say that most American engineers, after examining the accompanying drawings of the apparatus, would pronounce it an unmechanical and absurd contrivance; but, notwithstanding this, if its manufacturers tell the truth in their circular, it seems to be giving a very good account of itself in service, being in use in some 150 different establishments, many of which have from 5 to 14 boilers equipped with it.

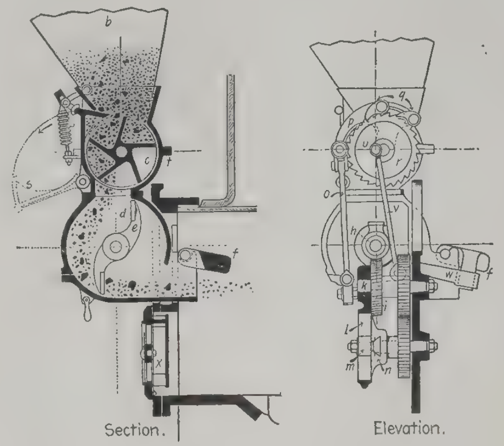


A GERMAN MECHANICAL STOKER. LONGITUDINAL SECTION OF INTERNALLY FIRED BOILER, WITH STOKER ATTACHED.

Made by "Die Saechsische Maschinenfabrik" Zu Chemnitz.

The makers state that either anthracite or bituminous coal may be used, but the kind best adapted is a nut coal, with pieces varying from ¼ to ¾ in. in size. By changing the speed of the rotating shaft, however, it is said that pieces as large as 2¼ ins. may be stoked. The feed is adjustable to suit different rates of combustion.

The general principle of the device is evident from the accompanying drawings. The coal is thrown into the furnace by wings on a rapidly revolving shaft, and is fed to that shaft in measured quantity by a slowly turning wheel at the bottom of a hopper. One would suppose that clogging and breakage of these two shafts would be too common to make the machine a success; but if that is the case how do so large a number come to be in use?



Cross Section and Front Elevation of Operating Machinery of Stoker.

It will be seen that the stoker is designed for attachment to an internally fired boiler; and it certainly is an attractive feature that none of the moving parts are directly exposed to the fire. Apparently, also, it can be attached to the front of an ordinary boiler with very little difficulty.

It will be seen that the stoker has firedoors of its own, fitted with slides; and as the doors remain closed, it is claimed that a smokeless combustion may be obtained through suitable manipulation of the slides and the chimney damper.

We leave American stoker manufacturers to decide whether this apparatus is so poor that the Germans adopt it for lack of something better (in which case the American stoker makers will do well to pay attention to their German export trade); or whether it is so excellent that it ought to be introduced in this country.

STEEP GRADES ON ELECTRIC RAILWAYS.

By S. L. Foster.

In 1892 railway men began to realize that heavier motors were needed. The forerunner of the latest series parallel controller appeared on the scene and the cost per mile was brought down to a more reasonable point. These powerful motors rendered feasible grades that it would have been unwise to operate with the old equipment. The toothed armature cores, instead of smooth cores, and the protected field spools, reduced the item of motor repairs, and a large amount of power formerly wasted at starting was saved by the new controllers. In San Francisco the unusual grades encountered led to the use of two 25 HP. motors on each single truck car.

These 25 HP. motors are far in excess of what is required to propel the cars on the level, and we thus see already that some of the penalties for operating electric cars on heavy grades are the necessity of transporting heavier motors than are needed on the level, the attendant lower average car efficiency and the increased rail joint abuse.

It is hardly necessary to note that single truck cars have been found to be better than double truck cars for heavy grade work as in the former the motors are given the benefit of all the adhesion the weight of the car can give, while in the latter some of this weight is supported by the four wheels that do not act as drivers for the car.

There is a misconception in some minds as to the power that is really required by an electric car on a grade. The formula used in determining the force required to propel a vehicle shows that when on a grade this force increases rapidly with the grade when the speed remains the same. But the speed of an electric car does not remain the same on a grade as on the level. The motors are only capable of a certain effort and as on a grade the car not only has to be advanced horizontally, but also raised vertically at the same time, the work to be done is increased and the car speed decreases until it is within the power of the motors.

Another feature of grade climbing—the freedom from wagon interference is often overlooked. On a road where heavy grades prevail very little wagon traffic is met, and the slow running and frequent stops and starts so prevalent on a level line and so wasteful of power are absent. When a car starts up a grade it has an uninterrupted run to the end and its short pieces of level track are usually clear. The result of these compensations is that the average amount of electrical energy absorbed on 1,000 car miles covering seven consecutive days on a level city line is but 50% less than the average on 1,000 car miles on a city line in which several 10 and 12% grades exist. The level line is 24,000 ft. long where there is a total rise of but 142 ft. and the other was 16,000 ft. long and comprises two hills. The line rises 186 ft. to the top of the first hill, descends 92 ft. and rises to the second hill top 143 ft. The same style of cars and motors was used in both cases.

When the new series parallel controllers came out, instructions were given to use only the series notch on heavy grades as it was more economical to run the motors in series than in multiple. Let us see what the basis of this advice was and its value. On grades over 6% about two times as much current is used and over twice the speed is attained by the car when the motors are run in multiple as when run in series. This excessive flow of current causes an increase in sparking at the brushes, sends the armatures to have the commutators turned sooner and the greater speed on the grade wears the bearings and gearings more rapidly. From the standpoint of the repair shop, the series combination is thus seen to be the cheaper.

From the standpoint of the power house engineer, too, it is better for cars to be run up hill on the series notch as the power plant can handle twice as many cars that are running on the series notch as if the cars ran on the multiple notch. The lines containing heavy grades are the bugbear of the engineer on account of the abnormal fluctuations in load due to the cars climbing the grades on the multiple notch. Where the plant is nearly loaded, this sudden occasional call for four times the normal current often results in the whole line being cut out in order to assure current for more important lines.

From the standpoint of the investor, the series notch is preferable, as when cars are run up the grades with the motor in multiple the system must be not only equipped with boilers, engines, generators and feed wire, of double the capacity that would be required if the series method of running the motors were used, but this double capacity must be running and ready at all times, as it is not a case of a load coming on at 7 a. m. and 5 p. m., but it appears at regular intervals through the day and must be provided for.

From the standpoint of the watts per car mile, or the coal pile, however, the multiple notch is found to be slightly cheaper. On grades over 6% under ordinary conditions, single truck cars equipped with two 25 HP. motors were found to require, when the motors were run in multiple, from nothing to 14% less expenditure of power than when the motors were run in series.

The current will be more when in multiple, but the time will be less than in an inverse ratio to the current or, what is the same, the speed will be more than in a direct ratio to the current. For example, on a given grade two times the current is absorbed and 2.6 times the speed is attained. Thus the power is less at the multiple notch. This saving, however, is not worthy of consideration, as it is undoubtedly more than counterbalanced by the loss at the generators, due to inefficient running at under load most of the time. This saving on a 14½% grade amounts to 1¼ K-W. hours per mile of grade run.

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*Extract from a paper read at the first annual meeting of The California Street Railway Association.

In other words, as roads are usually built with but few and short heavy grades and the rest of the lines more nearly level, the use of the multiple notch involves a slight saving for a few moments of each trip and a waste in the form of interest of money and unnecessary coal burned for inefficient generators for the rest of the time.

On a line where a number of tests were made the saving was for 6.2%, and the waste for 93.8% of the running time. The series notch is thus seen to be the more economical. Ordinary mechanical reasoning teaches us that the amount of power required to propel a car up a grade is independent of the speed. If the speed is slow the force required is less, but the time during which it is exerted is longer. If the speed is rapid the force is greater and the time less, so that the result is the same in either case. The explanation of this disagreement between theory and the facts is found when we consider the relative car efficiencies at the two notches. The efficiency is higher at the multiple notch on a heavy grade because the work done by the motors approaches more nearly their rated capacity where their efficiency is a maximum.

This greater economy at the multiple notch held good under the conditions of the tests made, only on grades above 6%. On such a grade the power consumed is the same at the series as at the multiple combination, while on lesser grades and on the level the series is the more economical notch at which to travel a given distance. The tests were made under ordinary conditions of load and voltage. Of course, every railway manager must decide according to his local conditions which is the larger, the value of the coal saved by the use of the multiple notch, or the extra expense for repair work on armatures due to the quadrupled flow of current, plus the interest on the additional station capacity rendered necessary in order to safely handle the sudden heavy calls for current made by the hilly lines, plus the interest on the extra amount of feeder wire needed to keep up the voltage when from three to four times the current usually used on the level is called for. There is still another expense to set against the saving in coal and that is the item of lamp breakage. If feeders of sufficient size are run to the hilly portions of the line so as to hold up the voltage for the few moments during which the cars are climbing at the multiple notch, these feeders will be too large for the line the rest of the time when the cars are not climbing, and the voltage will rise and as the lamps will be running up over normal candle power most of the time, their life will be shortened considerably.

The question of requiring more cars when the series notch is used on grades in order to secure the same headway will not come up unless the line is run with no layover at the ends. On the line tested comprising 33,000 ft. of single track and having five heavy grades each way, 1½ minutes only would be lost each half trip by changing from the multiple to the series method of climbing heavy grades or three minutes to made up in 50, the time of a round trip.

It is frequently asked what the steepest grade is that can be ascended by an electric car, and the question is as often left unanswered because the questioner cannot state the exact coefficient of friction between the car wheels and the rails.

It is easier and fully as much to the point to tell of what steep grades have been climbed and to call attention to the fact that it is not a question of how steep a grade can be climbed, but how steep a one can be safely descended. In San Francisco cars are operated successfully both ways on a 14.54% grade, and on the Piedmont road in Oakland on a 14¼% grade up and down. In Seattle, Wash., on Rainier Ave., by the help of sand a single truck car climbed a 16.85% grade 300 ft. long, but in this case it is not dared to allow a car to descend without an outside check on its speed.

Some motormen have devised a method whereby they can come down heavy grades rapidly, have the brakes on fairly hard and yet not slide the wheels. This result is produced by putting the controller on the series notch while the brakes are set. The maximum braking effect has been found as the result of an elaborate series of tests made by European engineers, to be produced by applying the brake shoes at a pressure just under the skidding point. In case the wheels slide, the brake shoes should be released at once, the wheels allowed to revolve and be then gripped again. The motormen referred to have found that by the use of the motors, they can hold the car braked at that point of maximum retardation just short of skidding and can keep the car wheels free from slipping, while maintaining a higher rate of speed than is possible when not using current in conjunction with the brakes. The idea of using power while descending grades, however, is just the reverse of what all street railway men have been seeking to realize, namely, how to recover, while descending, some of the power consumed while ascending. It also seems most dangerous for motormen to get into the habit of using current while descending a grade, lest in case an emergency arise, they continue to advance the controller instead of throwing it back to "off" before reversing. When at the series notch it is impossible to reverse the motors. The controller handle must first be thrown "off." If the controller is on, it necessitates one more operation before the car can be stopped, and in an emergency the time occupied for this extra move is extremely valuable.

It can perhaps be plausibly argued that a car can be stopped more quickly by causing sliding wheels to rotate than by leaving them sliding, from a consideration of the tests mentioned above. Here it was found that the pull per ton required to tow a car with the brakes set decreased from 42 lbs. to 5 lbs. as soon as the wheels slipped. Conversely it might be claimed that if the wheels were turned when slipping the car speed would be checked. It would be a good deal cheaper, however, to make these wheels turn by slacking off the brakes than by trying to do it by using current.

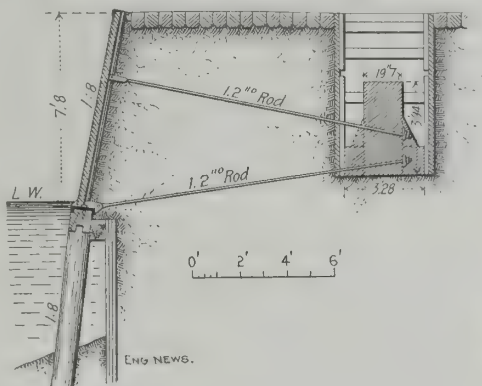

Fig. 1.—Quay Wall of Iron and Concrete on the River Spree, Berlin, Germany.

The problem of ascending grades where electricity forms only a portion of the power required for the work is solved in this locality in three typical ways—at Mt. Lowe, near Pasadena, Cal.; in San Francisco, on the Fillmore St. grade, and on Rainier Ave., in Seattle, Wash.

At Mt. Lowe two cars are permanently attached at opposite ends of a cable that passes around a winding drum in the power house at the top of the grade. The force of gravity on the descending car aids the ascending car in its ascent. The track construction is three rail with a turnout at the center of the route where the cars pass each other. The system is controlled entirely from the power house above. A positive difference in loads is made up by a stationary electric motor actuating the winder, and a negative difference is offset by a brake on this winder. Here grades as high as 68% are surmounted.

On Fillmore St., in San Francisco, we have a practical double track street railway proposition. The descending car assists the ascending car on the same principle as at Mt. Lowe. The positive difference between the loads of the two cars and the friction of the gearing, cable, etc., is made up by the use of the motors on one car; any negative difference being controlled by a band brake on the tail sheave on the hill top. When each of the two cars ends its upward or downward course, it is quickly released from the cable and proceeds on its trip. The grade here is 25.54% and about 25 HP. is used to work the whole mechanism including both cars. In this case two cars—one descending and one ascending—are essential for the working of the device.

At Seattle the line is single track, while under it is a second track in a conduit. The passenger car runs above and a load of pig iron as a counterbalance below. A descending car pulls the car of iron up to the top of the hill on to a bit of level track where it stands. The next ascending car by starting up and pulling up the cable, which is endless, starts this counterbalance car down and receives assistance from its descent in climbing the 17% grade.

Here one car only is needed at a time, but it must be always going in the right direction.

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A QUAY WALL OF IRON AND CONCRETE.*

The use of steel and concrete in combination is rapidly extending in this country, but German engineers are making still more bold experiments in this direction, many of which promise to be valuable improvements upon older practice. We show herewith a quay wall recently constructed along the Spree in Berlin and illustrated and described in the "Centralblatt der Bauverwaltung."

On top of a row of piles, driven into the river bed, are placed battered iron posts from 1.5 m. (5 ft.) to 2 m. (6 ft. 6 ins.) apart, to which plates of the well-known Monier construction are connected; they are from 0.6 m. (23⅝ ins.) to 1 m. (39⅜ ins.) high, and from 7.5 c. m. (2 15-16 ins.) to 6 c. m. (2⅜ ins.) thick. They are lined with cement mortar on the inside, and act as horizontal beams. The tops of the battered posts, on a level with the street surface, are braced by an angle iron, or some other light shape, and each post is anchored by two rods, one at the base and the other at a point above the center of pressure of the back filling, and slightly more than two-thirds of the height of the iron post, which gives, approximately, an equal stress upon the rods.

Two different methods of anchoring these rods are shown; in the one they pass through and are held by nuts and washers on the back of a continuous block of concrete; in the other case, which is the cheaper and easier method, an iron plate fastened to a frame of channels is used in place of the concrete.

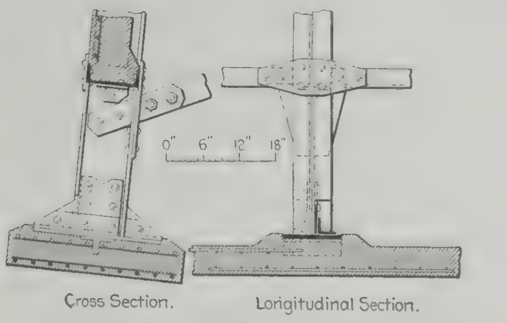

Fig. 2.—Foundation Plates for Iron and Concrete Quay Wall.

All iron that is placed under ground is protected by a coating of cement mortar 1 to 3; on the side exposed to the water the iron is cleaned and oiled.

Numerous experiments have proved that Monier plates offer a large resistance to impact; and a further advantage in this construction is the smooth and uninterrupted surface presented against the action of exterior forces. The wall at Berlin has been built as an experiment, and the observations during the last five years warrant the conclusion that it possesses a considerably greater durability than one built of wood, while its total cost per square foot of wall surface, including all incidentals, amounts to only about one-third more. These remarks apply to the construction shown in Fig. 1.

As to the expense of maintenance, actual experience is, of course, still wanting; it is well known, however, that cement offers an excellent protection to iron against rust, and that the Monier plates show satisfactory weather resisting qualities, and that, therefore, this item may be expected to be low. It is also to be assumed that the cost of future similar construction will be reduced, and the details simplified. The shore wall is perfectly tight, and proper drainage of the back-filling must, therefore, be provided.

Where it is not convenient to drive piles, a base of Monier construction, as shown in Fig. 2, and broadened out sufficiently to distribute the pressure, may be used. The baseplates retain moderate dimensions even with soil of very small compressive resistance, and are, therefore, to be especially recommended for such cases.

A mathematical investigation of the stresses in the front plate, rods and anchor plate, indicates that a considerable saving in material may be secured in carrying out similar work in future.

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GARBAGE DISPOSAL AT TACOMA AND SEATTLE, WASH.*

By A. McL. Hawks., Jun. Am. Soc. C. E.

Experience and Practice at Tacoma.

The population of Tacoma by the last census was 36,006, but garbage and refuse is collected from only about 15,000 people. Garbage collection is under the control of the Board of Public Works, the city's carts collecting street sweepings and the garbage and ashes being collected together by private carts. The garbage in the residence district is supposed to be collected twice a week and in the business district, and from boarding houses and hotels, daily. Ashes are removed from one to three times a week.

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*Abstracted from the "Centralblatt der Bauverwaltung." By O. J. Marstrand, M. Am. Soc. C. E.

*Prepared from information collected by Mr. Hawks for Mr. Rudolph Hering, M. Am. Soc. C. E., and published with the consent of Mr. Hering.

The approved form of receptacle for ashes and garbage is a galvanized iron can about 2 ft. in diameter, 3 ft. high, with reinforced bottom, heavy iron rim, two strong handles and a cover. Nearly all covers disappear after a few months, as they are not fastened to the can. The cans must be placed at the curb line in the business section and on the line of the alley in the residence district of the city.

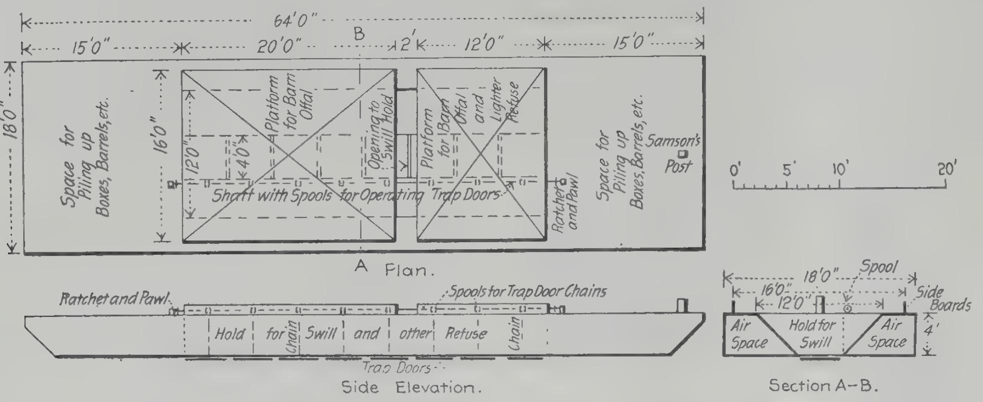


FIG. 1.—GARBAGE SCOW USED AT TACOMA, WASH., 1890 TO 1893.

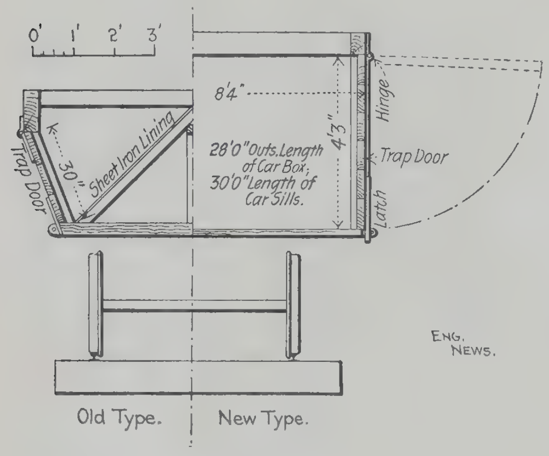


Fig. 2. Fig. 3.

Old and New Types of Garbage Cars at Tacoma, Wash.

Ordinary wagons are used for collecting garbage and ashes. Dump carts would, of course, be preferable. The garbage wagons are supposed to be water tight, with canvas covers, but such covers are not ordinarily used. They are drawn by two horses and accompanied by only one man in the residence, and by two in the business district, the hauls for these districts being respectively 1½ and ¾ miles. The wagons used cost from $75 to $125 each.

The only record of the amount of garbage, ashes and other refuse collected is for the year ending with July, 1895, the figures being taken from the books of the Northern Pacific Railroad Co., which at that time was hauling the garbage from the city. The record, in tons, is as follows:

August	295	February	250
September	290	March	230
October	330	April	240
November	320	May	90
December	310	June	156
January	360	July	108

Total for the year........................2,979 tons.

The composition of the material collected varies in winter and summer, as follows, the figures being percentages:

	Winter.	Summer.
Ashes	50	20
Barn refuse	25	50
Other material	25	30

The yearly cost of gathering the garbage may be estimated at $3,500; of hauling by train, $3,250; of spreading on land, $600; making a total of $7,350, when the garbage was shipped by rail and hauled to and spread on farm land. Disinfection of the garbage receptacles, wagons and cars is not practiced. The garbage weighs about 30 lbs. per cu. ft. in summer, dry, and 45 lbs. in winter, soaked.

The history of garbage disposal at Tacoma has been as follows:

In the summer of 1890 a garbage crematory was erected, but no information is available regarding its character and cost, further than a portion of the structure still standing, which indicates an ordinary furnace, and four fragments of bills from which the cost may be estimated as about $6,000. On Aug. 21, 1891, a contract was made for the operation of the crematory for a year at $1,051, but on Nov. 1, after several weeks of unsuccessful trial, the contract was cancelled by mutual agreement.

On Nov. 1, 1890, a contract was let for towing the garbage on a scow from the city dock about three miles out to deep water. The contract price was $550 a month for eight months, for six trips a week. The capacity of the scow was from 60 to 100 cu. yds., according to the method of loading, the weight being perhaps 1,000 lbs. per cu. yd. The contract was renewed on July 1, 1891, at $313 per month, and on July 1, 1892, for $219 per month for the same service. The latter rate continued until Sept. 15, 1893. The design of the scow is shown by Fig. 1.

After some months of scow service complaints arose that the lighter refuse and carcasses of animals lodged on the shores. The nuisances thus occasioned was mitigated through a part of the year by gray sea gulls, which from September to June followed the scow by thousands and picked up the floating matter. During the summer, however, the gull goes north, and in 1893, the complaints became so frequent and insistent that a change was made.

In September, 1893, a contract was entered into with the Northern Pacific Railroad to haul the garbage and street sweepings to Hillhurst, 16 miles distant, for $270.83 per month, or $3,250 per year. Farmers unloaded the wagons and carted the garbage about ¾ mile to their farms for fertilizing purposes. A man at $1.50 a day was stationed at the side track to unload the cars and load wagons, when at hand; at other times he sorted the material. Combustible material was thrown into one pile; tin cans, iron, etc., were thrown into another and afterwards shipped to a smelter where $7.50 a ton was paid for it; the fertilizing material was spread upon land at the rate of 36 loads, of 100 cu. ft. each, per acre the first year and 18 loads the second.

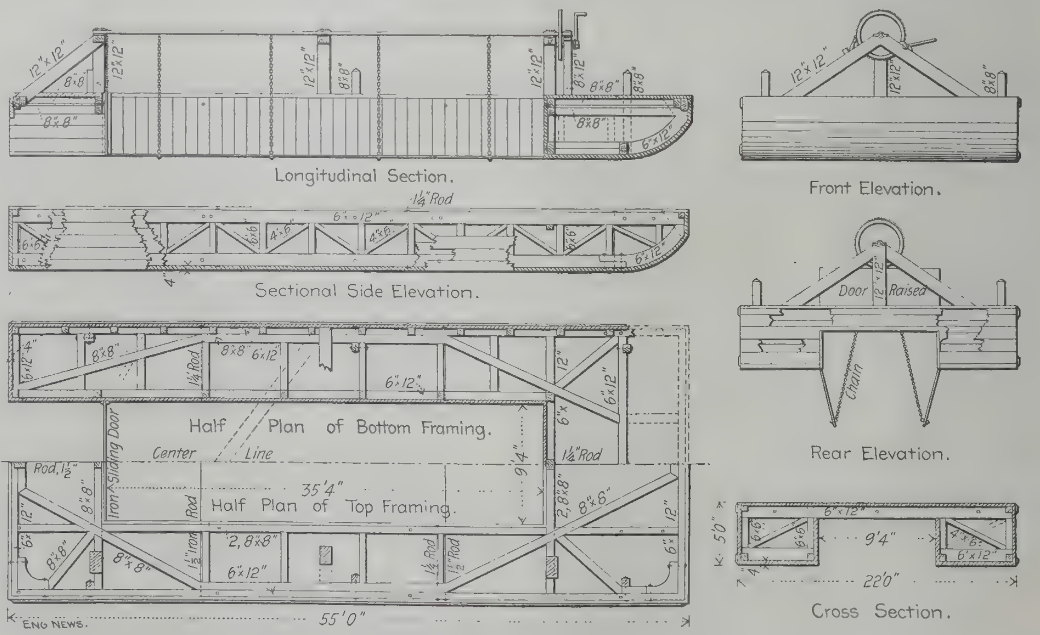


FIG. 4.—DETAILS OF GARBAGE SCOW USED AT SEATTLE, WASH.

From September, 1893, to April, 1894, the garbage was put on the farms as fast as received, the cost of cartage and spreading being 30 cts. per wagon load, excluding, and 35 cts., including, the sorters' wages. Between April and September, the farmer's busy time, the garbage was sorted and then stacked at the side track. This heap was not very offensive, no odor being perceptible at 60 to 75 yds. There was no farmhouse within ¼ mile and no complaints were made. A part of this heap was carried over to the summer of 1895, without offense. The heap would, of course, steam and give off odor if broken into.

The soil upon which the garbage was placed was a rather poor, sandy loam, which without garbage would yield about 1¼ tons of "green oat hay" or 8 to 12 bu. per acre of oats. With garbage the first year the yield was 3½ tons of hay, or 52 bu. of oats per acre. The second season was a dry one, but the yield even then was 2¾ tons of hay and 42 bu. of oats, while neighboring fields were giving but one ton of hay and 7 to 10 bu. of oats.

A comparison of the yield from 30 acres in hay and 10 in oats for two years, with and without garbage, based on the above figures, shows a gain of $474, or $237 a year, in favor of the land receiving garbage, while there would be a benefit for a few years after through an improvement in the soil. The farmers estimated that twelve loads per acre would keep the land up to the standard for the third and succeeding years, which by decreasing the cost would, of course, increase the profit.

If the use of garbage for low-priced crops shows such favorable results might it not be so profitable for market-gardening as to make it worth while for the gardeners to haul it from the city?

The garbage cars used by the Northern Pacific were of two types. Fig. 2 is a section of the older form, which was simply the common self-dumping ash car, modified a little and made larger. A few trips demonstrated that this car could not be loaded to its tonnage capacity with the light material to be carried and that the doors were too small for the easy removal of dead horses. Therefore the new type, Fig. 3, was adopted, which is simply a huge box about 7½ × 27 × 4 ft. 10 ins., inside measurement, having three doors on a side, each giving a clear opening of 4⅓ × 8¼ ft. Carcasses can be dragged from these cars by means of a horse and rope and the other matter can be discharged by means of a scraper within the car, moved by a team on the ground.

With the completion of a bridge in August, 1895, the city changed its method of refuse disposal, using the material for making a permanent roadway on the flats. At first the garbage was dumped here with the other material, taking care to keep the worst matter at the bottom. This not proving entirely satisfactory the "swill" is now taken to the "piggeries" by farmers and the remaining matter used for filling. Only one man is kept at the dump. The "hard times" has made a great reduction in garbage of all sorts, especially in "swill" from houses. Where the removal of the latter was once a source of expense to the householder, farmers will now remove it without charge, or even pay a small sum for it. In a few cases stable refuse is taken for fertilizing purposes by farmers living near the city.

Garbage Disposal at Seattle.

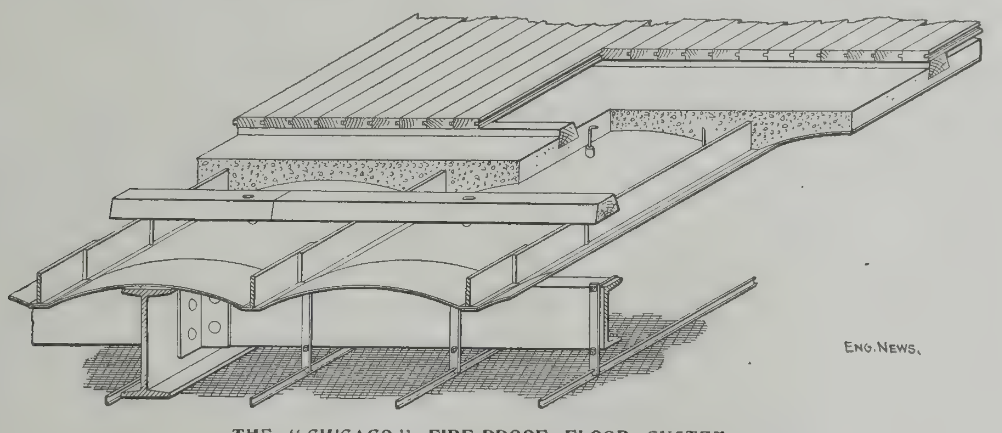
The collection of garbage at Seattle does not follow notably dissimilar lines from the system at Tacoma. Householders pay from 50 cts. per month for weekly, to $2.50 for daily, collections. The population served is about 20,000; the census of 1890 showed about 43,000 inhabitants.

Prior to 1889 no regular system of garbage and refuse disposal was in use. Since the great fire of that year these wastes have been dumped in Puget Sound, requiring a three-mile tow. The refuse is somewhat heavier than at Tacoma and is dumped in deep water, as there, but still it gives trouble along the shores.

About 15,000 tons per year are dumped in the Sound at a total cost of $97 per month, or $1,164 a year, which is about 8 cts. per cu. yd. The form of garbage scow used is shown in detail by Fig. 4.

THE "CHICAGO" FIREPROOF FLOOR.

The development of a safe and economical floor system seems to have attracted the attention of inventors to a greater extent than any other feature of fireproof building construction. Hardly a month passes that some new design is not presented to appeal for the favor of builders and architects, until now it has become a somewhat difficult task to carry in mind the different designs in actual use, to say nothing of the thousand and one which have only reached the dignity of letters patent. One of the latest floor systems which has been called to our attention is the "Chicago floor," which is the invention of Mr. Theo. Kandeler, a civil engineer of Chicago, Ill., and which is illustrated in the accompanying cut.



THE "CHICAGO" FIRE-PROOF FLOOR SYSTEM.
Theo. Kandeler, C. E., Chicago, Ill., Inventor.

The metal work of this floor consists of a series of steel bars, about 5 ft. long, and 3½ ins. wide, which are set vertically and spaced 2 ft. apart. To these bars are fastened 2×3-in. beveled wooden nailing strips, and between them are sprung sheet-iron arches, having 2½ ins. rise. This metal work complete is made in the shops in sections 5 ft. wide and 10 ft. long. In the building the sections rest on the floor beams and stringers, as shown, and are covered with concrete. The protection from beneath is secured by a suspended ceiling of fireproofing as shown.

The claims for this floor are perhaps best stated in its designer's own words, as follows:

> The safety of this floor does not depend on the quality of the concrete used, as all carrying parts, up to the floor strips, are steel, and can be proportioned with equal safety for the heaviest and for the lightest loads. If the floor strips should burn out, the concrete arch having a resistance of 50 lbs. per sq. in. would carry a load of 500 lbs. per sq. ft. All work essential to the strength of the floor is done in the factory where its quality can be perfectly controlled. The sections are opened for inspection before they are put in their places. Any amount and quality of fireproofing can be fastened above or below the floor, so that any degree of safety against fire may be obtained. The lightness of the floor follows from the exclusive use of steel for carrying purposes. The concrete is put in merely for fireproofing and deafening, therefore its quantity and weight may be reduced to a minimum. The quickness of construction is possible because all the slow work is done at the factory. This work may begin as soon as the plans of the building are far enough advanced to determine the dimensions of the floor sections, then the sections will be ready when the steel beams, which support them, are in place. The cheapness of our floor is practicable because 90% of the work in its construction is done at the factory, and factory labor is much cheaper than outside work. Another point is the lightness of our floor, which cheapens the steel I-beams, the columns and the foundations of any building in which the floor is used.

Mr. Kandeler calculates that the cost of this floor, taking into account the reduced weight of columns, I-beams, etc., will be 35½ cts. per sq. ft., as compared with 43½ cts. per sq. ft. for a tile floor.

HIGHWAY COMMISSIONS AND ASSOCIATIONS.

At the present time, when so much work is being done in road improvement and in promoting the construction of good roads, a list of the associations interested in highway work, will be of interest to many of our readers, and we therefore publish the following list, which has been kindly furnished us by Mr. M. O. Eldridge, Acting Chief of the Road Inquiry Bureau, Department of Agriculture, Washington, D. C.

Wisconsin League for Good Roads, 505 East Water St., Milwaukee, Wis.—Pres., Thomas M. Blackston, Sheboygan, Wis.; Secy., Otto Dorner, Milwaukee, Wis.; Treas., John Johnson, Milwaukee, Wis.; First Vice-Pres., Lucius Fairchild, Madison, Wis.; Second Vice-Pres., W. D. Hoard, Fort Atkinson, Wis.; Third Vice-Pres., A. Cressy Morrison, Milwaukee, Wis.; Directors, W. H. Rogers, Madison, Wis.; Wm. E. Crater, Plattville, Wis.; Thos. W Spence, Milwaukee, Wis.; C. C. Rogers, Milwaukee, Wis.; John C. Koch, Milwaukee, Wis.; A. K. Hamilton, Milwaukee, Wis.

Board of Highway Commissioners, Burlington, Vt.: Chairman, Oscar L. Hinds, Burlington, Vt.; Secy., J. W. Votey, Burlington, Vt.; Marcus Peck, Brookfield, Vt.

Ohio Road Commission: Chairman, Hon. Martin Dodge, Cleveland, O.

Connecticut Highway Commission, Hartford, Rooms 25 and 27, Capitol, Hartford, Conn.; Commissioners, James H. Macdonald, Chairman, Hartford, Conn.; A. C. Sternberg, Hartford, Conn.; Wm. R. McDonald, Hartford, Conn.

New Jersey Road Improvement Association: Prest., Clayton Conrow, Cinnaminson, N. J.; Vice-Pres., C. C. McBride, Elizabeth, N. J.; Secy. and Treas., E. G. Harrison, Asbury Park, N. J.

Iowa Road Improvement Association, Clinton, Ia.: Pres., E. H. Thayer, Clinton, Ia.; Secy., O. L. F. Brown, Des Moines, Ia.; Treas., C. B. Worthington, Des Moines, Ia.; Directors, 1st Dist., William Steyh, Burlington, Ia.; 2d Dist., Peter A. Dey, Iowa City, Ia.; 3d Dist., J. M. Muncey, Jesup, Ia.; 4th Dist., Wm. Larabee, Clermont, Ia.; 5th Dist., James Yuill, Cedar Rapids, Ia.; 6th Dist., Chas. F. Blake, Ottumwa, Ia.; 7th Dist., J. G. Barryhill, Des Moines, Ia.; 8th Dist., W. O. Mitchell, Corning, Ia.; 9th Dist., J. C. McCabe, Logan, Ia.; 10th Dist., G. L. Tremaine, Humboldt, Ia.; 11th Dist., H. C. Wheeler, Odebolt, Ia.

Virginia State Good Roads Association, Richmond, Va.; Pres., Joseph Bryan, Richmond, Va.; First Vice-Pres., Chas. E. Asburner, Brook Hill, Va.; Secy. and Treas, H. W. Anderson, "Times" Building, Richmond, Va. Vice-Presidents, 1st Dist., Orris A. Browne, Cape Charles., Va.; 2nd Dist., J. E. Booker, Suffolk, Va.; 3d Dist., B. B. Munford, Richmond, Va.; 4th Dist., Chas. T. Lassiter, Petersburg, Va.; 5th Dist., Geo. Young, Sutherlin, Va.; 6th Dist., H. A. Gillis, Roanoke, Va.; 7th Dist., H. L. Lyman, Charlottsville, Va.; 8th Dist., Geo. W. Barbour, Somerset, Va.; 9th Dist., H. C. Stuart, Elk Garden, Va.; 10th Dist., Lyman Chalkley, Staunton, Va.

Bureau of Highways, Sacramento, Cal.: Commissioners, R. C. Irvine, Marsden Manson, J. L. Maude and E. Marion Wolf (Clerk), all of Sacramento, Cal.

Massachusetts Highway Commission, 15 Court Square, Boston, Mass.: Commisioners, G. A. Perkins, Boston; Nathaniel S. Shaler, Boston; William F. McClintock, Boston; Charles Mills, Civil Engineer, Boston.

New York State League for Good Roads, Rochester, N. Y.: Pres., Gen. B. F. Tracy; Vice-Pres., W. Austin Wadsworth; Treas., S. S. Howland; Secy., John A. C. Wright, all of Rochester, N. Y.

Directors: Thomas R. Proctor, Utica, N. Y.; Hon. Wm. Cary Sanger, Albany, N. Y.; Warham Whitney, Rochester, N. Y.; J. R. Rosevelt, Hyde Park, Dutchess Co., N. Y.; Frederick Bronson, 76 Wall St., New York city; John C. Churchill, Oswego, N. Y.; Paul Tuckerman, Tuxedo, N. Y.; Arthur E. Clarke, Batavia, N. Y.; Winthrop Chandler, Barrytown, Dutchess Co., N. Y.; Chas. A. Willis, Havemeyer Building, New York city; N. G. Spaulsing, Schodack Landing, N. Y.; August T. Gillinder, 2 Nassau St., New York city; G. Howard Davison, Milbrook, N. Y.; A. Beekman Cox, Cherry Valley; Joseph C. Willits, 49 Wall St., New York city; W. A. Sweet, Syracuse, N. Y.; Dean Sage, Albany, N. Y.; Geo. P. Sawyer, Buffalo, N. Y.; John Bogart, 71 Broadway, New York city; I. B. Potter, Potter Building, New York city; Staley N. Wood, Hinsdale, N. Y.; Worthington Whitehouse, Elmsford, Westchester Co., N. Y.; Howard Willetts, 303 Pearl St., New York city; J. Y. McClintock, Rochester, N. Y.; W. Pierpont White, Utica, N. Y.; Martin I. Schenck, Greenbush, N. Y.

County Secretaries of New York League for Good Roads: (Albany Co.), Henry M. Sage, Albany; (Allegheny Co.), Capt. G. H. Blackman, Wellsville; (Broome Co.), F. M. Gilbert, Binghamton; (Cattaraugus Co.), John Sloan, Olean; (Cayuga Co.), H. V. L. Lord, Auburn; (Chautauqua Co.), Dr. W. M. Bemus, Jamestown; (Chemung Co.), George M. Robinson, Elmira; (Clinton Co.), E. C. Baker, Plattsburg; (Columbia Co.), H. R. Bryan, Hudson; (Cortland Co.), E. E. Mellon, Cortland; (Erie Co.), G. L. Williams or E. C. Sprague, Buffalo; (Fulton Co.), Geo. Fenton, Broadalbin; (Genesee Co.), Arthur E. Clark, Batavia; (Herkimer Co.), J. H. Ives, Little Falls; (Madison Co.), G. S. Tillinghart, Morrisville; (Montgomery Co.), G. S. Wagner, Fort Plain; (Niagara Co.), Eugene M. Ashley, Lockport; (Oneida Co.), T. H. Terris, Utica; Onondaga Co.), F. M. Power, Geddes; (Ontario Co.), C. C. Sackett, Canandaigua; (Orange Co.), Paul Tuckerman, Tuxedo; (Orleans Co.), Isaac Signor, Albion; (Oswego Co.), J. D. Higgins, Oswego; (Otsego Co.), F. E. Munger, Richfield Springs; (Queens Co.), F. McLachlin, Flushing; (Schenectady Co.), W. C. Vrooman, Schenectady; (Schuyler Co.), John M. Thompson, Watkins; (Steuben Co.), A. Crook, Bath; (Tompkins Co.), J. L. Mandeville, Brookton; (Wayne Co.), L. C. Cuyler, Pultneyville; (Yates Co.), John S. Sheppard, Penn Yan.

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Special Committee on Good Roads, Nashville, Tenn.: Maj. C. A. Locke, M. Am. Soc. C. E.; Hunter MacDonald, M. Am. Soc. C. E., and W. H. Schuerman, Professor of Mathematics in Vanderbilt University; all of Nashville.

Indiana Highway Improvement Association, Indianapolis, Ind.: Pres., J. S. Mount, Shannondale, Ind.; Secy., L. B. Eubank, Indianapolis, Ind.

Missouri Road Improvement Association, Kidder, Mo.: Pres., T. O. Stanley, Sedalia, Mo.; Vice-Pres., W. C. Adams, Atherton, Mo.; Secy. and Treas., Levi K. Chubbuck, Kidder, Mo.

Good Roads Association, Cromwell, Conn.: Pres., Dr. W. B. Hallock; Secy., T. W. Beaumont; Treas., Walter Fewthrop; Executive Committee, W. S. Coe, John B. Bond, Geo. S. Butler, H. W. Congdon, and A. N. Pierson, all of Cromwell, Conn.

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Douglas County Road Improvement Association, Omaha, Neb.: Pres., Chas. F. Manderson, Vice-Presidents, Guy C. Barton and William A. Paxton; Treas., Ben. B. Wood; Secy., Curtis C. Turner; Victor B. Caldwell; all of Omaha, Neb.

Michigan League of Good Roads: W. L. Webber, Pres., Saginaw; William Appleton, Vice-Pres., Lansing; E. M. Hopkins, Secy. and Treas., Saginaw; John McVicar, Detroit; C. V. De Land, Jackson; Silas E. Woodworth, Plainfield; H. C. Weeks, Allegan; S. S. Bailey, Grand Rapids; Dallas J. Don, Flint; G. W. Howe, Port Huron; C. H. Peters, Saginaw; Wm. Carpenter, Muskegon; William Crosby, Harbor Springs; Reuben Goodrich, Traverse City; William Chandler, Sault Ste. Marie.

Mifflin County Good Roads Association, Milroy, Pa.: Pres., Chas. Bratton, Shanks Run, Pa.; Vice-Pres., J. H. Peachey, Belleville, Pa.; Secy., S. T. Moon, Milroy, Pa.

THE NEW YORK & BROOKLYN R. R. CO. has been granted the right by the New York Board of Aldermen to build a tunnel under Ann St., from Park Row to the East River. The company proposes a tunnel under the East River terminating in Brooklyn at Middagh and Furman Sts. The length would be 8,225 ft., and approach grades of 4% as a maximum are proposed. Mr. Benjamin F. Henning, who has been prominent as an advocate of a gravity tunnel on this site, is the principal promoter of the scheme, and among others interested are Alonzo B. Cornell, E. R. Hoadley and Irving Washburn, of New York. The company has agreed to pay the city 2½% of its gross receipts. It is designed to use electricity for the motive power; but the cars will run by gravity alone down each approach and a good part of the distance across the river.

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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

The wisdom and zeal shown by Toronto, Ont., in making the most of her franchises for the use of the public streets might well be followed by many of the cities of the United States. In our issue of Nov. 7, 1895, we published some figures showing the revenue derived from street railway franchises in that city. The Board of Control of Toronto, of which Mr. R. J. Fleming is chairman, is now advertising for sealed proposals for the

> PRIVILEGE of constructing and maintaining a telephone service for the citizens of Toronto, for a term of five years, or longer.

We have capitalized the word privilege in the above quotation. On this word hangs the whole idea of compensation to cities for valuable franchises, but most of our American cities do not appreciate the fact.

◆

In our column of "Letters to the Editor" this week, a valued correspondent directs attention to the call for competitive designs for the bridge across Newtown Creek, Long Island, and condemns in strong terms the scheme which has been adopted for securing plans for the structure. We doubt not that he voices the sentiments of many of our readers, and we ourselves were inclined on first examination of the scheme to take a very similar view. As we read the advertisement referred to more carefully, however, and consider all the circumstances in connection with the case, we find ourselves obliged to examine the matter from the point of view of those who are in responsible charge of the work, and to ask candidly whether they have not adopted a wise course on the whole in thus opening to general competition the preparation of plans for this structure.

As a matter of fact, the question of the best design for this structure has been a subject of vigorous discussion for a long time. The crossing is one of considerable length, and the conditions of traffic are such that it is desirable to obstruct the channel as little as possible. The ordinary swing-span draw will not be permitted, we believe, by the army engineers. Of the substitutes which are available, at least three or four, and probably more, are covered by patents, and we know that some at least of these patented designs have been brought to the attention of the officials in charge of this work by their owners. Moreover, there is good reason to believe that some of these patented designs are exceedingly valuable for use upon just such sites as that of the Newtown Creek bridge. It would not be wise, therefore, for the Commissioners to employ an engineer to prepare plans for the work, with instructions to use no patented devices. Neither would it be well for them to employ him to decide between various patented designs, and others not covered by patents, without first finding what royalty the owners of these various patents would ask for their use. But this is practically what the competition which has been instituted is to determine, and this, we believe, is the reason why those submitting designs are asked to place a price upon them, instead of the more common course of naming a prize which will be given to the successful competitor.

◆

In this connection a few words regarding the general conduct of competitions may be appropriate. The architects, who have had to deal with competitions ten times as much as have engineers, when they found that there was no stopping them, took the wise course of so controlling and guiding them as to secure the best results to those instituting them and those taking part in them. They formulated a system of general rules to govern architectural competitions, which has been of great value to the profession and to the public as well. One of the govering principles of this code of rules is that calls for competitions should require general designs and not details. The wisdom of this rule is easily seen. The preparation of general designs is a matter of moderate time and expense; but for detail designs a large outlay must be made. As a matter of fact the only ones who will undertake the expense of making detail designs for a competition, are the plodders of the profession who can find no more profitable occupation.

Now, as we read over the advertisement for plans for the Newtown Creek bridge, it appears to us that it conforms fairly well to this principle, as what it calls for are general designs and not detailed plans and specifications. Competitors are not even required to submit an estimate of the cost of carrying out their designs, nor specifications for use in their construction. In fact we do not see that anything is called for that is not really necessary to enable the relative merits of the competing designs to be fairly judged, nor is anything asked for that a bridge engineer could not furnish with a moderate outlay of time and expense, not out of proportion to his chances of success. Further, his compensation is not restricted to any fixed sum; but is set by himself; and if he be so ingenious and talented as to originate a design of very great merit, he is free to set a price upon it in proportion to his own estimate of its worth. This feature of the competition has the added merit, it appears to us, of guarding against the very thing which has so frequently proved an annoyance and source of complaint in competitions, viz.: the use without compensation of a design submitted in the competition. By inviting competitors to set a price upon their designs, the commissioners, it appears to us, formally acknowledge the ownership by each competitor of his designs. In the light of this acknowledgment, the use of the designs of any competitor without payment of the compensation fixed by him, at the commissioners' request, would apparently make them legally responsible to him, whether the designs were covered by patent or whether they were not.

◆

The semi-circular shield used in constructing a large sewer in Paris, France, as described on another page, is deserving of attention as being, so far as we know, the first of all large shields of this form which has been made to work successfully. In 1892 a semi-circular shield, 30 ft. 8 ins. outside diameter, was put at work on the York Road tunnel of the Baltimore Belt R. R., but it failed on account of the settling of the crown and spreading of the haunches, and had to be abandoned. The cause of this failure was the light construction of the shield in proportion to its great diameter and the heavy load of unstable clay which it had to support. Indeed, the settlement began immediately upon the removal of the falseworks centering, and before the distorting effect of the hydraulic jacks in forcing the shield ahead through the clay had come into action. The French shield illustrated is only about 19 ft. in diameter, and is working in a sandy soil of considerable stability and with but a very small superincumbent load. Despite these favorable conditions of material and load, however, the successful operation of the shield is probably due largely to its heavy and rigid construction.

A second feature of this French work which will be of interest to engineers is the operation of the shield under a very small depth of earth—less than 2 ft.—without sinking or cracking the pavement above. Indeed, its success in this respect is remarkable, and gives much encouragement for the use of the shield system in tunneling under the streets of our large cities, where the demand for underground railways, sewers and subsurface conduits of all kinds is growing each year, and where the disturbance of the street surface means always heavy expense.

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At the recent conventions of railway mechanical officers at Saratoga, resolutions were adopted by both the Car Builders and the Master Mechanics, protesting against the bill now pending before Congress by which the introduction of the metric system is made compulsory. These resolutions were adopted in both associations by a practically unanimous vote.

That this protest is fairly expressive of the sentiment of a large proportion of those engaged in mechanical engineering work, it would be idle to deny. It is true that many of the arguments brought forward against the metric system are as puerile as some of those presented in its favor; but there is one argument against the change whose weight it is difficult to exaggerate, and that is the expense involved in changing the present standard system of measurements. Take the one item of screw threads. The interchangeability of the present system of screw threads depends upon, first, a set of standard diameters, round iron or other metals, and second, a standard form, size and pitch for screw threads of the different systems. In almost every branch of manufacturing industry standards have been adopted for the bolts, nuts and screw threads principally used. We may mention for example the carriage industry, the standard threads for gas-pipe and fittings and the standard limit gages for round iron adopted by the M. C. B. associations. Besides screw threads, thousands of other standards of size have been adopted in the various industries and have become a most important part of the modern system of manufacturing. Would a change to the metric system mean a change in all these standards? Doubtless it would, for it would be idle to retain standards whose dimensions could not be exactly given in metric units. That many million dollars are now invested in standard gages, templates, rules, scales, etc., and in the machinery for their reproduction and use cannot be doubted; and this investment would, of course, be destroyed by a change in the system of measurements; but this, in fact, would be a trivial part of the cost of a change in the system of measurements. For a period of some 20 or 30 years it would be absolutely necessary to maintain both systems in use, or until every existing machine built according to present standards had gone out of use. Take the railway cars of the country, for example. At every repair shop it would be necessary to carry a duplicate stock of bolts, nuts, round-iron, screw-cutting tools, etc., one for cars built on the metric system, the other for cars built on the present system.

It will be evident without further illustration that the interests which would be so seriously affected by a change in our system of measurements will be heard from very forcibly, as soon as any probability appears of a compulsory adoption of the metric system.

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For the other arguments against the metric system, it appears to us very little can be said. The argument that the foot or the yard are intrinsically less convenient units than the meter or the centimeter is about as trivial as the claim that the meter is a better unit than the older ones because it is a ten-millionth part of the earth's quarter-circumference. The standard of length in either case is an artificial standard kept in a government depository. As for the claim that division of a unit by vulgar fractions is more convenient than decimal division, it may be said that if in certain industries this is really the case, then there is no reason why the metric units should not be divided by vulgar fractions.

Practically, however, there is little reason to believe that decimal divisions are inapplicable in machine shop work. In fact, the use of thousandths of an inch for accurate measurement is now universal in all well-managed machine shops.

It is claimed that drawings on the metric system are liable to error through misplacement of the decimal point; but it appears to us that this argument cannot be based on any familiarity with the system in use. An error which multiplies or divides the true quantity by ten is so large that it is sure to be discovered before it makes trouble. On the other hand, the metric figures being all of the same size are more easily written and more legible than the vulgar fractions of the present system. Take for instance the dimension $1\frac{13}{32}''$. By the metric system this is written 0.036. We have one less figure to write, no small figures and no need for the inch marks.

Of the advantages of the metric system in computation, and in its simplification of the whole matter of weight and measures, it is not necessary for us to speak. They must be admitted by every one who has given the system careful and unprejudiced study. The question is whether all these advantages are worth the enormous sum which it would cost to make an entire revolution in our system of weights and measures. The people on whom the burden of cost of such a change would fall most heavily can be relied upon to answer this question in the negative; and as they are pretty certain to make a very strong showing on their side when the matter comes up for final action and to secure the ear of Congress, we are not likely to see the compulsory adoption of the metric system in this country at present.

The advocates of the metric system have frequently referred to the small amount of friction and expense that was caused by the change to the metric system in Continental Europe. It must be remembered, however, that when this change was made, manufacturing industry on the modern system was in its infancy. The system of standards, and the interdependence of manufactures was then almost unknown. The opponents of the metric system have good ground for asking, therefore, that the burden which the mere making of the change will impose upon the manufacturers of the country shall be carefully weighed before a change is compelled.

SAFETY IN LOCOMOTIVE BOILER CONSTRUCTION.

In our issue of June 18 we called attention to a published statement of the New York Railroad Commission to the effect that explosions of locomotive boilers of the radial stay type had been more violent than the explosions of similar boilers of the crown-bar type. As a result of our note the Master Mechanics' Association took up the matter at its recent meeting in Saratoga, and put itself on record as certifying to the safety of the radial stay type of boiler. No evidence was brought forward, in a discussion lasting more than an hour, tending to show that the radial stay boiler is not as safe in every respect as the crown-bar; and it was found that the New York Railroad Commission had based its recent remarks concerning radial stay boilers entirely upon experience with boilers of the Wooten pattern.

It is fortunate that the Master Mechanics' Association has taken this matter up and placed itself on record so promptly in support of the radial stay boiler as good and safe construction, else we might have had the New York Railroad Commission's deliverance on this subject quoted as authority in every boiler explosion case for years to come, and it might even have had a tendency toward keeping in use the crown-bar boiler on some roads which still cling to it.

But the discussion in the Master Mechanics' Association should be of value not only as an offset to the opinion rendered by the New York Railroad Commission. Many of the facts brought out in the discussion are not as generally known or not as generally realized as they should be, and some of these it is our purpose to note.

In the first place the essential feature of difference between the two types of boilers may be briefly explained. In the crown-bar boiler the downward pressure upon the roof or crown of the fire-box is carried by rows of crown-bars extending across the top of the fire-box from side to side and supported by the side sheets at the ends. A modern locomotive may have a crown-sheet area of 30 to 40 sq. ft., and with a steam pressure of 200 lbs. per sq. in. this means a total pressure of 86,000 to 115,000 lbs., tending to force the fire-box down and out of the boiler. In the crown-bar boiler this strain is resisted partly by the sling-stays which lead from the roof of the boiler to the crown-bars, partly by the stiffness of the stay-bolts which connect the side-sheets, and partly by the mud ring which connects the fire-box to the boiler proper at the base. What proportion of the total strain will be carried by each one of these three members is, of course, impossible to say; but neither the mud ring nor the side stays are designed to carry the strain which is brought up on them by the downward pressure on the crown-sheet.

In the radial stay boiler, on the other hand, the downward pressure on the crown-sheet is carried by stays which reach across to the roof of the outer shell, and thus the opposing pressure on these two surfaces are equalized.

An advantage of great importance in bringing the radial stay boiler into use is the greater facility with which it is cleaned. With modern boilers of high pressure the crown-bars and stays must be set so closely together that it is very difficult to clean the surface of the sheet. Under these circumstances the accumulation of scale on the sheet and consequent burning is more likely to occur. The obstruction to circulation due to the presence of the crown-bars is also an added objection to their use.

All these facts have long been known and as a result the past 30 years has seen a steady change in locomotive boiler practice. The crown-bar boiler, which was in practically universal use during the early decades of the railway era, has steadily been displaced until to-day probably 90% of all new locomotives are built with radial stay boilers. The experience related in the course of the discussion at the Master Mechanics' Association is good proof that this change has been a wise one. Many instances were given where locomotive boilers of the crown-bar type had exploded from low water, with the result that the fire-boxes were blown entirely out of the boiler. On the other hand, numerous cases were given of the failure of radial stay boilers from low water in which one or more rows of the stays merely pulled through the sheet, letting water and steam enough escape through the apertures thus formed to lower the pressure and put out the fire, and this with little or no injury to the engine, crew or the trains, and very little damage to the boiler.

It is impossible to reach any other conclusion from the testimony presented before the Master Mechanics' Association than that the radial stay boiler is safer than the crown-bar.

There are some features in the design of radial stay boilers to which attention was called in the course of the discussion that deserve especial emphasis. The first is the effect of making an arched or curved crown to the fire-box instead of a flat crown, the latter of course being always used with the crown-bar boilers. If low water occurs with a flat crown fire-box, the entire crown is overheated and softened until it comes down. If low water occurs with an arched fire-box crown, the central row of stay-bolts and a narrow portion of the sheet adjoining it is first heated. Ordinarily this causes the stay-bolts to pull through and this permits the steam and water to escape through the central row of stay-bolt holes, relieving the pressure and preventing an explosion.

But the pulling through of the bolts is more likely to occur if the stays are simply screwed in the sheet, like the side stays, than if they are given a buttonhead, like the stays used with crown-bars. Recent practice is tending toward the use of the buttonhead on radial stays and it is doubtful whether the change is an improvement. It was stated in the course of the discussion that when the Denver & Rio Grande R. R. was first opened, the locomotives had radial stay boilers, and notwithstanding the fact that the enginemen were a reckless set, and burned crown-sheets were common, an explosion was unknown. So confident did the men become that no serious mishap would follow an overheated crown sheet, that one man declared his intention of burning his engine on purpose; did it, and escaped without injury. At a later date the practice was introduced on that road of using buttonheads on the radial stays, and after that some explosions occurred. The safest construction for radial stay boilers, therefore, would appear to be to make the crown with considerable arch and make the central row or perhaps the central three rows of stay bolts without buttonheads. With this construction low water in the boiler should be reasonably certain to result in no serious damage.

The two most common causes of locomotive boiler explosions are broken stay bolts and low water. The former can be guarded against by a thorough system of inspection, in connection with the use of hollow stay bolts, which automatically give warning of breakage. It may be noted also that a crown supported by radial stays is less likely to come down in case of the forcing in of a side sheet than a crown supported by crown-bars, which has its support taken away if the side sheet fails.

The occurrence of low water can be guarded against to some extent by discipline, training and selection of enginemen, but with all care some accidents of this sort are bound to happen. It is, therefore, the duty of those entrusted with the design of boilers to adopt such precautions as shall insure against serious results from low water when it occurs. We have outlined above what the best practice at present appears to be. With this construction, supplemented perhaps by a proper system of fusible plugs in the crown-sheet, a railway officer in charge of motive power may feel reasonably safe against serious disasters due to low water in his locomotives.

LETTERS TO THE EDITOR.

Power Required to Move Balanced Valves.

Sir: Your issue of June 25, page 421, top of middle column, says that "the balanced valve requires on the average twice as much work to move it as the plain valve." Of course you will at once see that our report has been misquoted, as the converse was presented in the report, viz., the plain valve took about twice as much work as the balanced. We think this should be corrected. Very truly,

G. R. Henderson,
Chairman Committee on Slide Valves.
210 Ninth Ave., S. W., Roanoke, Va., July 1, 1896.

(We make the correction with pleasure. The error was so evident that it probably deceived no one.—Ed.)

Result of Employing an Incompetent City Engineer.

Sir: I have read with much interest the letter under the caption of "Know It All Engineer," in your issue of May 28. To further illustrate the "penny wise and pound foolish" policy pursued by many small municipalities in this state and elsewhere, I have only to cite a case which has come under my personal observation. A city not so far away has a population well on to 9,000 people; the city engineer is appointed for a term of years, at the handsome compensation of $50 per month; just think of it, $50 a month for a reliable civil engineer. This most worthy gentleman has caused to be placed on one of the principal thoroughfares a large quantity of broken stone called macadam, which would just about pass through a four-inch ring. This was dumped out and scattered upon the surface of the old street; the main street, at this writing, is "muddier," the mud and filth is deeper than in the old roads which lead up to the town. If I mistake not, $20,000 per annum is allowed by the city council for street improvements. As I understand the city does not even boast of a map, such a thing as a street profile is unknown, "hit or miss" is the motto. Any reputable engineer would be glad to accept one-fourth of the money now thrown away, as compensation. The day is not far distant when the "wise men" will be compelled to step down and out, and new brains and business ability take their places.

Until this is done many more dollars will be "ditched" and the salary of the city engineer remain at $600 per annum.
Observer.
Charlottesville, Va.

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The Competition for the Newtown Creek Bridge-

Sir: In your issue of July 2, I notice an advertisement from the joint committee of the city of Brooklyn and Queens county, N. Y., requesting bridge engineers to submit plans, strain sheets, etc., for a bridge to replace the present Vernon Ave. bridge. This advertisement is, by its terms and requirements, an insult to the engineering profession. It would seem that there should be engineers of ability in such work in and near Brooklyn from whom one could be selected whose reputation would assure satisfactory results, without trying to secure 15 or 20 separate designs from which some inexperienced man can construct a new bridge and thus benefit by the suggestions of those who have spent time and money in acquiring the necessary knowledge and practice for such work. It is different with contractors who compete for work. They do not spend days and weeks in elaborate calculations and careful work before submitting a proposition, but an engineer must make a complete study of his problem, must prepare elaborate plans and specificotions, receive bids from contractors, in order to submit a correct figure for the estimate of cost, and must finally remember that all his work may be thrown away or used without compensation to him to assist a cheaper man to make a reputation. The only privilege that is accorded by this advertisement to a self-respecting engineer is to refrain from encouraging such proceedings by joining in the competition. Yours very truly,

James Ritchie, M. Am. Soc. C. E.
625 Hickox Building, Cleveland, O., July 4, 1896.

(We have commented on this matter in our editorial columns.—Ed.)

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Securing Responsible Bidders on Contract Work.

Sir: You have frequently called attention to the fact that large amounts of money are saved to cities by advertising the letting of their contracts in your paper. This I do not deny, but I also affirm that you have done and are doing contractors a certain amount of harm, from the fact, not of the extensive advertising, but of calling together a lot of irresponsible, inexperienced bidders who slaughter prices and trust to luck or swindling to come out on their contracts. This could be remedied by suggestions to the numerous city officials with whom you come in contact that large deposits should be required to accompany bids, at least 10% of the bids, for instance. Take the city of Syracuse, N. Y., for example. At their letting in June, 1895, they required $6,000 on a bid in the neighborhood of $20,000, this to be retained till the completion of the work. The result was that they got responsible bidders and the work was finished satisfactorily. Take, on the other hand, Stony City, Ia. They require a check of $75, any foreman can bid, and trust to luck, either by selling out to the next highest bidder, or scamping on his work or beating his bondsmen to come out whole. I grant that the city will probably have to pay more when it requires a high deposit; but on the other hand the chances of litigation are less, and the chances for getting a decent job better. Might I suggest that as you have now educated municipalities up to the required point, that you now take our side of the question and see if you cannot give them a few ideas as to the desirability of having responsible contractors do their work, and that to attain this result, that they require a cash deposit amounting to at least 10% of the bid, and preferably 25%. Respectfully,

Fred. W. Abbot,
M. Am. Soc. C. E., Assoc. M. I. C. E.
620 Chestnut St., St. Louis, Mo., May 26, 1896.

(Our correspondent's letter is an excellent presentation of the evils due to careless or incompetence in the drawing of contracts, and invitations to submit proposals, and we hope it may be carefully studied by every one of our readers who has responsibility or influence in connection with this work. We regret that the publicity given to contract letting by advertising in our columns, should, in some cases, draw irresponsible competitors to bid against reliable firms; but the remedy, as our correspondent says, is not by avoiding publicity in contract lettings but by adopting the usual well-known measures to ensure responsibility in the bidders.

The officials of almost every city of any size know very well that the cash or certified check as an evidence of good faith is an absolute necessity in inviting bids; but in many small towns this necessity is not understood. Moreover, it is not obscure people alone who are uninformed on this matter. It will be remembered that in the advertisements for the last government loan no deposit was required on the part of the bidders.

What percentage the amount of the deposit should be of the cost of the work, is a question which, it seems to us, ought properly to be considered separately in connection with each important piece of work. In works involving much doubt and difficulty, a higher percentage should be required than in the case of work whose cost can be accurately estimated in advance. Enough should be exacted in any case to ensure that only responsible and competent contractors will enter bids, for it is a waste of time to attempt to do business with men who are irresponsible and incompetent. But, on the other hand, no greater deposit should be asked of bidders than is necessary to ensure bona fide and desirable bids, for everything in excess of this interposes a needless burden on every contractor taking part in the competition, and one which may be especially annoying and vexatious where decision upon the proposals is postponed for some time.—Ed.)

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Some Recent Tests of Louisville Cement.

Sir: The inspection and testing of cements as carried on for commercial purposes presents some entirely different features from similar work performed in a scientific laboratory or technical school, where experiments are made to determine the exact nature of different brands of cement with a view to establishing correct estimates to assist the practical engineer in drawing up specifications for such material. The conditions under which such work is done are as different as the ends attained. In the former case the inspector has to determine whether certain material furnished from the mills under ordinary running conditions comes up to requirements laid down by the engineer under whom he is acting, in the latter the scientist pursues investigations on isolated samples of the material the results of which, valuable as they are in themselves, are useless to the engineer as affording testimony of the value of the product turned out by the manufacturer in quantity at any particular time. In short, it is the province of the scientist to lay down rules for the guidance of engineers, and, what is more important, to establish a uniform system of testing applicable to all practical cases. Such can only be done by conducting experiments over a long period and under different conditions, and with all the different brands of material that come under the engineer's notice. The inspector is to be governed by such specifications in selecting the cement as are required by his clients. While such information, valuable to engineers and manufacturers alike, can be obtained by the work of the inspector, there is so little uniformity in the manner of testing as carried on by different men that no accepted standards can be selected from their discordant results and it is difficult to institute comparisons for this reason. In well organized laboratories for research, however, more uniform results can be obtained, as usually such experiments are carried on with care, and standard methods are employed in the testing.

Particularly noticeable is the absence of uniformity in the methods used in testing what are known as the natural cements. This is mainly due to the varying nature of the material, which allows the inspector more latitude in the selection of methods applicable to any particular case. Portland cement, on the other hand, is more uniform in quality and the testing can be conducted under conditions approaching more closely to standard methods. Portland cement, being the product of two ingredients, chalk and argillaceous clay, mixed in definite proportions, carefully selected and calcined with a degree of uniformity impossible with the natural rock, necessarily is more uniform in quality. The rock from which the natural cement is made varies so much quantitatively in the proportions of its ingredients that it is difficult to calcine it all to the same extent, for even the rock from the same quarry will show such wide variations in its composition that the resulting cement will vary widely in strength. It is therefore very important that we should have uniform methods of testing which will apply to the natural cements, and while much standardizing has been effected for the testing of Portland cement it seems to the writer that much of it is inapplicable to the systematic testing of the natural material. Unlike all other kinds of testing of materials for constructive purposes, in which tests taken under different conditions can be made comparable by deductions gathered from experience, or, as is more often the case, by mathematical analysis, the testing of cement depends so much on small details overlooked by some, and too much importance attached to them by others, that this kind of testing offers but little room at present for reducing results arrived at by different men to a common standard of comparison. For instance, from some tentatives pursued by the writer, the following details in the process of testing affect to a large degree the results, many of which are not considered in the reports of tests which from time to time are published:

1. The time the cement has been allowed to stand after being manufactured before gaging.
2. The manner of gaging, whether it has been accomplished by hand or machine.
3. The filling of the mold, whether the sample has been struck off on one or both sides.

A prolific cause for the rejection of natural cement is free or unslacked lime in the material which manifests its presence by checking the briquette, thereby reducing the effective area of the cross section and causing a reduction of the tensile strength. It is the opinion of many that in moderate amounts the CaO does not materially impair the value of the cement, especially if the cement be allowed to stand some time before using, thus giving the lime a chance to air slack. If the cement, hot from the buhrs, be gaged immediately, it would be rejected as incompetent if it showed the slightest signs of checking, while if allowed to stand it would pass inspection and be classed as good material. Thus much cement is rejected by the hasty inspector which would be passed by others. If the cement be used for plastering or work of that kind it is imperative that it shall contain no trace of uncombined lime. It is therefore quite important that the time elapsing between manufacture and gaging should be specifically stated in reports of tests. This will only apply to tests on neat briquettes, for unless the lime be present in very large quantities it will not show its presence in the usual manner in briquettes mixed up with sand. It is the writer's opinion that from this cause tests on natural cement made with sand briquettes are unreliable, for it is impossible to discriminate between inherent bad qualities in the cement and apparent lack of strength caused by the lime which in time would slack out and leave a reliable article.

Referring to No. 2. In laboratories where much testing is carried on, it is found necessary to use machines for mixing, as by the aid of such it is possible to perform four or five times as much work in a given time as could be accomplished by hand. The results, however, obtained are not the same. In the first place it is not easy to adjust the amount of water correctly for mixing with the machine, while with the hand sufficient can be added to bring the mass to the proper consistency. Even with different samples of the same cement the requisite amount necessary to enable the proper consistency to be reached will vary with the time the cement has been allowed to stand after manufacture. While the machine has the great advantage of rapidity, more accurate work can be done by the hand of an experienced person. The foregoing relates to tests made with neat samples, as machine made briquettes of sand and cement are entirely unsatisfactory, for the two components do not become thoroughly mixed in the machine on account of their difference in density. For commercial testing on a large scale machine mixers are almost a necessity, due to their increased rapidity, but for accurate scientific tests the spatula, handled by an experienced man, is by far the more reliable. In fact for comparative tests machine mixed samples are not at all trustworthy, and the element of the personal equation, incident to work performed by hand, introduces less variation into the results than the many defects of the different machines at present in use.

Referring to No. 3. The effect of this detail in testing is not as large as in the two preceding cases, but nevertheless it may give rise to errors which will seriously vitiate the results. The briquette made by striking off on one side only is decidedly inferior to that which has been turned and smoothed off on both sides.

In the first case the mold is laid on a glass plate or slab of some non-porous material, filled with the mixture by pressing with a former, smoothed over the top with a spatula and then allowed to set. Even with more than ordinary care the mold is often not completely filled by this method, as air bubbles will become caught at the bottom and further pressing will cause the air to enter the cement as there is no way by which it can escape. Thus one side of the briquette will be porous and a low tensile strength will be the result caused by eccentric loading on the specimen. By turning the briquette over, however, and applying the spatula to the other side, adding a little more cement if necessary to fill out the mold, a uniform density of cross section is ensured, which in some tests made by the writer made a difference of 3.7% on a series of samples. As these tests were made with more than ordinary care a larger discrepancy can be looked for under usual conditions of working. The following table gives the results of some tests made by the writer on several brands of Louisville cement during the past year:

No.	No. of tests.	Av'ge, lbs. per sq. in.	Remarks.
1.	4,997	121.7	24 hrs. in air and 6 days in water.
2.	210	120.0	24 hrs. in air and 5 days in water.
3.	40	124.1	24 hrs. in air and 4 days in water.
4.	58	118.0	24 hrs. in air and 3 days in water.
5.	113	116.7	24 hrs. in air and 2 days in water.
6.	840	117.2	24 hrs. in air and 6 days in water.
7.	3,471	68.2	½ hr. in air and 24 hrs. in water.
8.	271	72.0	½ hr. in air and 24 hrs. in water.

It will be seen from the table that the larger number of tests were made of seven days duration. The manner of testing employed for Nos. 1, 2, 3, 4, 5, 8, was as follows: Samples were taken from the mill as the cement was packed, one sample to every two barrels. This was continued throughout the whole year from time to time so that the resulting average is a fair criterion of the product throughout the year. The cement was allowed to stand 24 hours after manufacture before gaging. The gaging was done by hand, and the briquettes were struck off on one side only, a pressure such that a man could apply directly being used to force the material into the mold. The form of mold used was that adopted by the Am. Soc. C. E., which was laid on a glass plate during the filling. The briquettes were placed in still water until broken, which was done on a hand machine.

A glance at numbers one and six shows that a higher result was obtained from hand made briquettes than from those made by machine, number one being the hand-made samples, and number six the machine made. While the number of tests is not the same, they were so well distributed that comparison is quite justifiable. The same can be seen in numbers seven and eight, the latter 271 tests, mixed by hand, showing a higher breaking strength than the 3,471 tests of number seven, which were machine mixed. Except for the different method of mixing, numbers six and seven were treated the same as all the others; 87% to 94% of the cement would pass through a sieve having 2,500 meshes to the sq. in.

Robert S. Ball.

Louisville, Ky., May 29, 1896.

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Railway Yards and Terminals.

Sir: Your issue of June 18 contains a very interesting article on "Railway Yards and Terminals," by Mr. W. L. Derr. This subject is an important one and one that the text books on railway construction treat with extreme brevity.

The inadequacy of railway yards and terminals, for which Mr. Derr says the engineer is to some extent to blame, is due to a variety of causes. On all our older roads the volume of traffic has increased so many fold as to far exceed the most roseate imaginations of the original builders. Moreover, many projectors of railways are merely financiers or promoters, who can see only so many miles of main track from terminus to terminus, and fancy when they have constructed that much, with an occasional passing track, they have finished a railway. And in many cases the building of such a skeleton of a railway has exhausted all the available funds and the construction of suitable yards is a financial impossibility, even when their necessity is recognized. If the engineer of a single track railway 72 miles long should tell his employer that it would be necessary to build 48 miles of yard and side tracks, he would probably be considered an unsafe adviser, to say the least. But such a ratio of main track to sidings is not imaginary.

No typical plan will answer equally well for division points and terminal yards; the local conditions and the necessities of each case must be considered and a plan worked out to meet them as nearly as the limitations imposed will allow. A former chief used to say to me: "Go and see the division superintendents; find out what they are doing and how they do it; what they would like to do and how they would like to do it; then find out what must be done and the best way to do it; then make your yard plan."

The guiding principles laid down by Mr. Derr are well put. The capacity of any yard should not be gaged by the number of cars that can stand on its tracks, but by the number of cars that can be put through it in a given time. Yet, in a great many localities it becomes necessary to hold cars for various reasons, and the importance of providing sufficient "hold" tracks, so that the efficient working of the yard may not be interfered with, must not be overlooked. On an old established road the amount of space to be reserved for storage of "hold" cars can readily be estimated. The proper points for storage of empties should be well considered, and plenty of track room should be provided at the various points selected for this purpose. It often happens that the road has some long gravel pit tracks that can be utilized for storage of empties. Probably a large number of these empties can be profitably stored quite close to some large car shops, so that they might be put in thorough repair during the dull season and thus be ready to render efficient service when the rush season comes on. The empty car storage tracks on Mr. Derr's diagram are very long stub tracks, which are objectionable. As a rule, all yard tracks should have switches at both ends, and if in any case it appears necessary to use a one-ended track, such track should be no longer than sufficient to hold as many cars as the ordinary switching engine can readily handle. When a long stub-end track gets full of empties, the cars at the stub end are likely to remain for weeks and months, serving as bumping-posts, and no matter how long the track may be, there will always be a car run off the end of the track or broken on the bumping-post.

Mr. Derr's axiom that "all general movements of the traffic should be forward ones," has good sense behind it. Another principle, which he does not enunciate in words, but which he has indicated in his typical plan, is that at any division or terminal yard where the amount of traffic or switching (classification) is considerable, there should be two yards; that is, one for eastbound and one for westbound traffic. For instance, take a division terminal having one yard of twelve tracks, the yard may be overcrowded and the work delayed. Probably the congestion would be relieved if the same amount of track were properly arranged in two yards of six tracks each, rather than as one yard of twelve tracks. The movement of a "slow freight" over its division is expedited by having its train made up in station order. This can best be done by re-classification in a local order yard, subordinate to the classification yard, such as is indicated in the typical plan on page 396 in your issue of June 18. But if the yard has not proper facilities for such a re-classification, there will probably be a net gain in time and expenses if the trains are sent out as originally made up. Perfect classification in the rush season should not be attempted in a yard that was not designed for such work.

The "bad order" or "cripple" cars should have tracks especially provided for them, where repairs can be made promptly and economically. These tracks should be two-ended, so that cars can be taken out as soon as repaired without waiting for every car on the track to be repaired. The repair tracks should be located adjacent to the division storehouse and blacksmith shop. Some officers want to locate the repair tracks close to the reception or classification tracks, so that it may not be necessary to move a "cripple" but a short distance. But a bad order car that has been hauled five or 25 miles over the main line in a train, can be safely moved another half mile in a yard if necessary, and it is cheaper to move these cripples to the tracks near the storehouse by means of a switch engine than to have the car-repair crew spend their time "toting" heavy castings from the storehouse to distant repair tracks. It is customary to locate the storehouse and blacksmith shop adjacent to the roundhouse, and wherever it is best to locate these buildings, there should the repair tracks be.

It is said with good reason that the cars and their contents receive more damage in going through an ordinary yard than by passing over a division 200 miles long. The common method of "tail-end" switching, without having a rider on every cut, is responsible for a great deal of this damage to rolling stock and freight. Some object to poling and gravity yards because such a large number of men are required for riders, but there should be a rider for every cut, whether the tail-end or poling method is employed, and it will often be found a good business proposition to take some of the car repairers and put them on as riders. It is cheaper to employ men enough to avoid the necessity of repairing cars than to keep a large repair force and a heavy stock of car material at every yard. Again, the capacity of a locomotive in "drilling" cars can be increased or diminished according as the number of men employed with it is increased or diminished. In a properly planned yard, when a large increase of business occurs, instead of putting a second drill engine in service, the crew of riders should be doubled, and when business drops off again the same engine can still be kept busy, if the number of riders is decreased.

As noted by Mr. Derr, that very important car, the caboose, is also the source of considerable trouble in the yard. Each caboose has its particular crew. It is their temporary home; their storm clothes and dinner pails are in it. The conductor has there his desk, and the amount of clerical and literary work required of a conductor makes it necessary that he should have a desk or an office. The caboose is frequently the sleeping room of the train crew, hence as soon as possible after reaching the end of a division, the caboose should be set where it will not have to be disturbed until required for another train. The freight cars on arrival at a division point go forward in the same direction as they entered the yard. The locomotive and the caboose, after a rest of greater or less time, return from whence they came, and with the rule "first in first out," the oldest caboose should be at the front. The unique caboose track shown in Mr. Derr's diagram accomplishes the end in view very neatly. The cabooses are transferred from the eastbound to the westbound yard and arranged in order of their priority by one movement.

The scheme outlined in Mr. Derr's sketch has so many conveniences and good features that one really believes him when he says that it "does not represent any actual yard." I wonder if the plan has ever been drawn to scale. I have not attempted to do so, but I fancy it would require a piece of ground 2½ miles long and ¼ mile wide, to begin with. The sketch is an excellent arrangement, however; but railways do not as yet build their yards that way.

Mr. Derr says that the angle of the ladder track and the yard tracks should be the same as the frog angle. This view is held by many, but I do not consider it an axiom. On the contrary, there are advantages in using an angle greater than the frog angle. One is that a less length of land is required for the yard, and another is that the switches can be placed closer together. Where one switchman has to handle a dozen switches on one ladder track with a lively poling engine behind him, every foot of distance between the switches counts. If each switch is placed as close up to the preceding frog as possible, that establishes the minimum distance between switches, which is a function of the frog angle. Then the proper angle of the ladder track depends upon the distance between the parallel tracks and the distance between the switches on the ladder. As stated by Mr. Derr, the switching in a classification yard can be expedited by having switches operated from a tower by a simple set of levers without interlocking.

Mr. Derr describes a slip switch in a ladder track. There are some cases, where space is valuable, that slip switches are necessary and convenient. I have not found them necessary on a ladder track and would avoid their use wherever possible. They are hard to work and are the cause of many derailments and much profanity. The switchmen, with some reason, call them "puzzle switches." I would add to Mr. Derr's list of general principles the following: All yard switches should be point, or split, and not stub switches. Tracks in a classification yard should be not over 12 ft. c. to c., and repair tracks not less than 20 ft. c. to c.

In regard to switching passenger trains: At terminals all through trains have to be made up in reverse order after arrival and many of the cars have to be turned end for end. If a "Y," or balloon-shaped loop is provided it will prove a great convenience for such trains. Many of the "palace cars" are too long to be turned on the ordinary turntable.

The reason why so many badly arranged yards remain in service is often easy to guess. The superintendent may be alive to the fact that the work at a yard is unnecessarily expensive. The actual cost per day or per car is a matter of figures and can readily be demonstrated. A plan for reconstructing the yard may be prepared after careful study and the superintendent may feel confident that the reconstructed yard will enable him to make a great reduction in expenses. The cost of the proposed construction can be closely estimated, but it is not so easy to demonstrate by actual figures what the saving of expense will be, and the manager perhaps dreads the confusion which will reign during the period of reconstruction. The engineer who plans the rebuilding of a yard should use a bold hand and spare not. Such cases generally require radical treatment. The existing yards are generally the result of long-continued gradual growth of business and a persistent though short-sighted attempt to keep down expenses, as pointed out in the editorial on this subject in your issue of June 18.

It is unprofitable to attempt to operate a railway with old-fashioned light locomotives. It would be better to throw them away and buy new ones. The manufacturer whose shop is full of tools that were good 20 years ago will be distanced by his wide-awake competitor who buys the latest improved machinery. The railway company that continues to use old, badly planned or outgrown terminal yards will not be able to reduce its operating expenses to the figures shown by its more wide-awake competitor.

T. Appleton,
Great Northern Ry.

St. Paul, Minn., June 26, 1896.

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Obtaining the True Meridian by an Observation of the Sun.

Sir: I was much pleased to learn by the letters in your issue of May 14 that the method of obtaining a true meridian by a single observation of the sun was coming into use again. The observation is so easily made, the reduction of the formulae so simple, and the result so accurate and precise, that it should be universally understood and generally used in all sections of the country, and, as it requires nothing to be added to an ordinary complete surveyor's transit, except a little piece of red glass it should become very popular. In order to popularize it, however, it should be put in such shape and so carefully explained that all surveyors can apply it readily and confidently as to the result. It is with that end in view that I beg to trespass on your space by giving some practical hints as to the requisites for and manner of making the observation, and the solution of the spherical triangle, and show the degree of precision obtainable with an ordinary engineer's and surveyor's transit with a vertical arc, or preferably a full vertical circle, reading to single minutes.

I shall not attempt any demonstration of the theory as that is fully explained in all books on surveying under the topic of the Solar Attachment. All that the surveyor needs to supply himself with, in adddition to his ordinary outfit, is: (1) A piece of red glass cut or broken to a size sufficient to place in the cap of the eyepiece of his instrument and cover the aperture, so that he may look directly at the sun. (2) A table of mean refractions. All the later books on surveying contain this table; but if his book doesn't, the following will supply his wants near enough for all practical purposes, and can be copied in his field book:

Altitude.	Refraction.
17°	3′
20°	2′30″
25°	2′
40°	1′
60°	0′30″

(3) A table of declinations of the sun.

All nautical instrument dealers keep the nautical almanac for sale at a cost of 25 cts. The tables of declinations, etc., in these books are copied directly from the American Ephemeris or Nautical almanac, published at Washington for each year, some years in advance, and are based on the meridian of Greenwich. The "World Almanac" for 1896, on p. 38, contains a table of declinations for every day in the year, based on the meridian of Washington. This is a very convenient table, as it is all on one page and can be cut out and pasted in the field book. The "World Almanac" costs 25 cts.

The "Farmers' Almanac" also contains it, calculated for the 75th meridian, and so does the "New England Almanac," calculated for the meridian of New London. These two cost 5 cts. each if they have to be purchased. This is all the surveyor needs in the way of equipment.*

He should know his latitude to the nearest minute and his longitude approximately; then he is prepared to take his observation.

The simplest formula that I have seen is the following:

$$\text{Sin } \tfrac{1}{2} A = \sqrt{\frac{\text{Sin }(S-L) \text{ sin }(S-h)}{\text{Cos } L \text{ cos } h}}$$

$$S = \frac{L + h + p}{2}$$

In which A = the azimuth of the sun, or its angle with the true meridian.

L = the latitude of the place of observation.

h = the altitude of the sun, or the vertical angle diminished by the refraction.

p = the sun's polar distance = 90° + the sun's declination when it is south, and 90° — the declination when it is north.

Being desirous of knowing how closely a meridian could be obtained by this method, I established a true meridian at Perth Amboy in the ordinary way, and made my observations from the south end of that.

The latitude of Perth Amboy, N. J., is 40°30′ north, longitude, 74°16′ west.

On Feb. 1, 1895, I took a series of three observations as follows:

1st. Time, 9 h. 40 min. a. m., vertical ang. 22°28′, azm. 140°18′.

2d. Time, 9 h. 42 min. a. m., vertical ang., 22°48′, azm. 140°56′.

3d. Time, 9 h. 44 min. a. m., vertical ang. 23°07′, azm. 141°32′.

The three work out exactly.

As an illustration of the application of the formula I will work out the third.

The vertical angle reduced for refraction = 23°07′—2′ = 23°05′ = the sun's altitude at time of observation.

By the nautical almanac the sun's apparent declination for apparent noon at Greenwich on Feb. 1, 1895, was S, 17° 5′ 1.3″, which reduced to the longitude at Perth Amboy, or the 75° meridian, was the declination at 7 a. m., or 5 hours earlier; the difference for one hour was 42.76″; the time of observation, 9 h. 44 min. a. m., was 2¾ hours later than 7 a. m., making a difference of about 118″, called 2 minutes. As the sun is coming north, and its declination decreasing, the 2 minutes is subtracted and the declination becomes S 517° 3′; p., the polar distance, is 90°+17°3′ = 107°3′; then, by the formula:

$$\begin{array}{rl} L = & 40^\circ\ 30' \\ h = & 23^\circ\ 05' \\ p = & 107^\circ\ 03' \\ \hline & 170^\circ\ 38' \div 2 = 85^\circ\ 19' = S \end{array}$$

$$S - L = 85^\circ\ 19' - 40^\circ\ 30' = 44^\circ\ 49', \text{ and } S - h = 85^\circ\ 19' - 23^\circ\ 05' = 62^\circ\ 14'.$$

Then the formula becomes:

$$\text{Sin } \tfrac{1}{2} A = \sqrt{\frac{\text{Sin } 44^\circ\ 49' \times \text{Sin } 62^\circ\ 14'}{\text{Cos } 40^\circ\ 30' \times \text{cos } 23^\circ\ 05'}} =$$

$$\begin{array}{r} \text{Sin } 44^\circ\ 49' = 9.848091 \\ \text{“ } 62^\circ\ 14' = 9.946871 \\ 10 - \text{cos } 40^\circ\ 30' = 0.118954 \\ 10 - \text{cos } 23^\circ\ 05' = 0.036243 \\ 2\overline{)\ 19.950159} \\ 9.975079 = \text{Sin of } \tfrac{1}{2} A \\ \tfrac{1}{2} A = 70^\circ\ 46' \\ A = 141^\circ\ 32' \end{array}$$

As that agrees exactly with the azimuth as read on the instrument, it shows that the degree of precision is all that can be desired. By reducing the vertical angles of 1 and 2 each by 2′ for refraction and using the same declination they will each check out in the same manner. Here is another, taken when the declination is north: July 10, 1895, time 4 h. 8 min. p. m., vert. angle 36°, azm. 90° 20′. Vertical angle reduced for refraction =36°—1′= 35° 59′. Declination as above for July 10, at 7 a. m. =22° 15′ 10.6″. North, hourly change 18.93″ × 9 hours =170″, call it 3′. As the sun is going south the declination becomes N 22° 12′, and the polar distance 90°— 22° 12′=67° 48′—this will work out all right.

For a time calculation the formula is

$$\text{Sin } T = \frac{\text{Sin } A \text{ Sin } Z}{\text{cos } d}$$

in which

T=Solar time.

A=Azimuth of the sun as determined by calculation.

Z=Sun's zenith distance=90°—corrected altitude.

d=Sun's declination.

Using the example worked out above, we have A= 141°32″; Z = 90°—23°05′ = 66°55′; and d = 17°03′; then the formula becomes

$$\text{Sin } T = \frac{\text{Sin } 141^\circ\ 32' \times \text{Sin } 66^\circ\ 55'}{\text{cos } 17^\circ\ 03'}$$

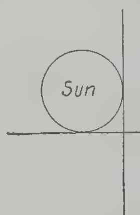
$$\begin{array}{r} \text{Sin } 141^\circ\ 32'' = 9.793832 \\ \text{“ } 66^\circ\ 55' = 9.963757 \\ 10 - \text{cos } 17^\circ\ 03 = 0.019520 \\ \hline \text{Sin } T = 19.777109 \therefore T = 36^\circ 46' \end{array}$$

in terms of angle from the meridian; 36°46′=36.75° × 4 for one degree = 147 minutes of time = 2 hrs. 47 minutes before noon by the sun; 12 m. — 2 hrs. 47 mins. = 9 h. 33 min., solar time. Equation of time for Feb. 1, 1895= 13 mins. 48.41 sec. slow, call it 14 minutes. Local time then for Perth Amboy, Long. 74° 16′ W., at the moment of observation, was 9 h. 47 mins. a. m., corrected for standard time 75th Mer. = 9 h. 44 mins. a. m. = time noted.

Now as to the practical part of the business: The surveyor can carry the little piece of red glass in his pocketbook and have it with him all the time without inconvenience, so that he may be always prepared for an observation. If he has his tables of refraction and declination pasted in his note-book and a pocket-book of logarithms with him he can work it out then and there; or he need simply note the day and hour and the two angles and work it out when he requires it, at any time.

Suppose one is running out a large tract of land for the purpose of laying it out, etc.; he selects one of the lines running nearly north and south and from the south end he takes the altitude and azimuth of the sun. The difference between his observed and his calculated azimuth is the true bearing of his line, and he has all his lines referred to the true meridian, and that part of the field work can all be done in five minutes.

As to the manner of making the observation: It is better not to try to bisect the sun. The better way is this: Get the sun in the position shown in this diagram, in which the vertical and horizontal lines represent the cross wires of the telescope. If before noon, take the lower and receding, and if in the afternoon the lower and preceding limb, and then add 16′ to each angle. The sun's diameter is 32′. This varies slightly, but not enough to affect the result for our purposes. If an instrument with a vertical arc is used it is necessary that it should be in perfect adjustment as a level or the observer won't get his altitude correctly. By using an instrument with a vertical circle he can then eliminate all errors of adjustment by this method: First, take the lower and preceding limb of the sun and read the angles; then reverse the telescope and take the upper and following limbs, and read as before. The mean of the angles will be the true vertical angle and azimuth without reduction to a centre, and all errors of colimation will be corrected. This last was the method formerly used by Mr. Geo. H. Blakeley, C. E., of the Passaic Rolling Mills when he was engaged in surveying some 15 years ago, and to him I am indebted for it.



It is fully agreed that the best time for making an observation is when the sun is moving rapidly in altitude, never near noon, or when the sun is low in the horizon. For that reason the little table of refractions given above covers sufficient range. For that reason, also, a vertical or diagonal eye piece is not a necessity, as the observation can always be taken at a time when the observer can look at the sun directly without inconvenience.

In practice it is advisable to use a line of reference and turn from that. In that case, when the red glass is used, it will be necessary to set on the line, then unscrew the eye piece cap, put in the glass and turn on the sun; with the red glass in the eye piece one cannot see anything much less bright than the sun.

If it is desired to let the sun shine through the telescope and quarter its image on a card held back of the eye piece, as mentioned by Mr. McCullough and Mr. Guinn, in your issue of May 14, and get the sun's position in that way, it will be necessary to pull the eye piece out to its full length in order that the cross-hairs may be reflected on the card, otherwise they won't appear. I mention this because I believe the fact is not generally known.

The method is an excellent one but it requires two men to do it, while the direct observation requires the observer only.

I said I was glad that this method of getting the meridian was coming in again. It was used years ago and for some unaccountable reason fell into disuse. I have before me now a copy of "Gibson's Surveying," newly arranged, etc., by James Ryan, published in New York in 1821, wherein on pp. 355 to 357 full directions are given "to find the variation of the compass by an amplitude," with examples worked out, and in Jackson's "Military Surveying," I recollect there was such a formula, with examples.

In conclusion, I beg to state that this is written for the men who are not familiar with this method of getting a meridian, but who might use it if they understood its application. Should it meet the eye of any such and they choose to work out the observations, I would suggest that having worked them out as they are, that they change the altitude and then the latitude a minute or so and then make the calculation and note the result. By that means they will see with what degree of care these factors should be determined. Very truly yours, C. C. Hommann.

Perth Amboy, N. J., May 25. 1896.

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THE PRICE OF GAS IN ST. LOUIS has been reduced by the Laclede and Carondelet companies to 80 cts., net, per 1,000 ft., for fuel, and $1,10 for illuminating gas, with 10% off for prompt payment in the latter case.

A HYDRAULIC SHIELD FOR SHALLOW TUNNELS.

A hydraulic shield, designed especially for tunneling under city streets at small depths beneath the surface has been in successful operation for some months in constructing a large outlet sewer in Paris, France, according to our French contemporary "Le Genie Civil." Besides its ability to work successfully with only from 1 to 2 ft. of earth above it, this shield is of interest on account of its semi-circular shape. The only other semicircular shield of large dimensions which we now recall was the one tried on the York Road tunnel of the Baltimore Belt R. R. (Eng. News, Jan. 9, 1892), and, as will be recalled, it failed to withstand the pressure of the soft clay and had to be abandoned. The cause of this failure, and the reasons for the success of the shield illustrated, are discussed more at length in another column, and here attention will be turned at once to the description of the Paris work.

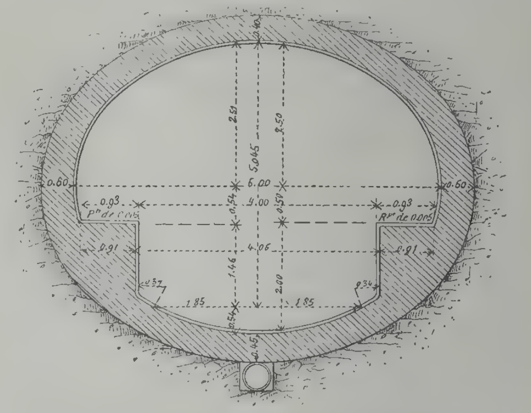

Fig. 1.—Cross Section of Paris Sewer Being Built by Hydraulic Shield System of Tunneling.

A part of the sewer work for the city of Paris comprises the construction of an outlet sewer 4,462.35 m. (14,636½ ft.) long, extending from the Place de la Trinite to the banks of the River Seine. About 1,887.05 m. (6,189.52 ft.) of this sewer are outside of the city limits proper, and at a depth of only 0.4 m. or 0.5 m. (1.31 ft. or 1.96 ft.) below the level of the roadway of an important city streets, the Boulevard National. The cross section if this portion of the sewer is shown by Fig. 1. It was intended at first to build this part of the sewer in open trench, but the great obstruction which such an opening would cause to the street traffic, coupled with a guarantee of M. Chagnaud to do the work by tunneling without any such interruption determined the engineers to change their original plans.

In brief M. Chagnaud proposed to use a shield of special design to suit the conditions which required the construction of a masonry lining, and the safe support of a roadway carrying a heavy vehicle traffic and a double track street railway, operated by Serpollet motors weighing 16 tonnes (35,264 lbs.) each. Ordinarily where shields have been used the lining of the tunnel has been of cast-iron segments, which, as soon as erected, would withstand the thrust of the hydraulic jacks used in driving the shield forward. Green masonry could not be subjected safely to such a thrust and especial provisions had to be made for taking the pressure of the jacks. In this respect and in its provisions for supporting the heavy overhead load the shield used was peculiar.

Figs. 2 and 3 are cross and longitudinal sections showing the construction of the shield. Two elliptical arch girders B B rest on two longitudinal girders C C, and carry an exterior covering or lagging of steel plates 28 mm. (11 ins.) thick. The rear of this lagging terminates in a vertical plane, but the front is visor shaped. Its length at the longest part is 5.25 m. (17.24ft.), of which the visor makes 2.1 m. (6.88 ft.). The longitudinal girders C C rest on two trains of iron rollers K K, and also act as a support and track for a third arch girder D, which is independent of the shield proper, and can be moved back and forward inside of it.

To the arches B B are attached six hydraulic jacks E E, each 0.24 m. (0.787 ft.) interior diameter, which are fed by a battery of four pumps P operated by a small electric motor V, and are double acting. Any one or all of these jacks may be operated at will. At N is the water supply and at S is a sill covered with a 1-m. (03937 in.) steel plate and forming a track for the rollers K K. Altogether the shield weighs about 50 tonnes (110,200 lbs.).

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*In all these tables the declination is for noon of the given day.

The method of operation is as follows: Steel frames G G, braced together by the I-beams H, are used to support the centers for the masonry arch during construction and also the temporary blocks for the lagging b. Altogether there are 37 of these used, spaced 1 m. (3.28 ft.) apart, and as the work progresses the rearmost frame is regularly transferred to the front and put into use again. The weight of the masonry on these frames—all being braced together—is enough to render the foremost frame firm against the pressure of the jacks, which thrust against it to drive the shield ahead. By this arrangement no thrust comes against the face of the masonry.

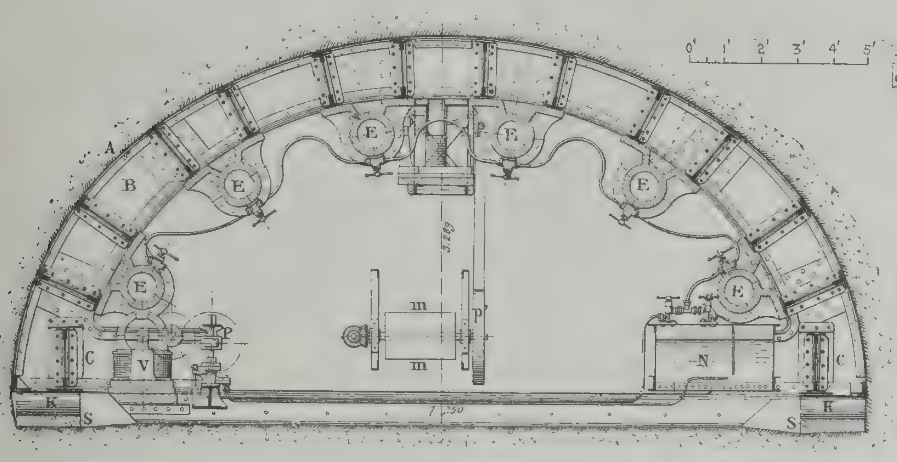

FIG. 2.—CROSS SECTION OF SEMICIRCULAR SHIELD FOR SOFT GROUND TUNNELING.

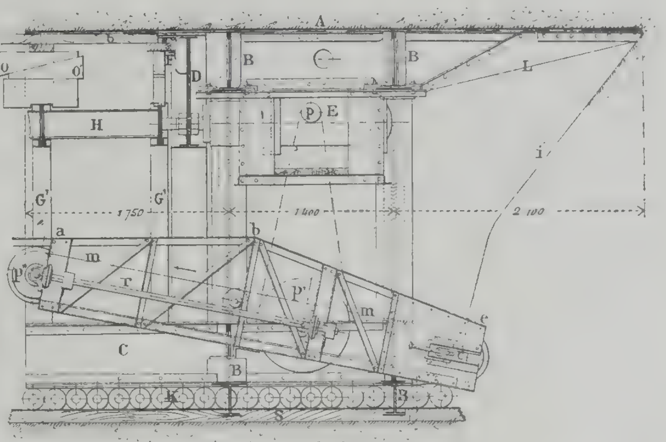

FIG. 3.—LONGITUDINAL SECTION OF SEMICIRCULAR SHIELD FOR SOFT GROUND TUNNELING.

From Fig. 3 it will be seen that the piston rod passes through the girder D, to which it is attached, and abuts against the frame G. As the piston rod is thrust out, the whole shield, with the exception of the arch D, advances and cuts into the sand which the muckers dig out and throw back upon the continuous belt conveyor m m. As the shield advances, the wedges O O are continuously driven so as to make the lagging take up the space left by the skin of the shield which slips from above it. It will be noticed that the forward end of this lagging is carried by the arch D, which does not move during the advance of the shield proper. The shield having been pushed ahead 1 m. (3.28 ft.), which is the stroke of the piston, the stroke is then reversed and this brings the arch D forward into position for a new center G and new lagging. At the same time new wedges are placed over the center G and everything is ready for another advance of the shield.

This reciprocating motion of the shield proper and the inside arch D is the essential feature, as it permits the lagging to be held steady while the skin slips from above it and leaves no void except the thickness of the steel plate which is taken up by driving the wedges O O. Practically no settling of the superincumbent earth is possible if the shield and centering resist distortion.

As stated above the shield weighs about 50 tonnes. Except when loaded vehicles are passing the superincumbent load is small. No very great load thus comes upon the sills S S; indeed it is estimated that this load is only 0.4 kg. per sq. cm. The pressure of the hydraulic jacks is ordinarily 50 atmospheres, but when hard places are met it sometimes amounts to 100 atmospheres. The jacks have a capacity of twice this last pressure. In the sandy earth in which the work is being done the shield can be driven ahead 1 m. (3.28 ft.) in about 15 minutes. The daily advance of the completed tunnel is 7 or 8 m. (22.96 ft. or 26.24 ft.).

The masonry lining is carried on at a little distance in rear of the shield. Centers for the roof arch are placed two at a time upon the metal frames G G, and the upper part of the lining built. The lower half of the sewer is then excavated and the lining built to connect with the completed roof arch. About 900 m. (2.952 ft.) of the sewer had been completed at the time of the publication of the article by "Le Genie Civil," April 25.

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METHODS IN USE FOR THE ANALYSIS OF ORES, PIG IRON AND STEEL BY THE CARNEGIE STEEL CO.

The Chemical Section of the Engineers' Society of Western Pennsylvania recently issued a circular asking for the co-operation of chemists in an effort to collect for publication the methods in general use for the analysis of ores, pig iron and steel. The reports of methods are to be published separately. The first report, now published by the society, is by Mr. John S. Unger, and it describes the methods in use in the laboratory of the Carnegie Steel Co., at Homestead, Pa. As the analysis of iron, steel, etc., is of considerable interest to a large number of our readers, we reprint Mr. Unger's paper in full, as follows:

Determination of Silica in Ores of Iron and Manganese.

To 1 gram of the ground ore in an 8 oz. beaker add 35cc. of HCl (1.20 sp. gr.), cover with a watch glass, and boil gently on a hot plate for 20 minutes. Remove and rinse watch glass and sides of beaker with 15cc. of water, filter off insoluble matter on an 11cm. filter, catching filtrate in an 8 oz. beaker, wash with water until all soluble matter is removed. The filtrate, which should not exceed 90cc., is placed on a sand bath and allowed to go to dryness. The filter is ignited and residue fused with 8 grams of carbonate of soda. The fusion is run up around the sides of the crucible and then the crucible is cooled by dipping cautiously in an 8 oz. beaker containing 35cc. water, finally turning the crucible on its side and leaving it. Cover beaker with a watch glass and add HCl gradually until effervescence ceases. After the fusion dissolves out of the crucible, remove with a glass rod and wash the crucible with water. The solution should not exceed 90cc. Evaporate on sand bath to dryness. When both solutions are evaporated, moisten the residues with 10cc. HCl (sp. gr. 1.20) and leave on bath for a few minutes; then add 20cc. hot water, and filter the first through an 11cm. filter, into a 16 oz. Erlenmyer flask, washing out beaker carefully, then filter the second through the same filter. If the alkaline salts have not all dissolved in the second add 20cc. hot water and stir until dissolved, filter and rinse the beaker with hot water wash, until filter is perfectly free from soluble salts. Ignite the filter in a muffle, cool and weigh as pure silica. The filtrate, which is preserved for further use, should not exceed 150cc.

Determination of Iron in Iron Ores.

To the filtrate from silica (given under silica) add 12 grams of B and A shot zinc and 10cc. conc. HCl and place in neck of flask a small funnel. Let the flask stand for about 20 or 30 minutes or until the iron is all reduced. Should the action on the zinc become feeble add 10cc. conc. HCl. When the iron is reduced test a drop of the solution with a drop of potassium sulphocyanide on a white porcelain plate. If it shows no color or just a very faint pink it is ready for titration. Have ready a 16 oz. wide beaker, a platinum triangle large enough to extend over the edges of the beaker, and a Gooch crucible with a tuft of glass wool ¼ in. thick at the bottom. Rinse the funnel into the flask with a wash bottle and pour the solution through the Gooch crucible, receiving the solution in the beaker. Rinse out flask three times with about 10 or 15cc. of water and wash the Gooch crucible once. To the filtrate in the beaker add 5cc. conc. HCl and place on a hot plate for 2 minutes. The solution will now occupy 225cc. Remove from the heat and titrate with standard bichromate solution, using 3 drops for each test toward the end, and adding the bichromate solution, 5 drops at a time, when almost done. Agitate each test drop by blowing gently and continue the addition of the bichromate until the last test shows an absence of blue precipitate after agitating and standing 30 seconds. The bichromate used, multiplied by the factor, gives the metallic iron.

The potassium sulphocyanide solution is made by dissolving 10 grams of the salt in 100cc. H_2O and is kept in a small bottle provided with a glass cap and a short piece of ⅛ in. glass tubing to be used as a pipette in taking out the test drops. The potassium ferricyanide solution is made by dissolving 0.1 gram of the salt in 100cc. water and test drops are removed as with sulphocyanide. The solution must be made up each day. One drop is used for a test.

The potassium bychromate is made by dissolving 52 grams in 12 litres of water, then shaking well and keeping the stock bottle protected from light.

The porcelain plate is 6 × 6 ins., with 12 depressions 1 in. wide by ¼ in. deep on its surface.

The bichromate solution is standardized by dissolving 3 portions of about 0.3 grams, 0.5 grams and 0.7 grams of perfectly clean soft iron wire of 99.80% pure iron in a 16-oz. Erlenmyer flask (having a small funnel in the neck), in 40cc. dilute HCl by the aid of gentle heat. When dissolved rinse the funnel and sides of flask and make solution up to 150cc. Add 12 grams of zinc and when the iron is reduced, titrate exactly as in case of iron in ore. The weight of the wire taken, multiplied by 0.998 and divided by the number of cc. of bichromate solution used, gives the factor and these factors should agree to the third decimal place.

For iron in manganese ores, the basic acetate precipitate of iron spoken of under manganese is dissolved in 40cc. dilute HCl, the solution made up to 150cc. and treated exactly as in the case of the determination of iron in iron ores.

Determination of Phosphorus in Steel, Pig Iron and Ores.

Dissolve 1.63 grams of steel in a 6 oz. Erlenmyer flask in 30cc. HNO_3 (sp. gr. 1.20). Place the flask over a burner and evaporate over naked flame to 15cc., add to the boiling solution 20cc. chromic acid solution, and again evaporate to 18cc., remove from fire and wash down sides of flask with from 5 to 7cc. H_2O and cool to 40° or 45° centigrade. Add 60cc. molybdate solution, previously filtered and heated to 40° or 45° centigrade, insert a stopper in flask, and shake for 5 minutes. Leave stand in warm place for 15 minutes, then filter through a 7cm. B and A, A grade) filter (previously dried and weighed at 110° centigrade), and wash with a 2% nitric acid solution until free from iron, then twice with 95% alcohol. Dry 20 minutes at 110° centigrade and weigh. Each milligram corresponds to .001 phosphorus.

For pig iron dissolve 1.63 grams, in a 4½-in. evaporating dish, in 40cc. HNO_3 (sp. gr. 1.20), evaporate to dryness on a sand bath. Then place on a burner and heat over naked flame until the mass ceases to evolve red fumes, allow dish to cool and add 25cc. HCl (1.20 sp. gr.), cover with a watch glass and evaporate to 10cc. Add cautiously 25cc. HNO_3 sp. gr. 1.42) and evaporate to 12cc., remove from burner, rinse watch glass and sides of dish, with 12cc. H_2O, filter through an 11cm. filter into a 6 oz. flask and wash with H_2O. The solution should not exceed 50cc. Heat to 40° centigrade, add 60cc. molybdate solution previously filtered, and heated to 40° or 45° centigrade,, shake and finish as for steel.

For manganese ores dissolve 1.63 grams in 40cc. HCl (1.20 sp. gr.) in a 4½-in. evaporating dish, by gentle boiling, then evaporate to dryness on sand bath, add 25cc. HNO_3 (sp. gr. 1.42) and evaporate to 12cc., dilute with 12cc. H_2O and filter through an 11cm. filter into a 6 oz. flask. The solution should not exceed 50cc. Heat to 40° or 45° centigrade, precipitate and finish as in case of steel.

For iron ores if no phosphorus exists in the insoluble residue and the ore is easily decomposed, proceed exactly as for manganese ore. Should phosphorus exist in the insoluble residue, dissolve 1.63 grams in 40cc. HCl (1.20 sp. gr.) in an 8 oz. beaker by gentle boiling for 20 minutes, dilute with 20cc. H_2O and filter into an 8 oz. beaker, washing with H_2O, set filtrate on sand bath and leave evaporate to dryness. Ignite residue and then fuse with 8 grams of Na_2CO_3 and dissolve fusion as for iron in ore, evaporate the solution to dryness on a sand bath, add to each beaker 25cc. HNO_3 (1.42 sp. gr.), and evaporate carefully to 12cc., dilute with 12cc. H_2O and filter both through an 11cm. filter into an 8 oz. flask, using the same filter for both solutions. Wash with H_2O, heat to 40° or 45° centigrade and proceed as for steel.

The chromic acid solution is made by dissolving 30 grams of pure chromic acid in 2 litres of HNO_3 (1.42 sp. gr.), at a gentle heat. It must be made up fresh at least every two weeks.

The molybdic acid solution is made by mixing 100 grams MoO_3 to a paste with 265cc. H_2O, then adding 155cc. NH_4OH (.90 sp. gr.) and stirring until all is dissolved. To this solution add 66cc. HNO_3 (1.42 sp. gr.) stir and set aside for an hour. In another vessel make a mixture of 395cc. HNO_3 (1.42 sp. gr.) and 1100cc. H_2O. Then pour the first solution into the second in a small stream, stirring constantly. Let stand for 24 hours when it is ready for use.

The filter papers for weighing the yellow precipitate are B and A 7cm. "A" grade. These retain the precipitate without it showing a tendency to pass through, and do not contain an appreciable amount of soluble matter, which might be extracted by the acid solution.

The stand for the evaporation over the burners is made of 1 in. angle iron bent and fitted with ¼ inch asbestos mill board, having a 2¼ inch hole over each burner; this supports the flask easily and prevents the solution from baking on the sides.

The drying bath is a copper drum with a coil of 1 in. steam pipe at bottom and fitted with a movable disk, near the top having ½-in. holes, through which the stem of the funnel is inserted, the whole being covered by a lid. Steam is supplied at boiler pressure and a temperature of 110° centigrade with very little fluctuation is constantly maintained.

Determination of Manganese in Manganese Ores.

To the filtrate from silica previously spoken of, add NH_4OH. When almost neutral, add it drop by drop until the solution assumes a redish brown color. When the last drop produces a redish brown precipitate, which does not dissolve on shaking, add 10 to 15cc. of ammonium acetate and bring to a boil. Boil one minute. Then remove and let the precipitate settle, filter through a 12½cm. filter, catching the filtrate in a 16 oz. beaker, wash out flask once with hot water. When the filter has run dry, place the funnel in the flask, and dissolve precipitate in 15cc. dilute HCl (1 to 1), wash iron out of paper and repeat the precipitation with ammonia and ammonium acetate, combining the filtrates. Wash the precipitate 3 times with hot water and reserve for the estimation of iron. To the filtrate add 3 drops of solution of phenolphthalein, then ammonia until pink, then 3cc. in excess. Pass a current of H_2S through the solution for 10 minutes, rinse delivery tube and set beaker on sand or steam bath for 30 minutes, filter through a double-pointed 7 and 11cm. filter, and wash with dilute NH_4HS water. When washed place a clean 12 oz. beaker under funnel and pour over precipitate 40cc. of a mixture of 20cc. hot water and 20cc. of 50% acetic acid, keeping the funnel covered with a watch glass. If the manganese sulphide does not all dissolve, pour the solution through the filter again, wash filter 4 times with hot water, and place beaker on a hot plate. Boil for 15 minutes, dilute to 150cc.; add 15cc. ammonium phosphate, and if a precipitate forms, add a few cc. of HCl until dissolved, bring to a boil and then precipitate by adding NH_4OH, drop by drop until the solution smells of NH_4OH. While precipitating stir constantly to bring the precipitate down in a granular form, filter through a 12½ cm. filter, using suction, ignite in muffle and weigh as $Mn_2P_2O_7$.

The ammonium acetate solution is made by dissolving 120 grams. in 2000cc. water, then filtering.

The ammonium phosphate is a saturated solution of the salt in cold water, diluted with an equal bulk of water.

Determination of Silicon in Pig Iron.

Weigh into a 4½-in. evaporating dish .9333 grams of sample, cover with a watch glass, then add 50cc. of a mixture of 10cc. H_2SO_4, sp. gr. 1.83, and 40cc. H_2O. Place over a Bunsen burner, supporting the dish on a piece of ¼-in. asbestos board, having a 2¼-in. hole in the center. and evaporate until dense, white fumes escape, and the drop of water which condenses on the watch glass falls back into the dish with a hissing sound. Remove dish from fire and let cool for two or three minutes. Then cautiously add 50cc. of a mixture of 10cc. HCl, sp. gr. 1.20, and 40cc. H_2O, place over burner and bring to a boil. Boil gently for one minute, remove from the fire, rinse the watch glass and filter the solution through an 11cm. filter. Wash once with water, then with dilute HCl (1 to 1) and finally with water until free from iron.

Ignite the precipitate in the muffle, cool and weigh. To the residue in the crucible add from 4 to 10 drops pure HFl, depending on the amount of silica present. Drive off excess of acid by heating gently on a hot iron plate, then ignite for two or three minutes in muffle, cool and weigh.

The difference in weight is divided by 2, and a decimal point inserted two places from the right hand gives the percentage of silicon in sample.

Determination of Sulphur in Pig Iron and Steel.

Weigh 5 grams of the sample into a 16-oz. side-necked flask, fitted with a rubber stopper and thistle tube. An 8-oz. beaker of the tall, narrow shape, containing 15cc. of cadmium solution and filled to within 1 in. from top with water, is placed under the delivery tube. Then 90cc. of a mixture of 40cc. HCl, sp. gr. 1.20, and 50cc. H_2O is poured into the thistle tube and the apparatus is placed on a stand made of ¼-in. asbestos mill board, having a 2¼ in. hole at one side and heated by a Bunsen burner. The heating is so regulated that the evolved gases are delivered at about three bubbles per second. As the action grows feeble, the heat is increased, until finally when all is dissolved, the solution is brought to a boil and kept boiling for one minute. The delivery tube is then raised out of the beaker and the flask is set aside.

The contents of the beaker are then poured into a 12-oz. wide beaker, the precipitate is washed out of the beaker with a wash bottle, and 5cc. starch paste are added. 35cc. of a mixture of 40cc. HCl. (sp. gr. 1.20) and 50cc. H_2O are then poured into the absorption beaker and rinsed into the solution in the large beaker. The sulphur is then immediately titrated with standard iodine solution.

The iodine solution is made by dissolving 8 grams iodine and 30 grams potassium iodide in 200cc. cold water and then diluting to about 1850cc. A standard steel is then tested by the method and the result noted, and from this the amount of water needed to dilute the iodine, so as to bring it to the required strength is calculated. After diluting, two determinations are made on the standard steel to see that the iodine solution is exactly right. The iodine solution is made of such strength that 1cc. = .01% of sulphur in the sample. Two litres of standard iodine are made up at once and the solution is preserved in a dark cupboard. The amount actually in use is kept in a special burette having a blackened receiver to exclude light. The stock solution is standardized every week.

The cadmium solution is made by dissolving 300 grams cadmium chloride in 1000cc. hot water in a large bottle and then adding 1500cc. NH_4OH (sp. gr. .90), filtering through a pleated filter into a 12 litre bottle. 6500cc. NH_4OH (sp. gr. .90) are then added to the solution and 3000cc. H_2O. The whole is well shaken when it is ready for use.

The starch paste is made by heating 1000cc. water to boiling point in a 1200cc. flask and adding gradually 10 grams of starch made into a cream with 50cc. cold water. Keep the solution boiling constantly. When all the starch is added boil five minutes, then set aside to cool, decant the liquid, throwing the last 50cc. away.

The solution is made up every three days.

Determination of Carbon in Steel.

One to five grams of the sample are weighed into a clean 8 oz. flask and 200cc. of copper potassium chloride are added, the flask is closed with a rubber stopper and shaken until the precipitated copper is completely redissolved, which is easily detected by the absence of copper covered particles at the bottom of the flask. Remove and rinse the stopper, then filter through a perforated platinum boat, having a layer of asbestos ⅛ in. thick at bottom and held in a platinum holder. Wash the residue twice with concentrated HCl, then with water until all the soluble matter has been removed. Dry the boat for two hours at 90° C., when it is ready for burning. Introduce into the combustion tube, pushing it against the roll of silver foil, start a current of oxygen from the cylinder through the apparatus at 2 to 3 bubbles per second. In the meantime weigh the potash bulb and the small calcium chloride tube filled with solid KOH. Attach the bulb and tube to the apparatus and light first two burners and leave burning for 5 minutes to heat platinum gauze in combustion tube to redness, then light the next burner and leave burning 2 minutes, following this by the others in exactly the same way. When all are lighted leave burning 5 minutes. Then shut off the oxygen and start the air current, being careful to make the change without allowing any back pressure from the air in the room. Aspirate air for 40 minutes, using 1000cc., and weigh.

The copper potassium chloride solution is made by saturating 2 liters of cold water with the salt, adding to the solution 100cc. of HCl (sp. gr. 1.20), then 1 gram of a high carbon steel, shaking until dissolved, then filtering the whole solution into a 2 liter bottle, through an asbestos filter.

The asbestos is prepared by rubbing the ignited fiber through a 20-mesh sieve, aided by a gentle stream of water, receiving the water and pulp in a large vessel, allowing the pulp to settle and drawing the water off by a siphon. Cover the pulp with strong, hot HCl, and digest over night, draw off the acid with a siphon and wash with water by decantation until free from acid, pour into a bottle with water sufficient to cover it, and when needed shake the bottle before drawing out a portion.

The purifying of the air and oxygen is effected in an apparatus having one side fitted to the aspirator bottles supplying the air, while the other side connects directly with the oxygen cylinder. The wash bottles are glass stoppered, filled to ½ height with KOH (sp. gr. 1.30), the attached $CaCl_2$ jars are filled to ½ height with solid KOH, the balance with $CaCl_2$ and a plug of glass wool on top; a Y tube connects each side with the combustion tube.

The combustion tube is of platinum, ¾ in. bore, with a body 20 ins. long, having 3-16 in. platinum tubes 3 ins. long extending from the body. The tube contains a roll of platinum gauze 4 ins. long, filling the bore of the tube and pushed into combustion tube until the anterior end is over the first burner, this gauze is followed by a roll 1½ ins. long, of silver foil inclosed in a piece of platinum foil, which just fills the bore of the tube, and this is then followed by the boat; the tube being closed by a cone-shaped ground joint which is reinforced by bands of nickel.

The combustion furnace is an ordinary 10-burner Bunsen furnace.

The absorbing train is made up of two U-tubes giving a total length in tubes of 44 ins.; these are followed by a Geissler potash bulb containing KOH solution (sp. gr. 1.30), (after a bulb has absorbed about ½ gram CO_2 a fresh one is used), and a 4-in. $CaCl_2$ tube containing solid KOH. The bulb and tube are weighed, and these are followed by an 8-in. $CaCl_2$ tube filled with solid KOH to prevent any CO_2 from the outside air entering the apparatus. The first U tube of the train is filled for the first 5 ins. of its length with granulated silver. This silver is removed from time to time as it becomes dark colored on the surface, ignited and replaced in tube. The silver is followed by 17 ins. of $CaCl_2$. In the next U tube there are 11 ins. of $CaCl_2$, then 11 ins. of anhydrous $CuSO_4$, followed by a plug of glass wool. The $CuSO_4$ is renewed after every 5 combustions. When the U tubes are first filled a combustion is made in the ordinary manner, but no weighings made, the object being to saturate any caustic lime which might be in the $CaCl_2$ used. The entire train is supported on a special support which permits of adjustment in a vertical or horizontal direction.

Determination of Manganese in Steel.

Weigh 200 milligrams of steel into a 2 oz. flask, add 20cc. of 1.20 HNO_3. When dissolved, boil gently for 5 minutes, remove and pour the solution into a 100cc. graduated cylinder. Wash out flask 3 times with H_2O, finally dilute to 100cc. mark. Pour the contents into a 4 oz. precipitating jar and mix by pouring into cylinder or jar at least three times, draw off 25cc. with a pipette into the flask in which the solution was made, add 6cc. HNO_3 (1.20 sp. gr.) from a burette, place on a hot plate together with a standard in which the manganese is exactly known and which has been treated exactly like the steel, and when almost boiling add ½ gram lead peroxide, measured approximately on a small glass spatula, and boil for 3 minutes. Remove, place in a cooling bath, and allow the PbO_2 to settle, which usually requires 15 minutes. Decant the solution into a comparison tube and compare with the standard properly diluted as for color carbon determination.

Determination of Manganese in Pig Iron.

Dissolve as for steel, place a small funnel in the cylinder and filter. Wash the residue thoroughly, being careful not to allow the washings to exceed 100cc., treat the filtrate as in case of steel.

Determination of Nickel in Steel.

Dissolve 1 gram of steel in 25cc. HNO_3 (sp. gr. 1.20) and boil in a 100cc. flask, until solution is complete. Wash contents of flask into a ½ gallon flask containing 700cc. hot water, add 100cc. sodium acetate solution and bring to a boil for one minute. Remove from plate and let settle for 3 minutes, filter through a 38½cm. pleated filter into a litre beaker, allow the precipitate to run dry. To the filtrate, which should be perfectly clear and almost colorless, add 3 drops phenolphthalein, then NH_4OH until pink, place on hot plate and pass a current of H_2S gas through the solution for 10 minutes, remove from the plate and add 12cc. acetic acid (50%), stir and allow the precipitate to coagulate on warm plate for 10 minutes, filter through a 12½ cm. filter and wash with H_2S water made slightly acid with acetic acid. Roast in a platinum crucible, carefully at a low red heat (usually at the front of muffle) until the paper has just burned off. Take out crucible and break up the precipitate with platinum rod to powder, then place in the muffle and ignite for 15 minutes at a bright red heat, cool and weigh. To the crucible add 3cc. (1.20 HCl), cover with a watch glass and warm gently on a plate until the precipitate has dissolved. Wash into a 150cc. beaker with H_2O, add NH_4OH until the solution smells strongly of NH_4OH and filter from the SiO_2 and $Fe_2(OH)_6$. Redissolve precipitate in 3cc. HCl and repeat the precipitation with NH_4OH, wash with hot H_2O, ignite in same crucible and weigh. The difference in the weight gives the NiO. A correction of 5% in the quantity of nickel present is made to provide for the nickel remaining in the basic acetate precipitate.

The sodium acetate solution is made by dissolving 3,000 grams of sodium acetate in 12,000cc. water.

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A NEW CONDUIT ELECTRIC RAILWAY SYSTEM.

The strength of public feeling against electric trolley railways has decreased considerably within the last few years, as people have come to understand better the small danger from overhead wires under ordinary conditions, and consequently we hear of fewer schemes for underground conduit constructions than we did a few years ago. There remain, however, enough objections, on account of unsightly poles and wires, accidents from broken wires, electrolysis, etc., to furnish an incentive to inventors to improve upon the trolley line by placing the wires underground. From time to time Engineering News has illustrated and described the most successful of these inventions, and this record is continued here with the illustration of a new conduit system which seems to possess several good features, and which is stated to have worked successfully upon a short experimental line. This system is known as the "K. A. K. surface and subsurface electric system," and is controlled by the firm of Krotz, Allen & Kelly, of Springfield, O. The inventors are Mr. A. S. Krotz, of Springfield, O., and Mr. W. P. Allen, of Chicago, Ill.

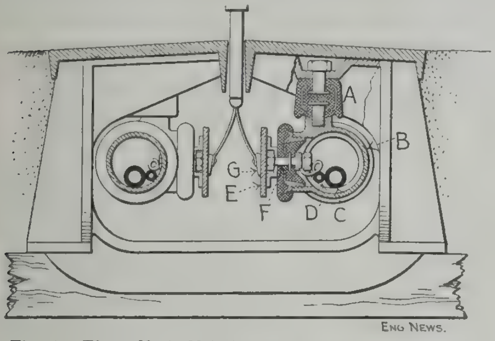

Fig. 1.—The "K. A. K." Conduit Electric Ry System.

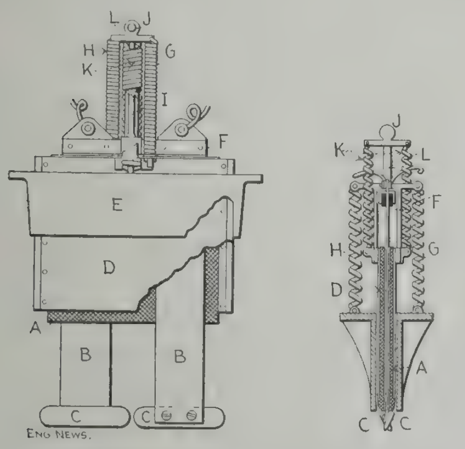

Fig. 2.—Trolley for "K. A. K." Conduit Electric Ry.

Fig. 1 shows the conduit and electrical construction for ordinary street railways. The cast-iron yokes rest on ties between the rails, the top of the conduit being flush with the top of the rails. Between the yokes the conduit consists of a metal casing. From the top of the yoke the insulated hanger A carries the gas pipe B. Inside this gas pipe is the insulated feed wire C. Auxiliary feed wires D, in independent lengths of from 500 ft. to 700 ft., are connected to the main feed wire C, each length of auxiliary wire carrying the current for a corresponding length of track and being connected to the main wire by fuses and switches inclosed in water tight boxes. It will be seen that any length of track can be cut out by simply switching off the current from the corresponding length of auxiliary feed wire. From the auxiliary feed wire the current passes to the contact rail E by means of the bolts F, placed every 24 ft., and from the contact rails it is conveyed to the motor by means of the shoes G.

The foregoing explains the essential features of the system as far as the conduit construction goes. It will be seen that both positive and negative wires are very fully insulated; the feed wires being insulated and inclosed in a water-tight pipe, and the pipe itself being also insulated from the metal work of the conduit. Especial stress is laid upon the efficiency of this insulation by the inventors.

Fig. 2 is a detail of the trolley used. B B shows two springs made of flat steel or spring brass. On their lower ends are attached cast-iron shoes C C for making contact with the conductor rails, as shown in Fig. 1. These shoes can be replaced at a trifling expense. The springs B B, one positive and the other negative, are curved in opposite directions at the bottom, and pass through and are supported in insulating material A which is protected and supported by the steel covering D, which in turn is fitted loosely in the base E, which is fastened permanently to the trucks. Springs B and B, which are fastened together at the top by the insulating fiber strip F, pass loosely through the insulation of casing D, and are held down by the springs G and H, which are attached to the post and cross bar I, J and K. The casing D is in turn held down by heavier springs K attached to the standard L and the base E. Binding posts are provided at the upper ends of springs B B, to which the wires leading to the motors are attached. To raise the trolley from the slot, a lever on the platforms attached in a proper manner to the cross bar J is provided, by which a single pull first raises the springs B B, drawing the shoes away from the rail, and together at the bottom of the casing D, as shown, and raising the casing D, and themselves from the slot. When raised the shoes are clear of the top of the conduit and the car can be moved by any other method of applying the power. This allows of the car being interchanged with lines having overhead trolleys, i. e., the conduit system can be used in the main city streets and the overhead trolley system in the suburbs.

This conduit trolley and the electrical construction in the conduit constitute the principal features of the system being described. To apply it to elevated railways and steam railway lines, the conduits are modified to suit the conditions, but the trolley and feeder construction are exactly the same in principle. Where cars are run in trains each car may have its motor and trolley or there may be a single motor car or locomotive to which the current is carried from the trolleys on each car, current thus being taken from a long length of contact rail. This last feature allows a section of track to be "cut out," say, at the crossing of another track, without interfering with the supply of power to the motor car, as long as the section of track "cut out" is not longer than the train.

Mr. W. P. Allen informs us that an experimental line several hundred feet long has been built at Springfield, O., and subjected to every test possible with so short a line to determine the efficiency of the system. This line has shown that the insulation is nearly perfect, and that snow and rain cause very little trouble. The company now stands ready to take contracts for equipping street railway lines with its system and will guarantee its practical operation.

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PROSPECTS FOR RAILWAY CONSTRUCTION AND FOR MANUFACTURING IN CHINA.

We reprint the following review of industrial affairs in China from a report by Minister Charles Denby to the Department of State, dated at Peking, April 6, and just made public. It doubtless gives a more reliable view of the prospects for railway construction in China than the numerous reports of great contracts, concessions, etc., secured by foreigners there which have been published during the past few months in the newspapers:

> The failure of foreign war and internal disturbances to adversely influence trade is noticeable. Notwithstanding the cession of Formosa and the closing of the Niuchwang custom house during several months, the trade of China with both western and Asiatic countries increased and expanded.
>
> The trade with the United States, while less than for 1894, was greater than for any other in the preceding eight years. The exports to the United States in 1895 amounted to $12,168,271; the imports from the United States to $4,028,707, of which more than $2,373,000 were for kerosene oil. It is noticeable that in 1895 the import of Russian oil exceeded that of American oil in quantity and value for the first time in the history of the trade. This is accounted for by the large stocks of American oil imported in 1894 and held over.
>
> The close of the war with Japan was looked forward to by foreigners as the date from which China was to depart from her traditional policy as to internal improvement and development. It was anticipated that this government would enter upon railroad construction, mining, and naval and military systems of great magnitude. While the views of the most enthusiastic have not been realized and China has shown a cautious conservatism, there has been no want of progress. The railroad from Tientsin to the vicinity of Peking has been authorized and is now being rapidly constructed. Great extensions of the line from Tientsin northward into Manchuria have been determined on, and will doubtless soon be undertaken.
>
> As to the general problem of railroad construction, the Chinese Government stands committed to the policy of using Chinese money only. An imperial decree has authorized the formation of native companies for the construction of lines in the south. It is not believed, however, that this policy will avail for lines of any great extent, and it may be predicted that China will resort, eventually, to the aid of foreign syndicates.
>
> The railroad development of China has attracted the attention of American financiers and builders of rolling stock and equipment. Many agents of American firms are now in this country awaiting the adoption of some definite plan by the Imperial Government. At least two combinations of American capitalists, represented here by agents, are prepared to build and equip from beginning to end any railroad system which China may desire.
>
> In the matter of naval and military reorganization, China showed after the war little desire to take immediate steps. Confronted by a debt of 200,000,000 taels* to Japan, and without resources to meet it, the government decided not to pledge its credit for ships and guns which were not immediately needed. The conservatism was a disappointment to many agents of foreign manufactures, among whom were several American firms. The success of Europeans in this line of trade in the past has been due to long representation here and great patience. The high standard of excellence recently attained by Americans in the production of ships, armor, and guns will doubtless enable them, by the adoption of a similar policy, to secure, in time, a share of this business.
>
> The provision in the treaty of peace between China and Japan authorizing the subjects of Japan to engage in manufacturing in the open ports of China, a privilege which inured to the citizens of all treaty powers, seemed to open a wide and profitable field of investment to foreign capital. When the commercial treaty between the above powers came up for discussion, however, the value of the said privilege was considerably restricted by the unexpected assertion by China of a right to levy discriminating taxes on goods manufactured by Japanese at the ports, and also on such goods when shipped inland. This subject was referred to in my dispatch of Jan. 21 last, and the disagreement of the two powers thereon has not yet been settled. The unrestricted right of foreigners to manufacture in China is so fraught with momentous consequences to foreign manufacturing interests that the failure of Japan to secure immunity from taxation for the product of her mills in China would excite little sympathy in manufacturing communities abroad. It would seem, therefore, that dangers still confront foreign manufacturing establishments in this country which no foreign government would find to its interest to remove and that Americans about to embark in manufacturing enterprises here might be advised to take notice of them.
>
> Intimately connected with the subject of manufacturing is the question of exchange. The customs statistical secretary says, in the first paragraph of his report:
>
> > Cheap labor and raw material are abundant, and with the continuance of the advantage which the East enjoys by the fall in the gold price of silver, there is every prospect of China becoming a most important manufacturing country, which will lead to a keen and formidable competition in textiles between east and west.
>
> It is safe to say that it will be many years before native manufactured articles will drive foreign goods out of the market. The silver question cuts both ways. The mer-

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*The average value of the Haikwan tael in 1895, according to the United States Treasury valuations, was 79.1 cents.

chant in China buys for silver and sells in Europe and America for gold; thus he largely gains. On the other hand, he buys in foreign countries for gold and sells in China for silver. Prices for foreign goods are necessarily raised, but the volume of trade continues to increase. Universal bimetallism would be welcomed by many foreign merchants residing in China, though the sentiment is by no means universal. It is safe to say that scarcely any one favors "free silver" for his own country alone.

THE STRENGTH OF MONIER PLATES.*

The growing use of iron and cement combined in construction has led Mr. T. Grut, Member of the Danish Society of Engineers, to investigate, theoretically, the strength of the so-called Monier plates, where a thin sheet, or combination of rods, of iron is built into the cement. He remarks that the usual method of assuming the neutral axis to pass through the center of the plate, as though the whole was a homogeneous mass, is a superficial one, and proceeds on more rational lines, by taking into account the different coefficients of elasticity of the two materials. That of iron being well known, the investigations have a special interest through the selection of a coefficient for cement. Experiments in Europe, and several by the author are reviewed, and it is concluded that for cement mortar 1 to 3, and half a year old, the coefficients of elasticity for tension and compression are practically alike, and their value lies between 300,000 and 400,000 kg. per sq. cm. (4,266,000 and 5,688,000 lbs. per sq. in.); nearer, however, to the lower limit. It is also noted that these values are considerably higher for the mortar mentioned than for pure cement.

After an extended analytical investigation, the author recommends the following two rules: First, that the neutral axis in a Monier plate, where the iron is placed at a distance of one-sixth the thickness of the plate from its lower edge, be assumed to lie at a distance of three-quarters the thickness from the same edge. In this case the tensile resistance of the cement is not considered; a course which the author believes to be the most prudent. Second, that the iron should not be strained above 525 kg. per sq. cm. (7,465 lbs. per sq. in.). This, the author remarks, is really using a safety factor of four, as the ultimate strength of a Monier plate is at the limit of elasticity of the iron; for as soon as that limit is passed, the expansion of the iron becomes so rapid that the cement, whether it be above or below the plate, can not follow it, but breaks, and the Monier construction, as such, is destroyed.

THE INVESTIGATION OF THE COST OF ARMOR plate ordered at the last session of Congress is being carried on by Secretary Herbert. It is stated that the Bethlehem Iron Co. has offered to supply an itemized statement of the cost of armor plate at its works.

CONVICT LABOR FOR ROAD WORK is being utilized in California and the California Highway Bureau has had a rock crushing plant erected at the penitentiary at Folsom. The convicts quarry the stone and attend to the crusher, and the broken stone is supplied free to road contractors, a check being kept to ensure that the stone is used for the purpose intended.

BOOK REVIEWS.

BICYCLE REPAIRING.—A Manual Compiled from Articles in "The Iron Age." By S. D. V. Burr. New York: David Williams. 8vo.; cloth; pp. 166; illustrated. $1.

This book is designed to be a practical manual for the use of those engaged in bicycle repairs. The various mechanical operations involved in the repairs of the various parts of a bicycle are described in detail, and in such a manner as to be clear to the ordinary workman. While there are many emergencies in repair work which are not touched on by the book, on the other hand we believe hardly any mechanic engaged in this class of work can peruse the book without finding some wrinkle that will be of practical use to him. The book will be found very helpful also by those who reside where bicycle repair shops do not exist, and who are therefore compelled to repair their wheels themselves, if they would not trust them to the tender mercies of the country blacksmith.

The chief criticism we have to make on the book is that its usefulness would probably have been greater if more space had been given to the actual description of methods of repair and less to the description of cheap hand-made devices for doing various jobs. The bicycle repair business has now become important enough for workers in it to afford to buy good tools. In fact, they often cannot afford to spend their time patching up cheap home-made substitutes.

HOW TO BUY LIFE INSURANCE.—The essentials to be considered in selecting a company. Policy restrictions and privileges, digested and classified for ready comparison. Tables showing dividends earned by 32 life insurance companies during the past ten years. By J. H. Lewis, P. O. Box 827, Denver, Colo. Published by the author. Small, 12mo.; cloth; pp. 198. $2.

While this little treatise is upon a subject somewhat aside from those usually discussed in this column, we feel that we can do no better service to our readers than to call their attention to its merits. Of the advantages of life insurance to every man who has others depending upon him for support, it is not necessary to speak here. Every intelligent man recognizes them. But we venture to say that there is no business of such great magnitude which is so little understood by those who patronize it.

Of the people who purchase life insurance, it is safe to say that not one in one hundred attempts an intelligent comparison to determine which of the many companies is the best for him to invest in. Few people ever think of such a thing. They select the company with whose name they are most familiar or the one whose local agent has the best success in winning their ear. It is manifest that a selection made in this way may be a wise one and may be the height of foolishness.

That men of the highest intelligence should be so careless in making an investment of such importance is inexplicable; and, moreover, it is wholly needless. The laws of the various states have so regulated the business of life insurance and enforced such publicity in its operation that any one who chooses may know all there is to be known concerning the merits of the various companies and of the different plans of insurance.

It is a very common fallacy with respect to life insurance that "one company is as good as another," or, to carry it still further, that since the object of all insurance companies is to pay to the beneficiaries of patrons a certain sum at death, that all plans of insurance are equally meritorious. Both these ideas are utterly fallacious; and so we may remark, is another idea, that because the premium rates are practically the same in all the "old line" companies, therefore the cost of a given amount of insurance is the same in all.

In the little book before us, the author describes first, the different plans of insurance and emphasizes the fact that there are actually only two plans, the assessment and the level premium plan. He describes each plainly and fairly and leaves the reader in no doubt as to the merits and demerits of each. The main part of the book, however, is devoted to a comparison of the various "old line" companies. All the various kinds of policies issued are described in detail and tables compiled from the State Insurance department reports show the results of the operation of all the principal companies for ten years past.

We cannot too strongly urge any of our readers who may desire to take out life insurance, to ignore what agents may tell them and instead take a copy of this little work, study the subject of life insurance for themselves and choose for themselves the best plan of insurance and the best company for their needs. A very moderate expenditure of time and study by any intelligent man will enable him to do this, and he can hardly expend either time or mental energy in a more profitable manner.

HEATING AND VENTILATING BUILDINGS.—An elementary Treatise. By Rolla G. Carpenter, M. S., C. E. M. M. E., Professor of Experimental Engineering, Cornell University. John Wiley & Sons, New York, 1895. 8vo.; cloth; pp. 411. $3.00.

The object of this book is to present first a statement of the scientific principles which apply to the subject of heating and ventilation of buildings; second, a collection of tests which give data showing the relation of theoretical principles to practical construction; third, a description of practical methods which are in use; fourth, a description of the methods of designing various systems of heating and ventilating; fifth, a collection of tables useful in designing. The work is arranged in a scientific manner, and the rules of practice are based on scientific reasons modified by such co-efficients as have been obtained by actual tests or experience. The chapter headings give a fair idea of the arrangement and scope of the work, and they are as follows: Nature and Properties of Heat; Principles of Ventilation; Amount of Heat required for Warming; Heat given off from Radiating Surfaces; Pipe and Fittings used in Steam and Hot-Water Heating; Radiators and Heating Surfaces; Steam-Heating Boilers and Hot-Water Heaters; Settings and Appliances; Methods of Operating; Various Systems of Piping; Design of Steam and Hot-Water Systems; Heating with Exhaust Steam, Non-Gravity Return Systems; Heating with Hot Air; Forced Blast Systems of Heating and Ventilating; Heating with Electricity; Temperature Regulators; Specifications, Proposals and Business Suggestions, Appendix, containing References and Tables.

The work is an important addition to the literature of ventilating and heating, and will no doubt take rank with the best treatises on the subject. In future editions we believe it may be improved by considerable enlargement so as to include details and illustrations of recent practice in heating and ventilating modern office buildings, auditoriums, etc., and by a careful revision of the text which will eliminate some unnecessary matter (for example, the C. G. S. system of physical measurements, with its dynes, ergs, etc.) and will give greater precision of language to some of the statements of scientific principles. We have read somewhat carefully the introductory chapters and note below what appears to be defects that may be remedied in the next edition.

Concerning the British thermal unit and the mechanical equivalent of heat the author says, page 4, "In English-speaking countries the heat unit is that required to raise one pound of water from a temperature of 62° to 63°." It is in fact almost universally defined as the heat required to raise a pound of water one degree at its temperature of maximum density, or from 39° to 40°, although some early writers have given the temperature as 32° to 33°, and a few recent ones 62° and 63°. Peabody, Thermodynamics, p. 5, says:

> A calorie is commonly defined as the heat required to raise one kilogram of water from freezing point to 1° C., and a British thermal unit that required to raise one pound from 32° to 33° F. In our work, for reasons that will appear in the discussion of the specific heat of water, we shall choose 62° F. as the standard temperature, and shall define a British thermal unit as the heat required to raise a pound of water from 62° to 63°. This statement is subject to the same indefiniteness as the thermal scale from which it is derived. The true value can be defined only after a logical thermal scale is developed.

For other references on this matter see Wood's Thermodynamics, 5th ed., p. 3, and Trans. Am. Soc. M. E., vol. xiii., p. 351.

The author says further, on p. 3, concerning Joule's figure, 772, for the mechanical equivalent of heat, "Later investigation has amply confirmed this result. This value reduced to a temperature of 62° F. and for this latitude is increased 6 ft.-lbs., so that at present the work equivalent of one heat unit is generally regarded as 778 ft.-lbs." The fact is that the corrections for temperature and latitude are by no means as great as 6 ft.-lbs., and the later investigations referred to, no doubt those of Rowland, show that Joule's original figures must have been considerably in error. The correction for latitude is only about 1 ft.-lb. or 0.15%, and the correction for temperature is uncertain, and runs in opposite directions, according to whether we take Regnault's or Rowland's figures on specific heat of water. The correction for the difference of temperature between 39° F. and 62° F., according to Regnault, is only about 0.06%. Wood's Thermodynamics, p. 25, says, concerning the corrections:

"If the mathematical equivalent of heat at 60° F. were 774.1, then at 39.1° F. or, say 40° F., it would be 774 (nearly), and reduced from the latitude of Manchester to that of New York, it becomes 774.8, nearly; and if the entire margin of error, 1-400, be positive and applicable to this number, the value would be 776.7, or, to the nearest integer, it would be 777." Prof. Wood says further, "It is apparent that the old value 772 is much too small, and 774.1, recommended by the committee of the British Association (1876) is not sufficiently large. According to Rowland's experiments (1880), the British thermal unit is about 784 ft.-lbs. per degree on the air thermometer, and nearly 779 on the mercurial thermometer." He then selects from these and other data the number 778, as being probably within 1-300 of the actual value for the mercurial thermometer at the latitude of New York.

On p. 43 it is stated that air expands 1 part in 460 for each degree of increase of temperature, while on p. 6 it is stated that when air is at a temperature of 32° F. its volume is reduced 1 part in 492 each time that the temperature is lowered one degree. Both of these statements lack precision, and the first is incorrect. A correct statement would be that air expands 1-492 of its volume at 32° for each increase of temperature of 1° F., and contracts 1-492 of its volume at 32° for each decrease of 1° F.

Another peculiar definition of Prof. Carpenter is that of the C. G. S. unit of force, the dyne, which he says is 1 gramme moved so as to acquire a velocity of one centimetre per second. What he probably means to say is that it is that force which, if applied constantly to a free mass of one gramme for one second, would give it an acceleration of one centimetre per second. He also says "the force of gravity in latitude of Paris is 32.2 ft." The measurement of a force in feet is, to say the least, unusual. The physical constants defined in the beginning a work of this kind should certainly be defined with more precision and clearness of language. Another sample of the author's style in his introduction is the following: "Heat has two qualities which correspond in a general way to intensity on the one hand and to quality on the other. The intensity of heat is termed temperature; this can be measured by a thermometer, but, except in scientific definitions no name has been applied to designate the unit quality of heat (the term entropy is now applied in scientific discussions to this property) and there is no method of measuring it directly, although it is of as much importance as temperature." A lack of scientific precision of statement and of clearness in expression characterizes much of this introductory chapter, and it might be improved by careful revision.

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*Abstracted from "Ingenioeren," by O. J. Marstrand, M. Am. Soc. C. E.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

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THE SAVAGE RIFLE has been selected as the weapon for the New York militia by the Commission appointed to examine the weapons offered for this purpose, consisting of Albert D. Shaw, Robert H. Thurston and E. W. Bliss. The gun is the invention of Mr. Arthur W. Savage, Supt. of the Utica Electric Ry. Co., and is manufactured by the Savage Arms Co., of Utica. Its magazine holds five cartridges which are held in a magazine similar to a revolver cylinder, so that there is no possibility as in the tubular magazine of a cartridge being exploded by the impact of the one behind it against its primer. There were twelve guns in the competition, and the Krag-Jorgenson and Lee-Metford weapons, the new standards of the U. S. Army and Navy, respectively, were also tested, but were found inferior to the Savage gun. Under the law providing for the selection of a new weapon, the Adjutant-General of the state of New York is authorized to contract for 150,000 of the new rifles, at a price not to exceed $20 each.

NO MORE HIGH SMOKESTACKS are to be used on the U. S. naval vessels. The high stacks on the "Brooklyn" and "Iowa" were adopted by Engineer-in-Chief Melville to increase the draft and lessen the use of the forced draft. The line officers, however, are said to oppose the high stacks, on account of their appearance, and consequently they will have to go.

HEAVY ORDNANCE is being placed in position to command the entrance to New York harbor. At Willit's Point, L. I., the work of mounting two of these large guns is in progress. They are 30 ft. long, 10 in. bore and weigh 30 tons each. The steel projectile weighs 575 lbs. and requires 250 lbs. of powder. Each gun can be fired at intervals of three minutes. After the discharge the guns disappear behind the parapet for reloading. In practice shooting the target is to be set six miles away.

SYSTEMS OF FIRING HIGH EXPLOSIVES with safety are to be tested by the naval ordnance bureau, according to Washington press despatches; and it is stated that $50,000 is available for carrying out the tests. Devices are invited from inventors both in and out of the service.

THE HASKELL MULTI-CHARGE SYSTEM is again to be tested, the Board of Ordnance and Fortifications having furnished funds sufficient to give the gun a test of 20 rounds. The gun to be tested is of 8 ins. caliber and has two auxiliary powder chambers attached to the lower side of the barrel. The 6-in. gun of this type which was tested some years ago and proved a failure was provided with four auxiliary powder chambers.

COMPLAINTS OF EXCESSIVE CHARGES for the transfer of grain from lake vessels to canal boats at Buffalo, and from canal boats to elevator or vessel at New York, are again made by the canal boatmen. In an appeal to the New York Produce Exchange the canal boatmen of Buffalo say:

> The result of such unjust methods on the part of the railroad and the wharf trust has been the accumulation of nearly 400 canal boats at this port, or nearly half of the entire diminished canal fleet is here to-day, unable to obtain cargoes at the low rate of 3¾ cts. a bushel on wheat, 3½ cts. a bushel on corn and 2⅜ cts. a bushel on oats to New York, out of which we, the canal carriers, must pay trimming, tugging, insurance on cargo and scalpage here, Hudson River towing, wharfage and trimming cargo at New York; also we must make good the shortage in cargo. After these deductions it leaves us about 2½ cts. a bushel net on wheat to run and man our boats. If we are lucky we will obtain a west-bound cargo to Buffalo at 45 cts. gross ton, free in and out. If we cannot secure an up-freight we are compelled to come to Buffalo light. On the other hand, the charge for transferring grain direct from the lake vessel to canal boats at Buffalo is 1 3-10 cts. a bushel, and for like service at New York it is 1 5-10 cts. a bushel, or, at both ports the extortion amounts to 2 8-10 cts. a bushel. or a clean gouge at both ports of plump 2 cts. a bushel against canal grain, if the grain is stored on its way to the world's markets, the extortion doubles up in short order. Contrast this robbery with the next-to-nothing terminal charges at the railroad docks of New York's fierce competitors and who can wonder that the trade that legitimately belongs to New York is like water seeking the lowest level, not to say anything about the full cent-a-bushel differential railroad rate against your port? The result of this gigantic railroad conspiracy against New York and New York's canal is to keep boats here in idleness from fifteen to twenty days waiting for cargoes, while at the same time competing railroads are flooded with grain. It may be truthfully stated that about all the grain and other freight that the canal and New York get is that portion that slops over the railroad grain elevator dams, as aforesaid.

It must be confessed that a charge of 1.3 cts. a bushel for transferring grain from a steamer to a canal boat does look a little steep compared with a net rate of 2½ cts. a bushel for carrying the same over 400 miles of canal and river navigation.

SHIPMENTS OF GRAIN from Buffalo to New York by rail and canal respectively are reported as follows for the period from May 1, the opening of navigation, to July 2, this year and last year.

1896.	Wheat.	Corn.	Oats.	Total.
By rail, bushels.	3,605,900	5,453,350	6,672,200	15,732,050
By canal, "	4,332,700	583,100	4,190,000	9,105,800
1895.				
By rail, bushels.	2,943,350	4,607,850	3,383,200	10,934,400
By canal, "	1,514,000	110,400	2,440,200	4,064,600

It will be seen from the above that the canal is carrying, so far, over twice as much grain as a year ago. It will be remembered, however, that the shipments by canal in the early part of last season were phenomenally small.

THE EXPORTERS' ASSOCIATION OF AMERICA is the title of an organization recently formed to co-operate in securing foreign markets for American manufacturers. Its officers are: President, Addison H. Nordyke, President of the Nordyke & Marmon Co., of Indianapolis; Vice-President, Jas. W. Cooke, New York city; Treasurer, A. M. Dolph, President American Laundry Machinery Co., Cincinnati, O. The headquarters are in the Morris Building, New York city, with Mr. Andrew H. Power, the secretary of the association, in charge. All responsible manufacturers and exporters and foreign buyers are eligible. The dues are $100 per year. Members have the privilege of using the association's rooms as headquarters while in New York, receive weekly reports of exports of goods in their line, and reports of financial standing of firms in foreign countries when requested, and have the consular and custom-house work in connection with exports attended to. The members of the Board of Governors besides the officers named above are C. H. Hutchins, President of the Knowles Loom Works, of Worcester, Mass.; A. H. Overman, President of the Overman Wheel Co., Chicopee Falls, Mass., Carl F. Lunkenheimer, Treasurer of the Lunkenheimer Co., Cincinnati, O., and others.

AMERICAN BICYCLE MAKERS are cultivating the export trade assiduously of late. In the month of May the value of bicycles and bicycle parts exported was $220,176.

THE MOST SERIOUS RAILWAY accident of the week and of many weeks occurred near Logan, Ia., July 11, on the Chicago & Northwestern Ry., and was a head collision at a curve between an excursion train and a fast freight. From press reports it appears that the excursion train left Logan without orders. It was running very slowly when struck by the freight, whose speed was about 30 miles per hour. The baggage car was driven back through the first coach, killing or injuring almost every one in it. Passengers in the other coaches were not hurt. Thirty-three persons were killed and 37 were injured. On July 12 an excursion train on the Chicago & Northern Pacific, at Altenheim, Ill., ran into an open switch and collided with two freight engines standing on the switch; five persons were killed and six were injured. As in the Logan disaster, the baggage car telescoped the first coach. This coach was a light one used ordinarily for suburban traffic. Had it been as heavy as the remaining ones, there would probably have been no serious results, as the train was running so slowly that passengers in the rear cars did not realize that a collision had occurred.

At Wilkes Barre, Pa., on July 13, an express train on the Lehigh Valley Ry. while rounding a curve struck a cow. The train was derailed and the locomotive rolled down a high embankment; three passenger coaches were thrown upon their sides; one person was killed and 19 were injured. The derailed train is stated to have run over 200 yds. on the ties.

AN ELEVATOR ACCIDENT occurred in an apartment house at Adams and Dudley streets, Boston, Mass., July 10; workmen in the building had been accustomed to let themselves down governing the elevator by the brake after steam had been turned off. At the time of the accident 13 men crowded into the car when it was 60 ft. from the ground; the brake refused to work and the car fell the entire distance. All those in the car were injured.

ACCIDENTS ON THE BROADWAY CABLE RAILWAY, at the 14th St. curve, in New York city, have attracted much attention of late. The company has always run its cars around this curve at the full speed of the cable, claiming it was impossible to slacken the grip while the car was rounding the curve. So many accidents have resulted and so much public complaint has been made, however, that the company proposes, it is said, to introduce an auxiliary cable to operate cars on this curve. The Board of Aldermen has an ordinance before it limiting the speed on curves to four miles an hour.

THE TIDAL WAVE which visited the coast of Japan on June 15, appears from the fuller accounts now at hand to have been even more destructive than at first reported. The number of lives lost may be placed in round numbers at 30,000. The United Press correspondent at Tokio on June 26, stated that the totals had then reached 29,073 killed, 7,737 wounded, and 7,844 houses washed away or wrecked. It is an excellent showing of Japan's progress in civilization that it should be possible to obtain such detailed figures of the extent of so great a calamity. The cause of the tidal wave appears to have been some earthquake or volcanic eruption beneath the sea at some distance off the Japanese coast. While this occurrence ranks among the greatest disasters of modern times, its record of fatalities is not the largest, as has been claimed by the daily press, but is exceeded by the loss of life due to the breaking of the levees of the Yellow River in China in 1887, and we believe by some others. An interesting summary of great disasters was given in our issue of July 6, 1889.

THE RUNAWAY OF AN ELECTRIC CAR, on a steep grade on 39th St., Brooklyn, on June 7, last, has been reported upon by the New York Railroad Commission. The board recommends that passengers be prohibited absolutely from riding on the running-boards or side steps of open cars and that all cars operated over grades steeper than 5% should be equipped with some sort of auxiliary brake, and in ascending such grades, conductors should be required to remain on the rear platform to protect the trolley pole or assist at the brakes, in case of emergency. The board appears to have overlooked the fact that if such a rule is put in operation it should apply as much to cars descending such grades as to those climbing them. There is much more danger in coming down a long or steep grade than in going up it.

WATER POWER DEVELOPMENT at Garvin's Falls, N. H., 13 miles from Manchester, is proposed. At this point the Merrimac River falls 30 ft., and with proper storage 4,500 HP. is said to be available. Among those interested are W. A. Russell, J. M. Wheaton, W. A. Tucker and Philip Y. Saltonstall, of Boston.

THE EXTENSION OF THE WHEEL PIT of the Niagara Power Co. at Niagara Falls, was begun on July 9, and will be prosecuted by double shifts until completed.

THE CLIFF PAPER MILL at Niagara Falls, illustrated in our issue of March 26, began running on July 11, with electric power developed by the water-wheels and generators in the power house at the base of the cliff.

TESTS OF A BOILER of the Cahall vertical water-tube pattern were made at the works of the Armstrong Cork Co., Pittsburg, Pa., on May 4 and 5, by Thos. H. Pray, Jr., of 95 Milk St., Boston. The boiler was rated at 250 HP., and notwithstanding that it was run on the first day 3% above its rating, and on the second day at 66% above, the steam in both cases showed a large amount of superheating, 46° on the first day and 26° on the second day. The evaporation from and at 212° per lb. of combustible on the first day was 13.9 lbs., and on the second day 11.7 lbs. Pamphlets containing the detailed figures of the tests will be sent on request by Messrs. H. E. Collins & Co., of Pittsburg, Pa.

THE BIDS FOR A NEW WATER SUPPLY FOR JERSEY City, submitted recently by the Rockaway & Hudson Water Co., is reported as about to be formally rejected. It is said that bids will again be called for soon. If this is done it will be the fifth or sixth call within the past four years.

ELECTRIC TRANSMISSION OF WATER POWER AT PELZER, S. C.

The accompany views show a large water-power plant recently installed for the Pelzer Mfg. Co., of Pelzer, S. C. The plant is located on the upper Saluda River, in the western part of the state. The power house contains five pairs of 39-in. horizontal Victor turbines each pair coupled direct to a 1,000 HP. generator and regulated by a Giesler electro-mechanical governor. The electric current which is thus generated is transmitted to the cotton mills of the corporation, located about 3½ miles away. The electrical transmission was installed merely for the sake of locating the factory on the most eligible site. It was deemed cheaper to carry the power to the factory than to choose a less favorable location for it. The dam and power house were built by W. A. Chapman & Co., of Providence, R. I.; the electrical machinery was furnished by the General Electric Co., and the turbines and other apparatus for the water-power development by the Stilwell-Bierce & Smith-Vaile Co., of Dayton, O.

DAM AND POWER-HOUSE FOR WATER POWER DEVELOPMENT WITH ELECTRIC TRANSMISSION AT PELZER, S. C.

BURNSIDE SHOPS, ILLINOIS CENTRAL R. R.

(With inset.)

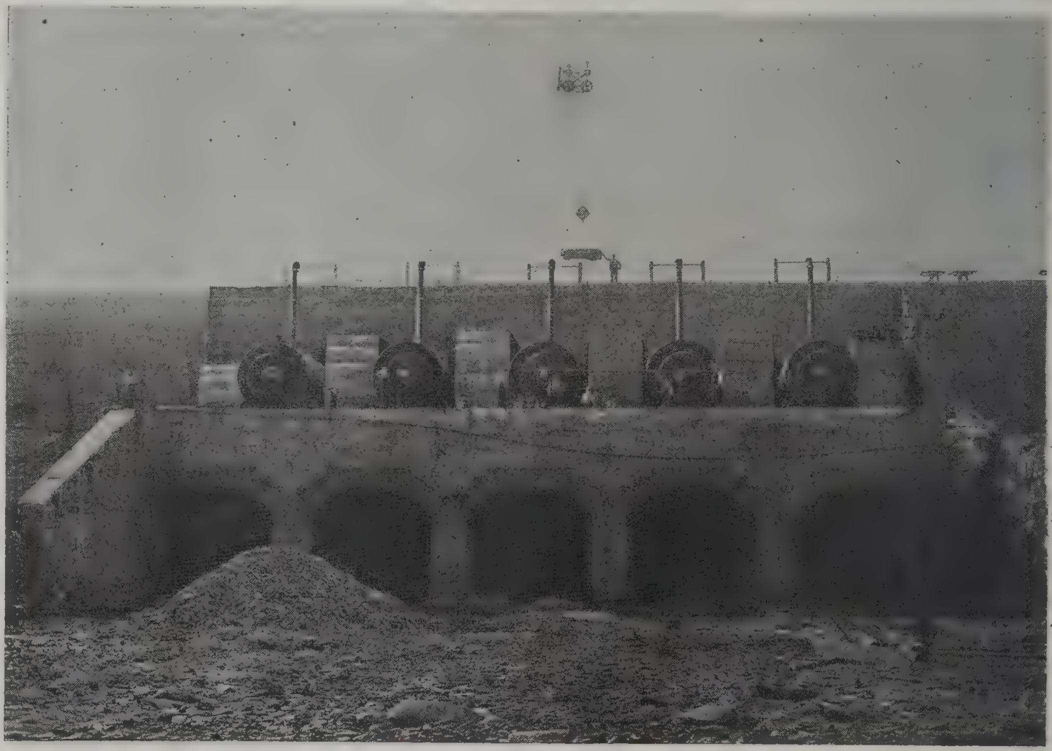
II.

Locomotive Shops.

In the article describing and illustrating this notable railway shop plant, published in our issue of June 18, the ground constructions, minor buildings, and the smallest group of main buildings were considered. In the present article we take up the construction of one of the larger groups of buildings forming the locomotive or metal-working shops. Each building will be described in such detail as the importance of its structural features may seem to warrant. The buildings devoted to locomotive and metal-work are three in number, viz.: a machine shop, blacksmith shop, and roundhouse, and are all located to the south of the oil house, store house and boiler house. All of these buildings were built in 1892 except the blacksmith shop addition, 254 1-6 × 110 ft., which was built in 1895.

Machine Shop.—The machine shop is 552 ft. 2 ins. long and 160 ft. 3½ ins. wide out to out of walls, and is covered by a double roof, as shown by the cross-section Fig. 12. Fig. 13 is a diagram plan of one end of the building, and is inserted to aid in explaining the character of the construction. The opposite end of the building is exactly the same. Turning to Fig. 12 it will be seen that two triangular trusses cover the building. The outer ends of these trusses rest on the side walls and the inner ends on a row of columns which extend lengthwise down the middle of the building. Details of the roller bearings at the wall ends and the inner end truss bearings are shown by the drawings. The west half of the building is open to the roof, and is designed to have an overhead traveling crane. It is into this half of the shop that locomotives from the transfer table are run for repair, there being a series of 24 transverse tracks, each with its pit between rails, for this purposes. The east half of the building is given up to machine tools and machine work, and there is overhead the framework shown by Figs. 13 and 14, which was designed to be floored over, except in the center, and to be used for lighter kinds of work, when the demands of the company should require greatly increased plant, but at present it is used to carry the shafting, a small crane, air hoists, etc. The various parts of this framing and their purposes can be ascertained by inspecting the reference letters and titles in Figs. 12, 13 and 14.

The structural features of the machine shop having been explained, attention may be turned to the equipment for doing work. The power generators may be taken up first. These consist of engines and dynamos, and are all located in a small attached building or annex on the east side of the shop. There are in this building one 200 HP. Bullock-Corliss engine for running the shafting from which all machinery is driven; one 150 HP. and one 50 HP. Buckeye engine, and one 100 HP. Ideal engine. These three smaller engines are used to drive two 80-light and one 40-light arc dynamos and two incandescent light dynamos, operating about 1,000 16-c. p. lights.



HORIZONTAL TURBINES IN POWER HOUSE AT PELZER, S. C.

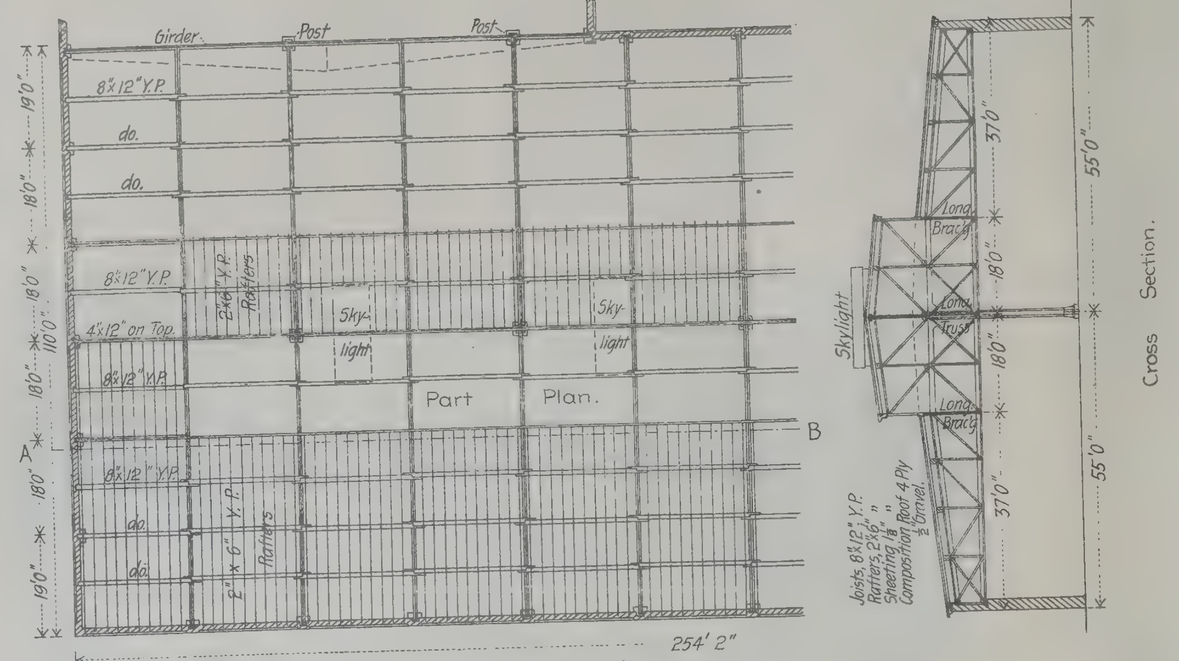
To enumerate the various tools used would be of little value, and all that need be said is that the equipment is ample for constructing and repairing all classes of machine work for locomotives and cars. To handle material there are hand and power cranes of various sorts, air hoists, and push cars and trucks. The air for the hoists is obtained from the mill building power house, as will be described further on. All machine tools are located in the east half of the building, and the erection is done in the west half, which is open clear to the roof. Facilities for the erection of 24 engines at one time are available.

Blacksmith Shop.—Under the roof of the large blacksmith shop building, which covers an area of 71,960 sq. ft., are a wood working shop, a boiler shop and the blacksmith shop proper. The main building, 440 ft. long and 100 ft. wide, runs north and south, and the addition, 254 ft. 2 ins. long and 110 ft. wide, joins onto the north end and extends west. Beginning at the south end of the main building the first 100 ft. in length is used as a wood working shop for locomotive wood work. A wooden partition extends transversely across the building and divides the wood working shop from the boiler shop, which takes up the next 200 ft. of the length of the main building. At the north end of the boiler shop is a brick partition, and beyond this the main building and the addition or the blacksmith shop proper.

The structural features of interest in this building are confined principally to the roof trusses. Owing to fear of delay in securing steel the trusses for the main building were made of wood, and of the design shown by Fig. 15. The main or center truss has a span of 51 ft., and is carried on cast-iron columns, extending in two rows lengthwise of the building, and 25 ft. 9 ins. from the outer walls. Between these two rows of columns and the outer walls the space is covered by steel trusses. A raised cupola, with side lights, runs the entire length of the wood-working and boiler shops, but over the blacksmith shop the skylight is replaced by ventilators for obvious reasons.

The interior arrangement of the boiler and wood shops calls for but little mention. Entering them from the east side are a series of tracks, which are connected with the locomotive transfer table. Between the interior rows of columns carrying the main roof truss are longitudinal, wooden trusses, designed for a traveling bridge crane, and there are also various cranes and jacks located at different points where needed. The power to operate the machinery is supplied by a 100 HP. Westinghouse standard engine.

The blacksmith shop addition is of later construction than the main building, and the character of its roof construction is entirely different, as is shown by the general plan and elevations in Fig. 16. These drawings show the design and construction in sufficient detail with the exception perhaps of the connection details between the old and new buildings. Across the end of the



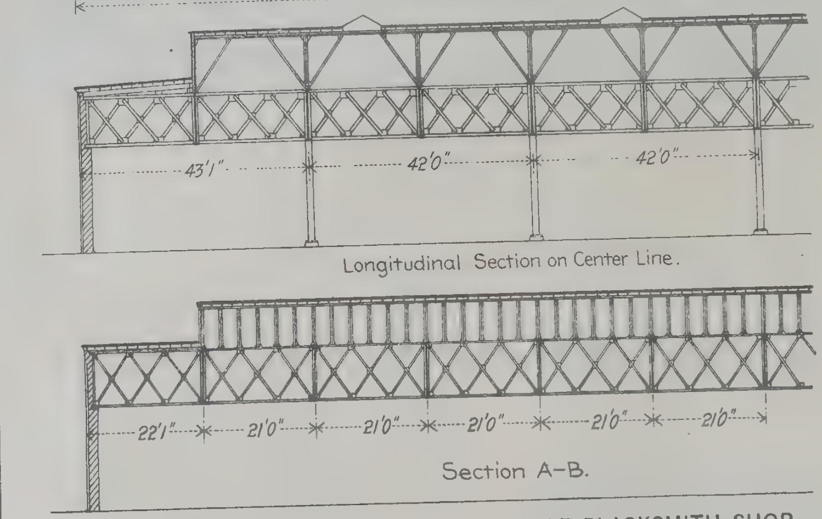


FIG. 16. GENERAL PLAN AND SECTIONS OF BLACKSMITH SHOP ADDITION SHOWING CHARACTER OF ROOF CONSTRUCTION.

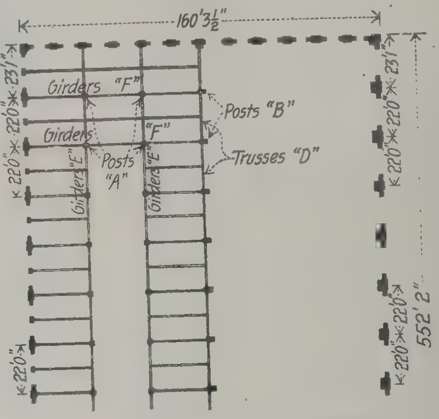


FIG. 13. SKELETON PLAN SHOWING LOCATION OF INTERIOR GIRDERS AND TRUSSES.

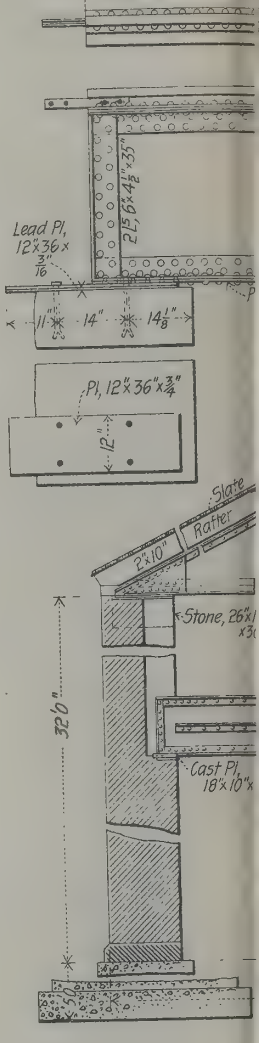


FIG. 17.
MANNER
MAIN
ADI
BLACK

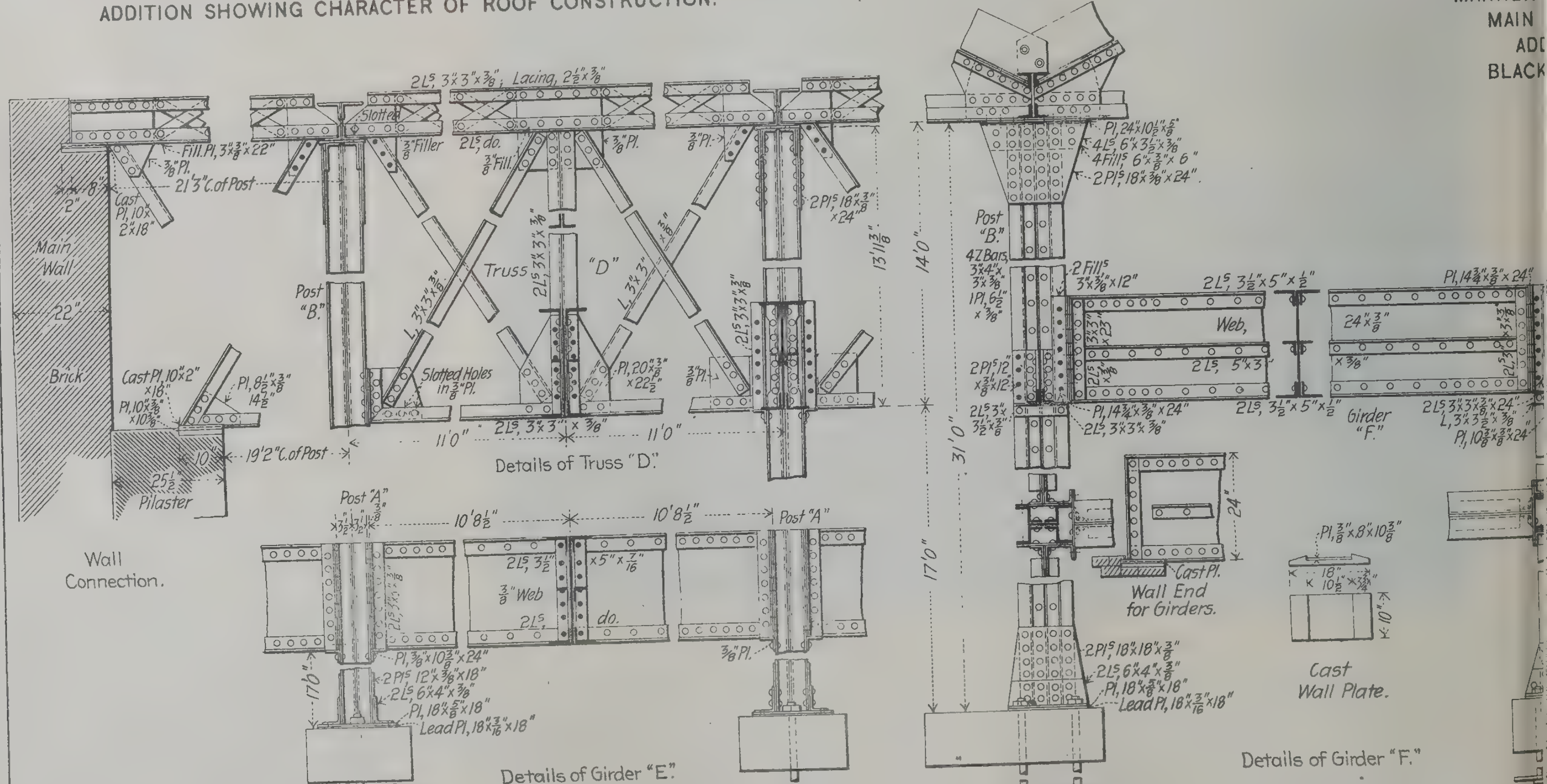


FIG. 14. DETAILS OF INTERIOR GIRDERS AND TRUSSES TO CARRY SHAFTING, CRANES, HOISTS, ETC.

GENERAL SHOPS ILLINOIS CENTRAL

John F. Wallace, M. Am. Soc. C. E., Chief Engineer Illinois Central R. R. H. W

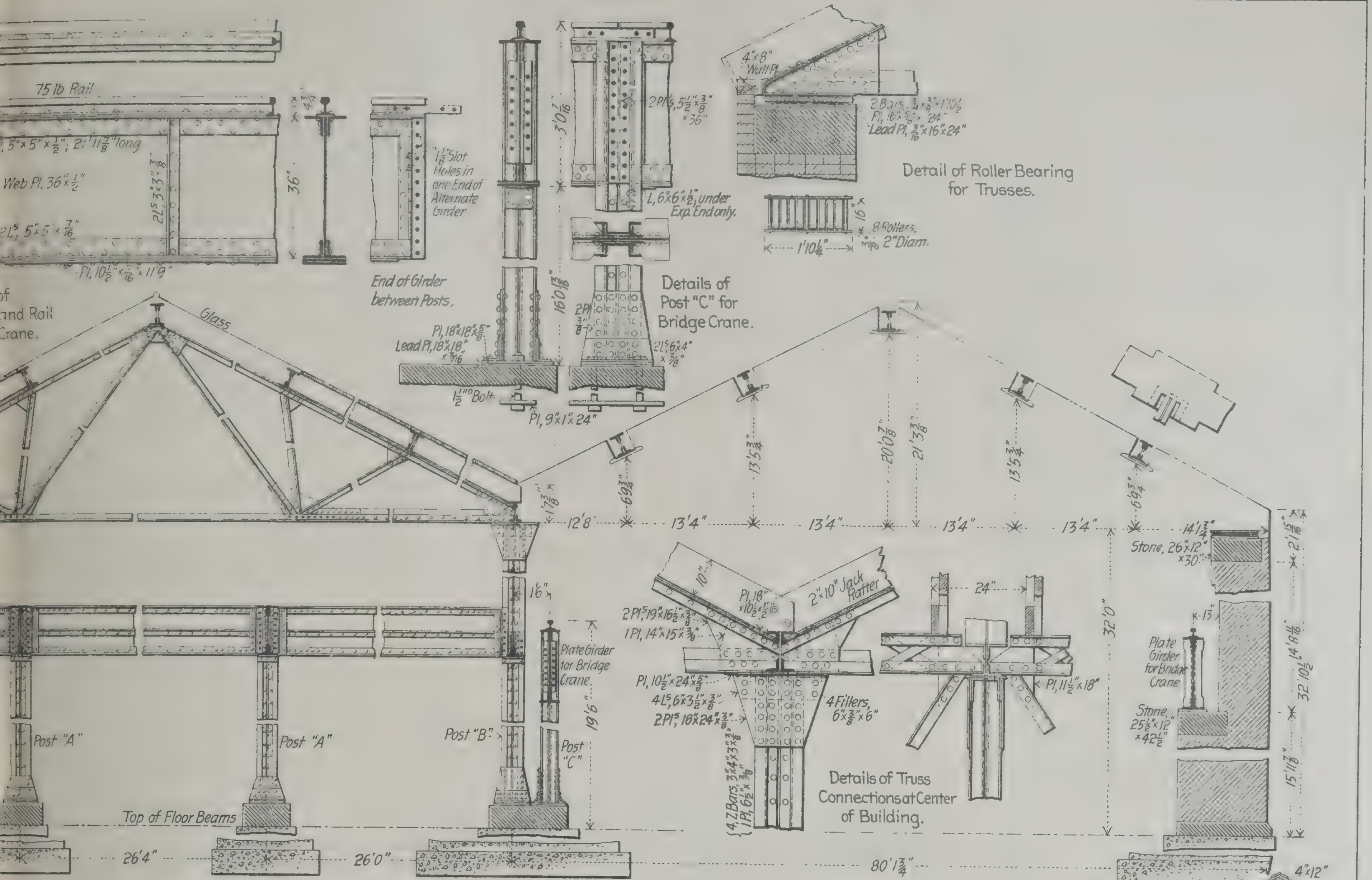
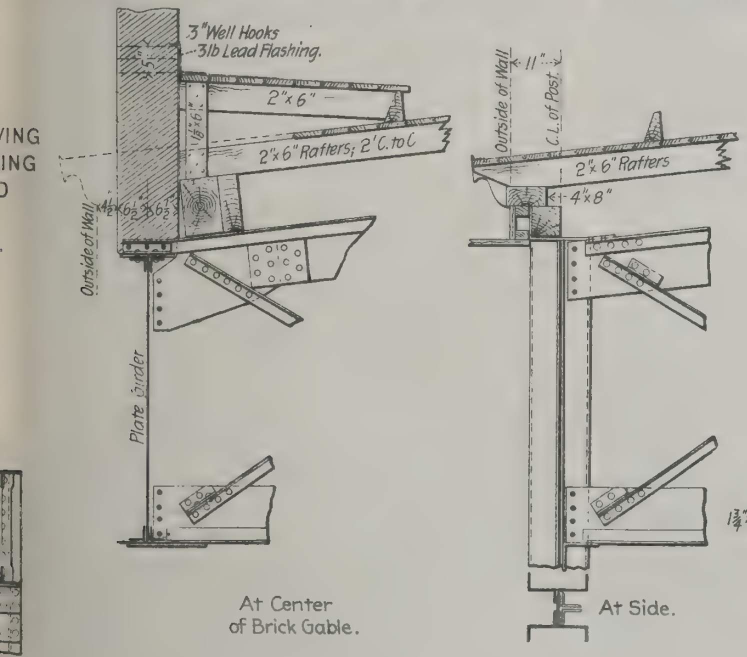
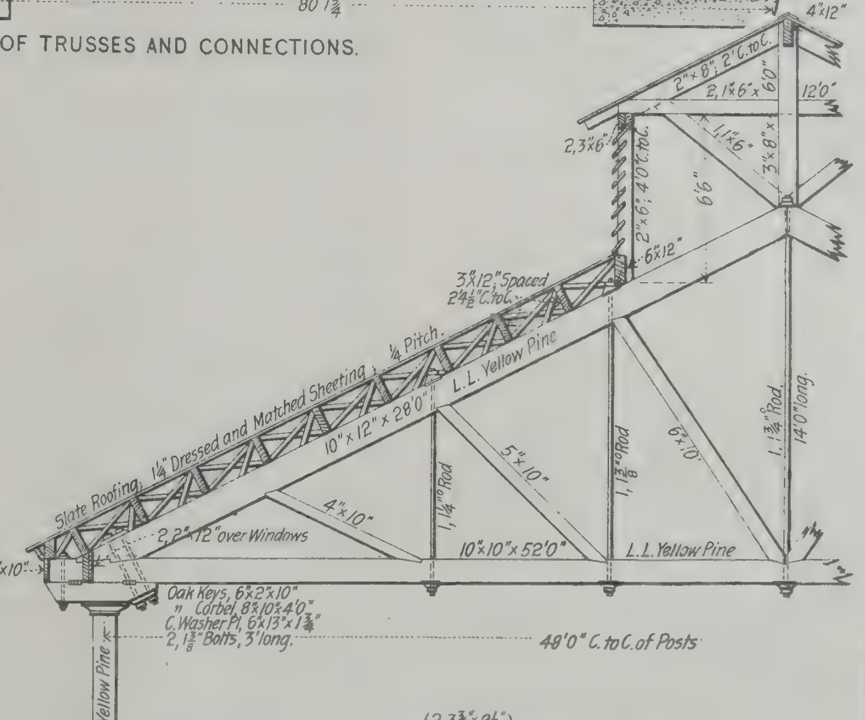


FIG. 12. CROSS SECTION OF MACHINE SHOP SHOWING ROOF TRUSSES AND CONNECTIONS.



At Center of Brick Gable.

At Side.



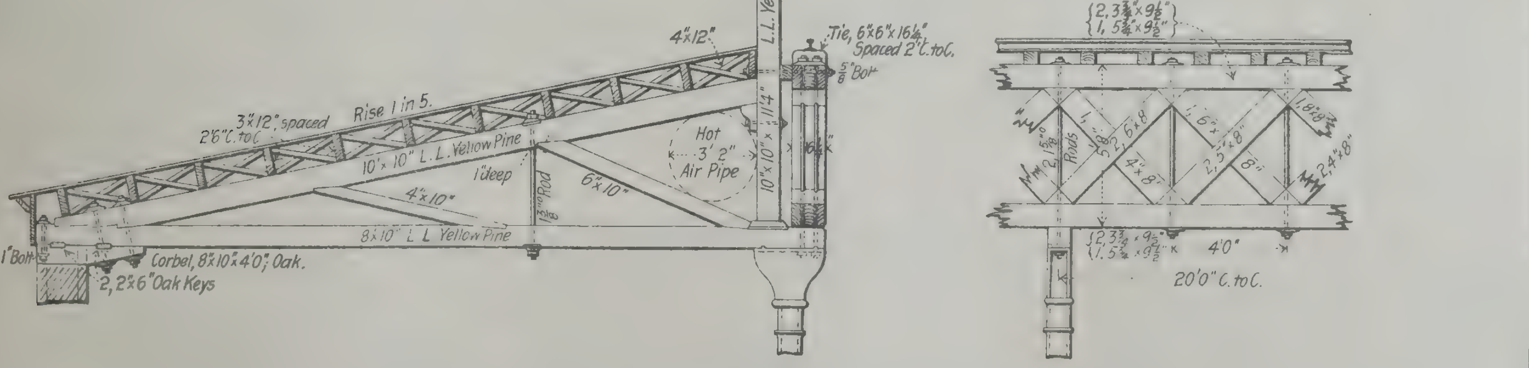


FIG. 15. WOODEN ROOF TRUSSES FOR BLACKSMITH, WOOD AND BOILER SHOPS.

RNSIDE, ILL., LOCOMOTIVE SHOPS.

M. Am. Soc. C. E., Chief Engineer of Bridges and Buildings, Illinois Central R. R.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

old building extends a plate girder carried by the side walls and two intermediate columns, which supports two of the roof trusses of the addition and also the brick end wall of the old building, as shown by Fig. 17.

The interior arrangement of the blacksmith shop addition calls for no particular mention.

Round House.—The round house is a ring shaped building, 316 ft. outside diameter and with a circular interior court 166 ft. in diameter, in which is located the locomotive turn table. Forty locomotives can be stored in the building at once. The walls are of brick and the roof is carried by wooded trusses which have no features demanding particular mention.

The foregoing description with the illustrations give the essential structural features of the locomotive shops of the Burnside plant. The drawings should be studied in particular since care has been taken to avoid repetition of information given by them in the descriptive matter. In a succeeding article the car shops will be described in detail.

For the information from which this article has been prepared we are indebted to Mr. John F. Wallace, M. Am. Soc. C. E., Chief Engineer, and Mr. H. W. Parkhurst, M. Am. Soc C E, Engineer of Bridges and Buildings, Illinois Central R R.

A SMALL ASPHALT-LINED RESERVOIR AT INDIO, CAL.

By J. B. Lippincott.

There is a small asphalt-lined reservoir at Indio spurr, four miles east of Indio station, which is in the Colorado desert west of Yuma. Its length is 88 ft., and its width is 48 ft. on top, and its depth is 4 ft. Its inner slopes are approximately 30° from the vertical, or steeper than 1 to 1. It was built in 1892 under the general direction of Mr. Sutherland Hutton, an asphalt expert and contractor, of Los Angeles, Cal. The sides and bottom were made of asphalt concrete, 3 ins. thick, which was tamped into place while hot with irons. The sides are floated with a coating of asphalt and carbonate of lime, approximately ⅛-in. thick. The sides would have been better with more slope, 2×1 being preferable. An earthen bank was made from the material excavated, 4.5 high and 4 ft. wide on top, with an outer slope 1½×1, the material being sandy loam.

Arroyo Grande (San Louis Obispo) asphalt, 76% pure, costing $25 per ton in 1892 (now $15), was used. It was fluxed with 40% "G grade" asphalt (costing $14 per ton), refined from maltha which will stand 350° flash test. The asphalt concrete, "because of the absence of sand in the locality," was mixed in Los Angeles, the proportions being: Asphalt, 15%; sand, 20%; gravel, 65%. It was cast in blocks, shipped, reheated, laid on this earthen bank and tamped into place behind boards or wooden forms.

Further experience in making asphalt concrete is said to indicate that a much smaller percentage of asphalt should be used, good concrete having been made with as low as 5% of asphalt. Enough asphalt should be used to make a bond in the material and no more, large amounts making the concrete soft under high temperatures. The ideal should be perfect mixing and a low percentage of asphalt.

The writer has seen concrete that was said to have been made of 5% of asphalt and of sand with quartz and granite pebbles of from ½ to 1 in. diameter, in which, under the hammer, the pebbles would go to pieces before the bond would yield. The surface of the concrete in this reservoir was floated with a composition of asphalt and carbonate of lime. The greatest skill and care has to be used in this portion of the work. If the liquid asphalt is heated to too great a temperature it will crack, and if not high enough it will run. The requisites of each case have to be considered and the heat adjusted to them. The liquid asphalt on the side has done some running, but it was found that the sand which was drifted by the lodging on and adhering to it stiffened it and held it in place, which would suggest that a sand blast applied to asphalt coating while it was still hot would not interfere with its imperviousness and would keep it from running.

This reservoir, which is uncovered, has stood temperatures in the shade of 123° for several days, and as the reservoir is emptied every other day, the entire asphalt coating is alternately exposed to and shielded from the direct rays of the sun.

At the ends of the boards or forms, where the concrete was joined to the next abutting layer, cracks of considerable size appeared, which were closed with the liquid asphalt. Coarse grass grows with considerable vigor through the concrete, giving trouble. Since first constructed, this reservoir has never been repaired, has been in constant service and has not leaked. It was built for Mr. C. H. Gale, of Indio. It is filled from two 500-ft. artesian wells, with 5 and 8-in. casings, respectively. Its capacity is about 84,000 gallons, and it is used in irrigating 10 acres of land.

The following is a statement of cost:

Prepared asphalt concrete, 40 tons (2,000 lbs.) at $8	$320
Freight on above	140
Labor	140
Plant (kettles, etc.), not valued	....
Dressing after laying	100
Total cost	$700

The total area of the asphalt concrete was 4,700 sq. ft., making the cost 14.9 cts. per sq. ft.

A PROPOSED STANDARD SPECIFICATION FOR PORTLAND CEMENT.

An interesting paper has recently been prepared by Mr. Wm. J. Donaldson, of Philadelphia, the object of which is to urge the adoption by the United States of a standard specification for Portland cement, the use of which should be required on all work done under the direction of officers of the corps of engineers, and also by the Navy, the Supervising Architect's Office, etc.

Mr. Donaldson sums up present conditions as follows:

1. Lack of uniformity.—The specifications now in use on the various branches of government work show that they have been drawn up by the different engineers in charge of the various departments; with few exceptions they show great difference as to requirements for strength, which is one of the essential features. Some specifications advertise brands alone, without specifying any requirements. The majority of specifications call for no tests on the stability or, in other words, the constancy of volume; few provide for tests on mortar—sand with cement—one of the most vital considerations in determining the true value of cement. The neat tests appear to govern those specifications in which a requirement is asked for; a test which accepted authorities have rendered obsolete and of little value. Slight consideration is taken of fineness, upon which the cost of work largely depends.

2. Low requirements.—Considering first the question of fineness, where such provision is made, in the majority of cases the No. 50 sieve, containing 2,500 meshes per sq. in., appears to represent the standard. Some few specify the No. 100 sieve, containing 10,000 meshes per sq. in., but in all of which the provisions for the minimum percentage of residue asked for, appears to have been taken from specifications made years ago, long since fallen into disuse. As to the strength, some specifications for Portland cement call for minimum tensile strength equalled and surpassed at the present time by the best American natural cements, while the highest provide for a strength far below the performance of the best brands.

3. Acceptance based largely on commercial reputation of brand.—Where brands are specified, the policy followed appears to be a selection of some brand or brands, which have been manufactured for some years—usually foreign cement—in which case two or more brands of Portland cement of entirely different quality are found side by side. Where provision is made for the substitution of other brands, their acceptance is based on their equality, in which the standard of quality is not defined, and unjustly left to the discretion of the engineer.

He then presents his reasons for the adoption of a standard specification by the government, and instances as an example the standard specifications adopted on the Continent of Europe by the congress of cement testing laboratories of Germany, France, Austria, Belgium and Switzerland. The following are the specifications proposed by Mr. Donaldson for adoption as standard. It will be noticed that they are exceedingly full and detailed, and are unique in that the method in which the tests shall be made is fully laid down:

Quality.

Cement.—All cement used to be well seasoned Portland cement, and must conform to the following requirements and be capable of passing the tests herein specified. Manufacturers to guarantee that all cement has been seasoned, or subject to aeration at least 30 days before leaving the works.

Manufacturers to furnish certified tests, from their laboratory, on every car load when shipped; such tests to show they pass the stated requirements, but which shall in no wise be a guarantee of acceptance by the government. This provision acting only as a guide to the cement manufacturer, as acceptance or rejection of cement will be made on government tests.

Packing.—Cement to be packed in strong and well coopered barrels, 400 lbs. gross, or in strong cotton duck bags, three or four bags to the barrel, and 380 lbs. of cement to the barrel.

Sampling.—Samples to be drawn from at least 10% of every one 100 barrels received, the government reserving the right to sample every barrel. Samples to be drawn from the interior of barrel or bags by an iron tube (after the pattern of a molasses gager), and thoroughly mixed as one sample. Tests to be made from the average sample taken from 10 barrels, representing the lot of 100 barrels sampled. Acceptance or rejection to be made as the tests meet or fail to meet the requirements.

Chemical composition.—Full chemical reports to accompany each shipment, the government reserving the right to analyze every sample taken, which must conform to the following requiremnts, and be a tri-calcic silicate cement:

Lime	62 to 66%
Silica	20 to 22%
Sesquioxide of iron and alumina	8 to 12%
Magnesia	not over 3½%

Sulphuric acid....not over 2%, for slow setting cement.
Sulphuric acid, not over ½ of 1%, for quick setting cement.

Time of setting.—A cake of neat cement to be moulded on glass to determine time of setting:

Slow setting, initial set to be over 30 minutes.
Final set to be not over 12 hours.
Quick setting, final set to be not less than 30 minutes.

Slow setting cements to be used in all cases, except for submarine work and in places where water and tides interfere with slow setting cements.

Fineness.—Cements to be of such fineness that 95%, by weight, shall pass through a No. 100 sieve, having 10,000 meshes per sq. in.; 80%, by weight, shall pass through a No. 200 sieve having 40,000 meshes per sq. in.

Checking and cracking.—Two cakes of neat cement to be molded on glass. One to be immersed in cold water, after having set hard, and examined from day to day for surface checking and warping. The other, after having set hard, to be immersed in water at 212° F., and allowed to remain in the water at that temperature for 24 to 36 hours. Examination to be made of the pat at the end of that time for constancy of volume and checking. Should the pats become contorted, or show signs of cracking or warping, the cement will be rejected.

Specific gravity.—The specific gravity shall not be less than 3.00.

Tensile strength.—Neat briquettes shall stand a minimum tensile strain per sqare inch without breaking:

12 hours in air and 12 hours in water	200 lbs.
1 day in air and 6 days in water	500 "
1 day in air and 27 days in water	650 "

Sand, mortar briquettes, 3 parts of sand (No. 4 standard crushed quartz) to 1 of neat cement shall stand a minimum tensile strain per square inch without breaking:

1 day in air and 6 days in water	150 lbs.
1 day in air and 27 days in water	250 "

Manner and Method of Testing.

All Portland cement will be tested according to the following manner described:

Sample.—When the sample is received, carefully mix in a suitable vessel to thoroughly distribute the coarser particles and make it more uniform.

1. Setting.—Mix 100 grammes of neat cement with the correct percentage of water, previously ascertained. Mold the same on a piece of glass 4 ins. square, making the centre of the pat about ½ in. in diameter, and drawing the mass down to a fine edge on the glass; the whole pat assuming a circular shape. When the surface of the cement will sustain a weight of ¼ lb. supported on a wire 1-12 in. in diameter without making any impression, the difference between this time and the time of making is the initial set.

Final set.—When the surface of the cement will sustain a weight of 1 lb. on a wire 1-24 in. in diameter without making any impression, the difference between this time and time of making is the final set.

Fineness.—Pass 100 grammes of cement through a No. 100 and No. 200 standard brass gage sieves (containing, respectively, 10,000 and 40,000 meshes to the square inch). The weight of each residue gives the percentage of fineness of the cement passing through these sieves.

Hot and cold water test.—Mold two pats of neat cement as heretofore described under setting. Allow same to set in air (covered with a damp cloth to prevent surface drying) for 24 hours.

Immerse one in cold water, and allow it to remain in water for an indefinite period—for at least seven days—examining it, from time to time, for warping, checking and cracking.

Immerse the other pat in water 212° F., and allow it to remain for 24 hours in the water at the same temperature; at the end of which time remove the pat and examine for disintegration and constancy of volume.

Mixing and gaging.—Never mix more than a sufficient quantity for one mold, when the initial set is under ten minutes, using 150 grammes of neat cement for each mold, with the addition (at one time) of the proper percentage of water previously determined. Mix and knead the cement thoroughly by hand, using rubber gloves as a protection, and afterwards troweling it in order to bring it to a fine edge, and causing it to shed water. After being thus thoroughly worked until the mass is homogenous, proceed to fill the molds, having first wiped the inside with an oily cloth, in order to prevent sticking, and laying them on a flat smooth piece of slate. Press the cement in with the thumbs, being careful to allow no air bubbles in the cement. Having filled all the molds, smooth them off with a spatula or trowel upon which a slight pressure is exerted.

In the case of neat cement, do not turn or move the moulds from the table after the cement is put in, as the under side will present a smooth surface similar to the upper, if a perfectly smooth surface is used to lay the moulds on and the cement has been carefully pressed in. Cover the briquettes with a damp cloth, immediately after molding, in order to prevent rapid surface drying and to cause a uniform set.

For 24 hour neat test, remove filled molds from slab as soon as set and stand on ends without covering of damp cloths, for 12 hours. Then remove briquettes and immerse in water for the balance of the 24 hours.

For 7 or 28 day tests, remove briquettes from molds at the end of 12 hours, and allow them to remain under a damp cloth for the balance of the 24 hours; then immerse in water for 6 days or 27 days. Then break them in a good testing machine, such as Riehle's or Fairbanks'.

Sand briquettes.—In the case of sand briquettes weigh out 600 grammes of sand and 200 grammes of cement, and mix dry in a pan, add half the percentage of water ascertained in the neat test. Mix this mass well on a slate slab, to thoroughly incorporate the sand and cement, using a trowel for this purpose. This complete mixing is very necessary in the case of a finely ground cement. Care should be taken that the mortar does not become too dry during the manipulation; if it does, dip the trowel in water, which will be sufficient to keep it moist. Having thus mixed it well, press it into the molds, previously arranged as in the case of neat cement. Smooth and trowel the top and bottom of the briquettes, turning them carefully for this purpose, in order to bring the moist cement to the surface, thus filling the voids and making both sides of the same degree of smoothness. This will prevent one side from being more absorbent than the other when immersed.

For 7 or 28 day sand mortar test, remove the briquettes from mold at end of 12 hours and place under damp cloths, immersing them in water at the end of 24 hours (the same as in the neat tests for like periods of time) for 6 days or 27 days, respectively, as the requirements may be.

Sand.—Sand used should be standard crushed quartz, No. 4, capable of passing a No. 20 sieve and caught on a No. 30 sieve (sieves, standard brass gage, having 400 meshes and 600 meshes to the square inch, respectively).

Water.—Water used for tempering and gaging, as well as for the immersion of briquettes, should be clear, and between 65° to 70° F.

Notes.—When mixing rapid setting cements care should be taken that the initial set does not take place before molding; if it does, the mass should be rejected. Care should always be taken to keep the briquettes completely submerged in the water while immersed, and make the test as soon as they are removed from the water. Stand the briquettes on end while immersed in the pans, so that the maximum surface will be at all times exposed to the water.

Mark on each briquette a number, same referring in some suitable record book to brand, days of making, tesing, breaking and full tests and properties of cement.

The advantages to be derived from uniform specifications and manner of testing such as advocated are enumerated by Mr. Donaldson as follows:

1. A standard system applicable alike for all departments.
2. Knowledge of the proper and economic use of Portland cements.
3. Higher standards and consequent rejection of inferior brands, due to an accurate system of tests.
4. All cements placed on an equal footing and merits determined.
5. Incentive to the betterment of quality.
6. The fostering of an American industry.

In conclusion, Mr. Donaldson presents some argument for the above specifications which are worth careful consideration. He urges that present specifications are defective in not insisting on fine grinding. The residue on a 200 sieve, he states, is of no more value than so much sand, as it has no setting properties, and in comparing the price of different cements, it should be remembered that it is only the fine portion that is of value; one cement may be nominally more expensive than another and yet be actually the cheaper, on account of its smaller percentage of unground particles. The improvements in grinding machinery during the last few years have made it possible to grind cements finer than formerly, at slight increase of expense, so the engineer need not be deterred from insisting on finely ground cement by reason of extra cost.

Another important point raised by Mr. Donaldson, is the advantage of shipping cements from the works to the place of use, in bags instead of barrels. It is exceedingly common to see in specifications a clause inserted requiring the cements to be shipped in casks; when, if the engineers only knew it, it is better to have it shipped in bags. The cement is thus more perfectly seasoned; it can be more readily and cheaply handled; and the manufacturer can afford to sell it at a materially less figure, as the bags are returnable, and are used over and over again. In other words the purchaser of the cement gets a better article at a less price.

◆

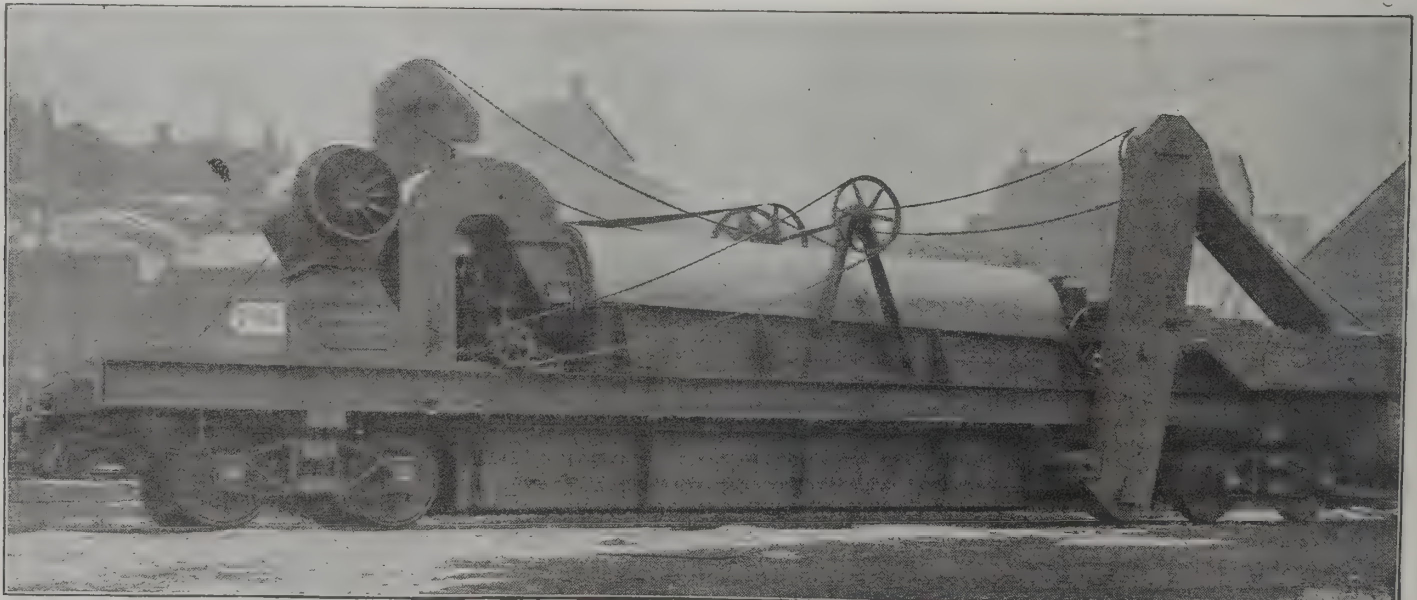
A PORTABLE DRYING AND HEATING PLANT.

We show herewith an invention of much practical interest in many industries. It is a drying and heating apparatus mounted on the trucks of a standard railway car, so as to be easily moved from place to place, and adapted for drying and heating sand, crushed stone, or other materials on a large scale, and with great economy and efficiency. The plant was designed and built by the F. D. Cummer & Son Co., of Cleveland, O., and consists of an all-steel car frame, 48 ft. in length and 9 ft. 3 ins. wide over all. On this is set a Cummer, style A, patent dryer and heater, with a 25 HP. Westinghouse engine and the necessary elevating and power transmitting machinery.

The firebrick about the dryer is so secured, we are informed, as not to be likely to crush or loosen under the shocks and jars experienced on the road, and the lowest point of the dryer has more clearance above the rails than a locomotive pilot. The car has M. C. B. couplers and Westinghouse air brakes, and has been examined and accepted by the railway officials for transportation.

Two elevators are used in connection with the dryer, as shown, one feeding the drier, and one delivering the dried and heated material to the screen or to any point desired. The operation of the apparatus is easily regulated, and the material heated can be delivered dried and uniformly heated to any temperature from 150° to 600° F.

The cut herewith is reproduced from a photograph of a drying plant recently built for a large asphalt paving company. The apparatus shown will dry and heat about ten tons of sand per hour.



PORTABLE DRYING AND HEATING APPARATUS.
Designed and Built by the F. D. Cummer & Son Co., Cleveland, O.

◆

LOW LEVEL BRIDGES IN QUEENSLAND.

Australia is a country famous for its alternations of drought and flood. Water courses which, in the dry season, shrink till they almost disappear, are converted by sudden rains into broad, deep rivers, which subside, however, as quickly as they rise. To carry highways across these streams by bridges at a level above the highest floods is a very expensive task, as high piers or long spans are required and iron or steel bridges are expensive. Moreover, as is well known, the greater part of the country is sparsely inhabited, and the traffic will not warrant great expense in the maintenance of highways.

To meet these conditions, the Australian engineers have in some case adopted what are known as low-level bridge. Instead of building a bridge above high-water mark, they make it high enough, merely to clear the water surface at moderate floods, and permit the higher floods to submerge it entirely, considering it better to suffer the inconvenience of a stoppage of traffic during the short time that these higher floods last than to go to the expense of a high-level bridge.

Of course the low-level bridges are especially designed to resist the force of the current of water when submerged; but, on the other hand, they are not subject to danger by drift piling up against them and forming a dam, as the debris is not carried down a river in considerable quantity until a stage is reached at which a low-level bridge would be submerged.

A paper describing some of these low-level bridges was recently read before the Institution of Civil Engineers, by Mr. A. B. Brady, M. Inst. C. E., of Brisbane, Queensland, and we reprint the substance of it as follows:

Herbert River Bridge, Garloch.

The level of the decking of this bridge is 10 ft. above high water of ordinary spring-tide, or 29 ft. below the highest flood-mark. The bridge has a total length over the abutments of 481 ft. 3 ins.; and consists of 14 spans of 33 ft. each, the clear width of roadway between the curbs being 16 ft.

The piers, 13 in number, together with the abutments and wing-walls, are built of Portland cement concrete composed of one part of cement, three parts of clean sharp river-sand, and six parts of hardstone broken to 2-in. gage. The string-courses under the steel superstructure were formed of a stronger concrete composed of one part of cement, two parts of sand, and three parts of hardstone broken to 1½-in. gage. The pier foundations were laid on rock at depths varying between 4 ft. 6 ins. and 6 ft. below high water, temporary wrought-iron caissons, constructed in sections bolted together having been used. The maximum depth of sand overlying the rock-bottom was 4 ft. 6 ins; and the maximum depth of sinking in the rock 1 ft. 6 ins. Each pier has semi-circular ends with a batter of 1 in 12 above the plinths; the batter of the sides, between the splayed plinth and the underside of string-course, being 1 in 24. All exposed faces of the concrete in the piers and abutments were floated with a mixture of one part of Portland cement to two parts of sand.

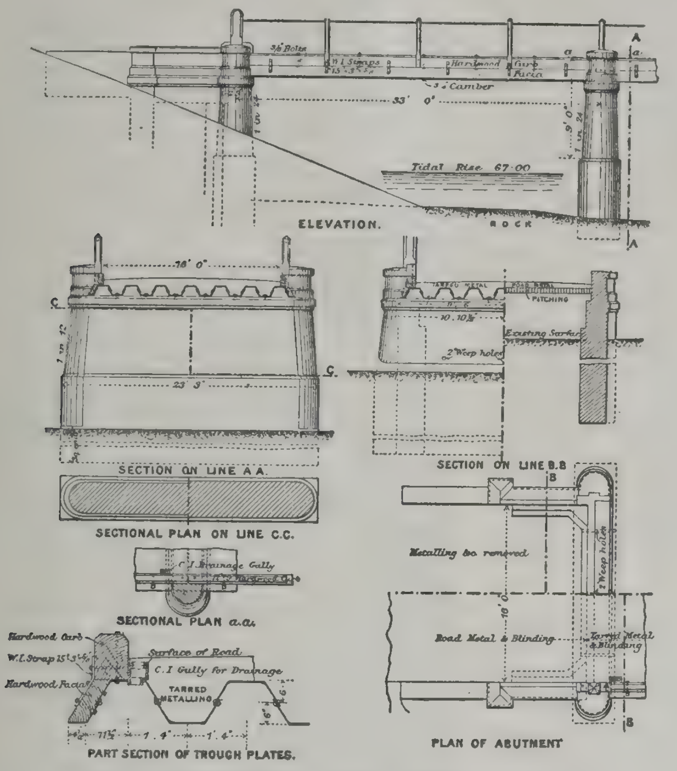


FIG. 1.—THE HERBERT RIVER BRIDGE, GAIRLOCH.

The superstructure or decking of the bridge was formed of mild-steel or trough-plates 12 ins. in depth, weighing 25.82 lbs. per sq. ft. of area covered. The plates were

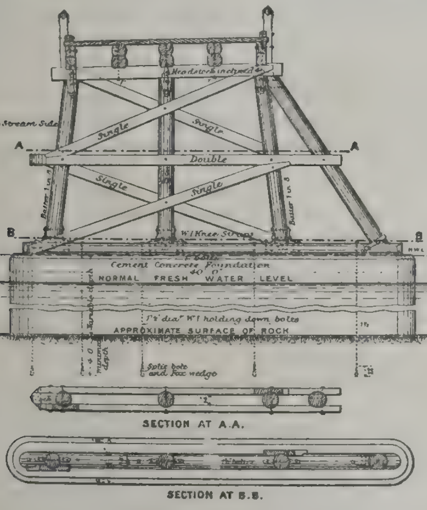


Fig. 3.—The Mary River Bridge, Tiaro.

campered to the extent of ¾ in. at the centre of each span, and the sections riveted together with ⅝-in. rivets at 6-in. pitch throughout. The trough form of superstructure possesses many advantages for short spans, as girders may be entirely dispensed with, and, in the case of low-level bridges, the small depth of the troughs offers but little resistance to the passage of flood-waters during the wet seasons. The whole of the steel-work received three coats of tar. For securing the steel superstructure to the piers and abutments, 1-in. lewis-bolts were fixed in the concrete string-courses, the upper surfaces of which were trowelled smooth and level, to form a uniform bearing for the steel-trough decking. The bolt-holes at one end of each trough were slotted to allow for expansion of the decking.

The road or carriage-way was formed of metalling, broken to 2-in. and 1-in. gages in equal proportions, mixed with boiling coal-tar. The troughs were completely filled with tarred metal, and were covered to a depth of 7 ins. at the crown and 5 ins. at the curbs, being well punned and afterwards rolled and covered with sand. Drainage from the surface of the roadway is provided for by 30 gullies having outlets through holes cut in the trough decking. The curbs are of Moreton Bay ash, 12 ins. by 9 ins., bolted to the steel decking; and the handrailing is of hardwood posts and iron chains easily removable.

The approaches were made in cutting through the sandy formation of the banks, the cutting for the south approach having a maximum depth of 17 ft. The slopes were faced with bricks laid in cement; and concrete water tables were constructed at the foot of the slopes.

During the construction of this bridge exceptionally bad weather was experienced; and two of the highest floods known in the locality occurred, resulting in considerable delays, loss of plant and materials, and damage to the approaches. In April, 1894, two and a half years after the bridge was opened for traffic, the Herbert river was visited by the most disastrous flood that has ever been recorded in the district, considerable damage occurring to the tarred metal or asphalt roadway on the bridge, necessitating its entire renewal. In repairing the roadway the quantity of tarred metalling, which, on account of its depth in the troughs of the decking, required a long time to set sufficiently hard for traffic, was reduced by filling the troughs to a depth of 12 ins., and forming a surface over the decking, with Portland-cement concrete, upon which tarred metalling or asphalt was laid to a depth of 6 ins., and reduced by rolling to 5 ins. The concrete was composed of one part of Portland cement, one part of river sand, and six parts of stones from the river of 2-in., 1-in. and ¼-in. gages in equal quantities. The asphalt was formed of broken river-metal of 2-in. and 1-in. gages in equal quantities, mixed with ¼-in. screened river-gravel, in the ratio of six parts of stone to one of screened gravel. After being thoroughly dried, heated, and well mixed with the required quantity of boiling coal-tar, it was stacked to allow the superfluous tar to drain off, and then laid on the surface of the concrete and rammed and rolled. The surface was finished with 1 in. of tarred sand and screenings, composed of four parts of coarse sand and two parts of fine gravel screened, dried, heated and mixed with boiling coal-tar as before. After finishing, the entire surface was covered with clean sharp river-sand to a depth of ½ in.; and, to give sufficient time for the asphalt to harden, a month was allowed to elapse before the bridge was reopened for traffic.

The contract for the construction of this bridge was let in January, 1890, and it was completed and opened for traffic on the 4th of November, 1891, the total cost of the bridge and approaches amounting to £7,737 16s. 7d. The cost of the bridge, exclusive of approaches, amounted to £5,704 4s. 0d., or £11 17s. 0d. (nearly $60) per lin. ft. The cost of the concrete and asphalt work, together with some other necessary repairs, amounted to £684; the total cost of the bridge being thus increased to £13 3s. 6d. per lin. ft. ($66).

Balonne River Bridge. St. George.

This bridge is wholly of bloodwood (Eucalyptus corymbosa), and consists of twelve spans of 35 ft. each, with two end-spans of 28 ft. each; the total length over the decking being 481 ft., and the width of roadway between the curbs, 18 ft. The height of the bridge above the lowest or dry weather level of the river is 15 ft., the highest flood having reached a level of 16 ft.

Each pier has four piles spaced at 6-ft. 2-in. centers at the level of the headstock; the two outer piles having a batter of 1 in 8, and the two intermediate piles being planted vertically. The diameter of the piles, exclusive of sapwood, is 17 ins., the butt-end being placed downwards in every case. Each of the outer or battered piles was lewised to the rock-bed of the river, each hole being cut to a depth of 5 ft., the dimensions at the bottom being 46 ins. long by 14 ins. wide. The sides and one end were cut vertically, and the opposite end tapered so as to reduce the length of the hole at the surface to 26 ins. The sides and ends of each hole were carefully rough-tooled to exact lines; and properly-shaped wedges of seasoned bloodwood were then inserted, and made to bear evenly against the rock. The feet of the piles were squared for a length of 6 ft. 6 ins.; they were then inserted in position between the wedges, and firmly driven home, the whole being securely bolted together above the surface of the rock. The wedges and the feet of the piles before being fixed were twice coated with Stockholm tar; and, after fixing, the interstices were completely filled in with strong-cement grout. The two intermediate piles in each pier, and also the abutment piles, were planted in rock, the holes for which, 24 ins. in diameter, were jumped or excavated to a depth of 4 ft. The feet of the piles were freed from sapwood, and twice coated with Stockholm tar; they were then planted in the rock, the space round each pile being completely filled with cement concrete. The sites of eight of the twelve piers were above the summer level of the river, but the first four piers from the St. George side of the river were in water, necessitating the provision of a cofferdam for each pier, to admit of the holes in the rock being cut without the aid of divers. Each pier was capped with a 12-in. by

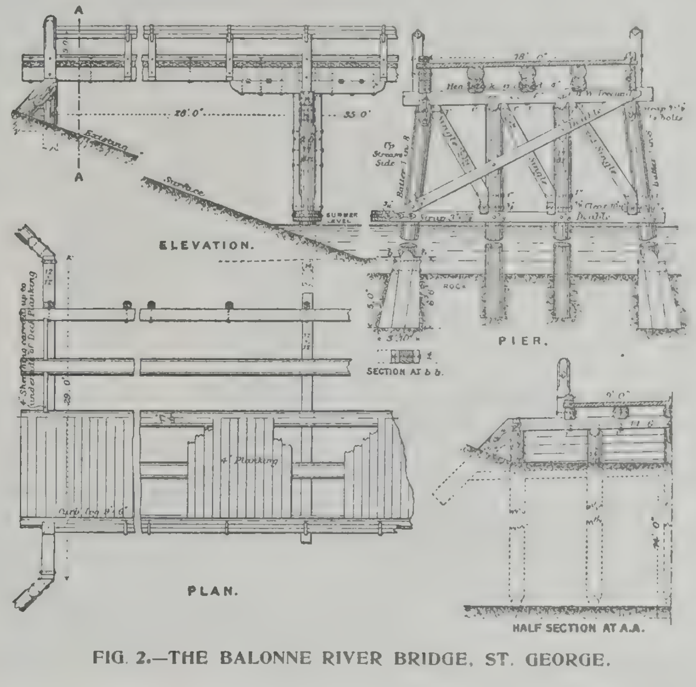


FIG. 2.—THE BALONNE RIVER BRIDGE, ST. GEORGE.

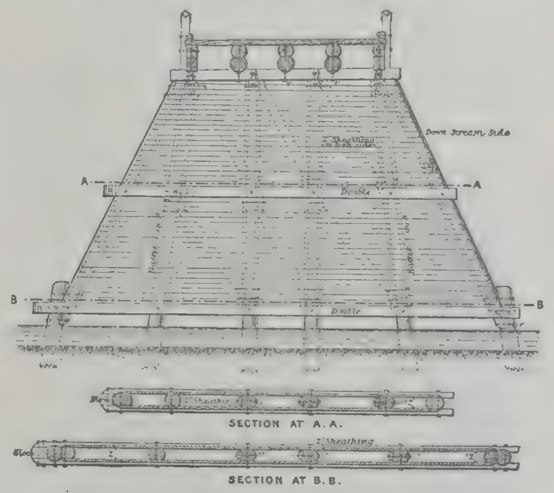


Fig. 4.—The Mary River Bridge, Gympie.

12-in. headstock inclined 4 ins. in its length towards the upstream side of the bridge, and provided with double 10-in. by 6-in. walings above water or rock-level, three 10-in. by 12-in. struts between the piles, and double 10-in. by 6-in. diagonal braces. The walling and braces were cogged on to the piles, and the whole well bolted together. The upstream ends of each pair of walings were shaped and blocked solid to form a cut-water, and were well secured with wrought iron straps and bolts.

Each span consists of five girders or stringers scarf-jointed over the piers, and carried upon single corbels, 14 ft. long, through which the girders were bolted. The corbels were cogged on to the pier headstocks; and, in addition to being bolted, the girders were keyed to the corbels with well-seasoned wedge-keys tightly driven, working 3 ins. square, and having a 4-in. projection on each side for tightening. The superstructure is secured to the piers by through-bolts and anchor-bolts. The decking consists of 9-in. by 4-in. planks laid transversely over the girders in one length from side to side, and spiked down with 8-in. by ½-in. spikes. The outer girders and corbels exposed to view are of hewn timber 14 ins. by 12 ins.: the inner girders and corbels being of round timber 17 ins. in diameter, exclusive of sapwood, adzed flat to a thickness of 14 ins. over all bearings and for the planks of the decking. The entire superstructure is built with an inclination of 4 ins. toward the upstream side to prevent lodgment of driftwood under the bridge decking in time of flood. The abutments were sheathed at the back of the piles with 4-in. planking, carried also along the wings of the abutments. The curbs measure 9 ins. by 6 ins., and are rounded on one edge and bolted through the decking and girders; the curb on the upstream or lower side of the bridge being raised 1½ in. to allow for drainage from the surface of the decking. The handrails, 6 ins. square, are placed diagonally on 9-in. by 6-in. intermediate posts, and 9-in. by 9-in. main posts over the piers, terminating at the ends of the bridge in 12-in. by 12-in. guard-posts securely fixed to the girders of the end spans and tenoned into the abutment headstocks. The handrailing is only 3 ft. above the decking, and of exceptional strength, without intermediate rails and wires, so as to offer as little resistance as possible during floods, and to enable it to withstand the pressure due to the accumulation of flood debris. Strong permanent handrails are to be preferred to movable handrails, which are troublesome and expensive, and their removal at the vital moment is often neglected.

The whole of the timber-work received three coats of oxide paint, with the exception of the decking, which was covered with three coats of Stockholm tar. Since it was opened for traffic, this bridge has been several times submerged by floods without sustaining injury.

The construction of the bridge was commenced in October, 1890, and it was opened for traffic in June, 1892, after many troublesome delays in consequence of wet weather and floods. The total cost amounted to £4,467 16s. 4d., inclusive of approaches, which alone cost £419 10s. 0d., the cost of the bridge per lin. ft. amounting to £8 8s. 4d.

The author also describes two bridges across the Mary River. We reproduce the cuts illustrating them, as they show sufficiently the features of principal interest in their construction.

◆

A DIRECT-ACTING STEAM PILE HAMMER.

We illustrate this week a steam pile hammer made by the Vulcan Iron Works, of Chicago, which is a modification of the steam hammer for this purpose invented in England in 1841 by James Nasmyth. The apparatus is slung between the leaders of a pile driver and has its whole weight resting on the pile, the pile cap and cylinder casting being connected by four turned rods, upon which the hammer head slides. The general design of the apparatus is shown in Fig. 1.

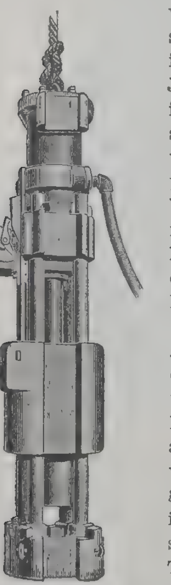


Fig. 1.—View of Vulcan-Nasmyth Steam Pile Hammer.

In the detail drawing, Fig. 2, A is the hammer head, bored out for the four rod guides B, the lower or striking end of the head being of smaller diameter and passing through the cap D, which rests on the pile. The guide rods attach the cylinder C to the cap D, and are secured by keys at each end. The hammer head is attached to the rod of the piston E. The oscillating valve F works within a cylindrical chamber formed in the steam chest, this chamber being provided with three ports; port G opens into the lower end of the cylinder, H is the steam and I the exhaust port, steam being admitted from a flexible pipe attached at J. The spindle of valve F carries at one end (outside the steam chest), the arms or tappets K, L, which engage with lugs on the rod M attached to and moving in connection with the hammer head. These lugs are not in the same vertical plane, only one lug engaging with each of the tappets. At the end of the upstroke of the cylinder and hammer head the lower lug will have passed the tappet L without striking it, but will strike the tappet K, moving the valve so as to open communication between ports G and I, and allow steam to exhaust from below the piston. At the end of the downstroke the upper lug will pass the tappet K and strike the tappet L, moving the valve to the left, so as to open communication between ports G and H for steam admission under the piston.

In sinking test piles for the foundations of the Chicago Public Library (Engineering News, July 6, 1893), a Vulcan-Nasmyth hammer was used, weighing 4,500 lbs., having a stroke of 42 ins., and striking 54 blows per minute. The last 20 ft. were driven with a follower of oak, requiring 48 to 64 blows for the last foot, and as the ratio of blows without follower to blows with follower is as 1 to 2, it was estimated that only 24 to 32 blows would have been required if the last foot had been driven with the hammer striking the pile direct. In the same soil it required about 16 blows of a 3,000-lb. drop hammer falling 30 ft. to drive a pile the last foot, using a follower, and 32 to 36 blows of the same drop hammer falling 15 ft., also using a follower.

◆

UNIFORM METHODS OF TESTING IRON AND STEEL.

Several years ago a committee was appointed by the American Society of Civil Engineers to report upon uniform methods of testing the material used in metallic structures. The committee has made, we believe, one or two preliminary reports, and its final report has just been presented at the annual convention in San Francisco. An abstract, summarizing the recommendations of the committee was prepared by Mr. Henry B. Seaman, 40 Wall St., New York city, a member of the committee, who has had it printed for convenient reference, and will mail copies to those desiring them. We reprint this summary in full as follows:

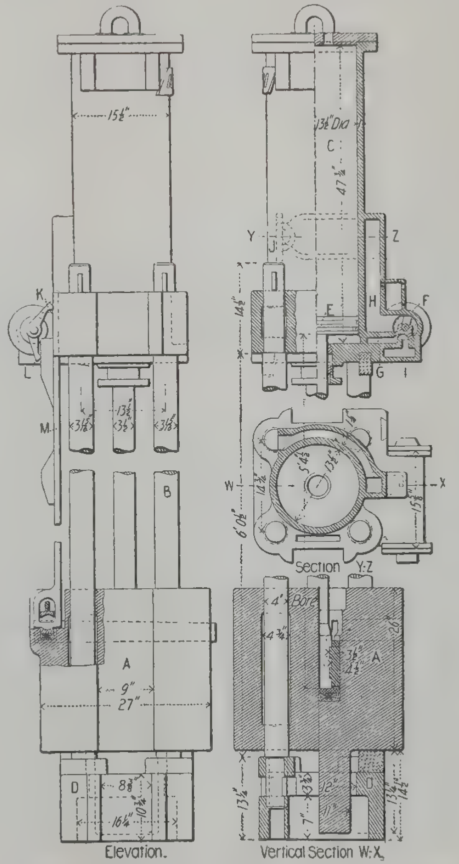


Fig. 2.—Details of Vulcan Nasmyth Steam Pile Hammer; Vulcan Iron Works, Makers.

Cast Iron.

We recommend the transverse tests of a specimen 2 × 1 ins. in section and 27 ins. long, resting flatwise on dull knife-edge supports 24 ins. apart, c. to c., with an applied weight of 2,000 lbs. or more, midway between them. The specimen, if of satisfactory strength when cast under the same circumstances as those which attend the casting of the full-sized piece, must carry at least the minimum weight named above, and exhibit when broken the fracture of gray iron of good quality. Failure shall be produced in not less than two minutes nor more than five minutes from application of the first load, and the bar must show a center deflection before breaking of at least 3-16 in., and must indicate a good quality of gray iron.

Wrought Iron.

The committee recommends that the expression "elastic limit" be confined in its use to its original meaning, since its more general adoption leads to ambiguity and to useless discussion and dissension. The usual methods of testing indicate the first strength or "yield point" of the material, and in order to avoid the objections already mentioned, the committee has confined itself to the expression "yield point" when applied to practical testing. The "drop of beam" is considered sufficiently accurate to determine the "yield point," but the increased accuracy of autographic records, or use of instruments of precision is recommended.

Experimental investigations show that the relative dimensions of a test piece become of little practical consequence if the gaged length exceeds about four times the greatest diameter of the specimen. It is therefore recommended that a minimum gaged length of 8 ins. be used for the general practice of testing specimens, with a distance of not less than 12 ins. between shoulders of the specimen, or between the jaws of the testing machine. Under these conditions, however, it is understood that the gaged length shall in no case be less than four times the greatest diameter of the test piece, and that the minimum thickness shall be ¼ in.; also that the sectional area of test piece shall not be less than ½ sq. in. In obtaining the final elongation, the curves of reduction each side of the point of fracture should be included in the measured length.

In testing it is recommended that the load be applied continuously and at a rate as nearly as practicable of 4,000 to 5,000 lbs. per sq. in. per minute below the yield point, and of 7,000 to 8,000 lbs above the yield point.

It is recommended that the ordinary bending test be continued, and that it be made rapidly with pressure, rather than with blows of a hammer, as the results are thereby more comparable. The nicked bending or fracture test, however, does not show any essential property of the material which would not be disclosed by the tests already mentioned, and hence its adoption is not recommended.

For the requirements of wrought iron with the tests outlined, the following are recommended:

	Bars, per sq. in.	Tension; plate, angle and other shapes.	Compression; plate, angle and other shapes.	Web plates.
Yield point, lbs. (1=1,000)	26	26	26	26
Ultimate, lbs. (1=1,000)	50	48	48	46
Elongation in 8 ins., %	20	15	12	8
Reduction of area, %	30	20	16	12

Specimens should bend cold 90° without fracture, with inner radius of bending not exceeding twice the thickness of the test piece for bar iron, nor three times that thickness for plate and shape iron.

Rivet iron must be soft and tough, and pieces of the full diameter of the rivet must be capable of bending cold until their sides are in close contact without showing signs of fracture.

Rolled Steel.

The methods of testing wrought iron may, in general, be applied to rolled steel. In addition to these, however, the quenching test may be used to advantage, by which a specimen heated to cherry red is to be quenched in water of 82° F., and then tested as usual.

The drifting test is not recommended as a requirement for quality, and the annealing test is recommended only for full-size eye-bars.

For the requirements of rolled steel, it is recommended that a mean ultimate resistance be specified for each grade of steel, and that the ultimate resistance of the test specimen should not vary more than 4,000 lbs. per sq. in. either way from the resistance specified. It is also recommended that the yield point, the elongation and the reduction of area each be a function of the ultimate strength found in the test specimen.

The following requirements are recommended for the various grades of steel:

Ultimate Strength per Square Inch.

Low steel	60,000 lbs.	± 4,000
Medium steel	65,000 "	± 4,000
High steel	70,000 "	± 4,000

Yield point = 55% of the ultimate resistance of specimen.

$$\text{Per cent elongation in 8 ins.} = \frac{1{,}500{,}000}{\text{Ultimate}}$$

$$\text{Per cent reduction of area} = \frac{2{,}800{,}000}{\text{Ultimate}}$$

Rivet steel when heated to a low cherry red and quenched in water at 82° F. must bend to close contact without sign of fracture. Specimens of low steel when treated and tested in the same manner must stand bending 180° to a curve, whose inner radius is equal to the thickness of the specimen without sign of fracture. Specimens of medium steel, as cut from bars or plates and without quenching, must stand bending 180° to an inner radius of 1½ times the thickness of the specimen without sign of fracture; while those of high steel, also without quenching, must stand bending 180° to a radius of twice the thickness of the specimen without sign of fracture.

Steel Castings.

In steel castings the tension test is recommended, with the following requirements:

Ultimate	65,000 lbs. per sq. in.
Yield point..	35,000 " " "

Elongation in 8 ins. = 15%.
Contraction = 25%.

Respectfully submitted, James G. Dagron, Robert W. Hunt, Henry B. Seaman, William H. Burr.

* * *

TESTS OF THE EFFICIENCY OF AN INJECTOR

By Karl Andrén.

The following results were obtained from a series of experiments upon an injector manufactured by the Penberthy Injector Co., of Detroit, Mich. and listed as No. CC in their catalogue for 1895.

Four series of tests were made under the following conditions:

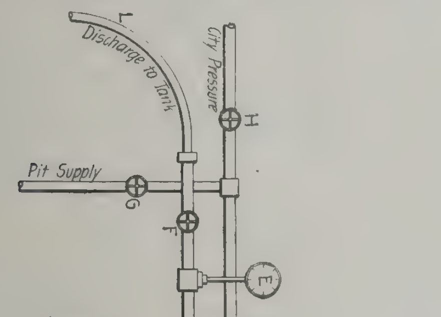
I. Greatest discharge, under constant steam pressure and suction head, against varying pressures in the discharge pipe, the water being supplied to the injector at the city pressure, 50 lbs.

II. Least discharge, under the same conditions.

III. Greatest discharge, under constant steam pressure and with a lift of the supply water of 9 ft. 10 ins., against varying pressures in the discharge pipe.

IV. Least discharge, under conditions of the third series. The accompanying sketch explains the arrangement of piping used in the tests.

A represents a separator, made of 4-in. steam pipe, and having cast-iron caps at the top and bottom, as shown. B is the steam pipe from the boiler: This passes centrally through the top cap of the separator and extends downward about half way between the two caps. This pipe is open at its lower end. The steam leaves the separator near the top cap and is carried to the injector P. E is a pressure gage in the discharge pipe and F is a throttling valve, by means of which varying discharge pressures may be obtained and registered on E. G is a globe valve in the lifting pipe, connected to the pit supply. This valve was closed, except in the lifting tests. H is a globe valve in the city water pipe. This valve was wide open during all tests on greatest discharge when city pressure was used. In all the tests the injector steam valve I was wide open, as recommended by the manufacturers. Preparatory to all tests on least discharge with city pressure, the limiting action of the injector was determined by alternate manipulations of the valves H and F, until the desired discharge pressure was noted at that point, directly after which the injector would fail to work without leaking at the overflow. In all lifting tests the globe valve H was closed. During tests for greatest discharge with suction the valve G was opened wide, the desired discharge pressure being regulated by means of the throttling valve F. In the lifting tests for least discharge, the valve G was operated in connection with the throttling valve F in a similar manner to that before described in the least discharge at city pressure. J and K are two accurate centigrade thermometers, set into oil cups in the suction and discharge pipes respectively. To the end of the discharge pipe is coupled a piece of rubber hose L. This leads to a wooden tank set on Fairbanks' scales, not shown in the drawing. The scale arm weight was adjusted to balance the tank when empty, and 350 lbs. in weights were placed on the scale pan. A boiler steam gage was also near at hand so that all readings were easily obtained from a stand near the injector. The time in seconds was noted for each discharge of 350 lbs.

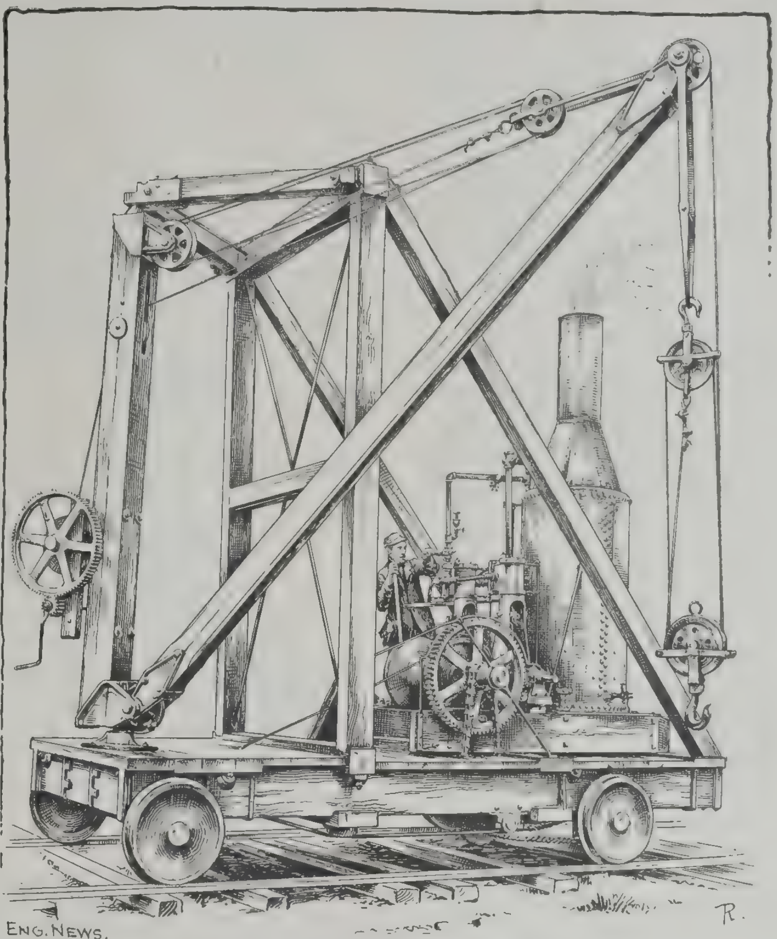


Arrangement of Apparatus for Injector Test.

The diameter of the injector combining tube was determined by the micrometer measurement of a soft wooden taper rod, which was accurately fitted to the smallest section of the tube. It was found to be 0.215 in.

Explanation of the symbols used in the equations:

W = Weight in lbs. of water discharged during the test.
S = Weight in lbs. of steam used during the test.
L = Total heat of the steam.
t_3 = Temperature in degrees Fahrenheit of the suction water.
t_4 = Temperature in degrees Fahrenheit of the discharge water.
q_3 = Heat of the liquid corresponding to the temperature t_3.
q_4 = Heat of the liquid corresponding to the temperature t_4.
350 = Weight in lbs. of the water + steam (condensed) discharged = capacity of the weighing tank during each test = $W + S$.



AN ECONOMICAL TRAVELING DERRICK CAR.

All the results were obtained by substitution in the following formula, which is adapted from the equation (219) in Prof. Peabody's "Thermodynamics of the Steam Engine."

$$W(q_4 - q_3) + (W + S)\frac{AV^2}{2g} = S(L - q_4)$$

But since $S = 350 - W$

$$W(q_4 - q_3 + L - q_4) = 350(L - q_4) - 350\frac{AV^2}{2g}$$

and hence

$$W = \frac{350\left(L - q_4 - \frac{Av^2}{2g}\right)}{L - q_3} = \frac{350\,(L - q_4)}{L - q_3}\text{(practically).}$$

The following deductions can be made from the accompanying tabular results of tests:

Tests of the Efficiency of a Penberthy Injector.

I. Tests with maximum discharge. Water supplied to injector under pressure of 50 lbs per sq. in.

Discharge head lbs. per sq. in.	Average Steam pressure (gage) lbs.	Temperature (Deg. F.) of		Discharge gals., per hour.	Lbs. of water pumped per 1 lb. steam.
		Suction.	Disch'g.		
20	68	50	104	626	20.49
30	71	50	105.8	626	19.82
40	68	50	104	626	20.49
50	70.5	50	107.6	626	19.17
60	70.5	50	107.6	626	19.17
70	68.5	50	105.8	626	19.71
80	72	50	110.3	597	18.27
90	72	50	122	502	15.11
100	Injector leaked at overflow.				
II. Tests with minimum discharge. Water supplied to injector at pressure of 50 lbs. per sq. in.					
20	71.75	51.8	202.1	242	6.68
30	70	51.8	199.4	243	6.81
40	71	53.6	199.4	242	6.90
50	71	53.6	199.4	245	6.90
60	71.75	53.6	192.2	256	7.32
70	70	53.6	179.6	271	8.15
80	70.5	53.6	163.4	315	9.50
90	70	53.6	158	336	10.04
100	Injector leaked at overflow.				
III. Tests with maximum discharge. Injector working with suction lift of 9 ft. 10 ins.					
20	75	72.5	149	474	13.85
30	72	64.4	137.3	486	14.70
40	71.5	61.7	134.6	491	14.74
50	70.5	60.8	132.8	491	14.94
60	71	67.1	140.9	485	14.49
70	71	67.1	140.9	488	14.49
80	70	68	145.4	459	13.62
90	Injector leaked at overflow.				
IV. Tests with minimum discharge. Injector working with suction lift of 9 ft. 10 ins.					
20	70.5	68.9	190.4	281	8.56
30	70	63.5	185	281	8.56
40	71	62.6	185	281	8.33
50	70.5	60.8	181.4	281	8.89
60	71	59	179.6	286	8.51
70	71	59	170.6	306	9.28
80	71	65.3	165.2	344.6	10.43
90	Injector leaked at overflow.				

1. Since the life of a boiler is greatly increased when fed with hot water, a larger injector than that size, which, when working at its maximum capacity, is just sufficient to feed the boiler, should be used. The considerable increase in the temperatures of the feed water, when the injector is working at least discharge, warrants this suggestion.

2. In case the injector is to be used as a pump, in which case it would generally be regulated so as to give the greatest discharge, it is seen that it is much more efficient against high heads than againtst the lower heads.

3. A comparison of II. and IV. shows that the discharge with a lift of 9 ft. 10 in. is greater than the corresponding discharge when the city pressure was used, while the final temperatures of each set vary only slightly. This is not true for the maximum discharges of each set.

4. In general, the maximum discharge of each class is decreased as the pressure head is increased, while the corresponding temperature of the discharge is proportionally greater. But a comparison of the minimum discharges of each class shows that the temperature of each discharge decreases as the pressure head is increased, while the discharge per hour is materially increased.

* * *

A TRAVELING DERRICK CAR.

The accompanying cut represents a simple and economical derrick, mounted on a car fitted with propelling gear, and intended for use in quarries and similar places, and in the construction of buildings, foundations, sewers, etc., where fixed derricks have many disadvantages. The car, derrick-post, boom and supporting frame are of timber, and on the car are a two-cylinder hoisting engine and a vertical boiler. A sprocket chain from the main shaft drives a countershaft under the car platform, while another chain, running from a smaller wheel on the countershaft drives a sprocket wheel keyed to the rear axle. The derrick has the ordinary cast-iron shoes and fittings, wire rope falls, and wrought-iron blocks and large sheaves. The car is 16 ft. long, with wheels set to 8 ft. gage of track, and it will work on a grade of 2%, with maximum load. The mast is 12 ft. high, and the boom 18 ft. long, the latter swinging through an arc of 270°. The weight is about 15,000 lbs. This machine is manufactured by the John F. Byers Machine Co., of Ravenna, O., It should meet the wants of a large number of manufacturers and others who could use a traveling crane to advantage in loading and unloading goods, machinery, etc., but cannot afford the expenditure necessary for an all-metal machine.

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The advantages and disadvantages of the head house or "dead end" plan for the arrangement of railway stations are now under discussion in connection with the proposed new union station for Omaha, Neb. The present principal station is on the outskirts of the town, and a new one was proposed on practically the same site, but though work was commenced it does not seem probable that it will be carried to completion, as there is a strong movement in favor of a new and more central location, and accommodating other railways besides those using the present main station. This would be a terminal station, with a head house at the end of the train shed. Through trains would either have to head in, and then put out in a reversed position, a fresh engine being attached to what was the rear of the train; or else such trains must run past the station and then back in, pulling out again without being reversed. The daily papers appear to be decidedly in favor of a station on the new site, and the great terminal stations at Philadelphia and St. Louis are pointed to as examples of "head-house" stations used by through trains. It should be noted, however, that many through trains of the Pennsylvania R. R. do not now enter the Broad St. terminal station at Philadelphia, but pass by that city by a cut-off built for this purpose. On those through trains that do enter there is more or less inconvenience caused by the reversal of position and the necessity of reversing all the seats of the cars. A similar arrangement also used to exist on the Baltimore & Ohio R. R. at Baltimore, and the delays and inconveniences due to this arrangement were among the reasons for building the Belt Line tunnel, giving trains a through station. The question is largely one of traffic conditions. If there are many through trains, it may be advisable to so locate and arrange the station as to provide through tracks, but if the traffic is mainly terminal the head-house plan may be the best. The great terminal stations of the Pennsylvania R. R. and the Philadelphia & Reading R. R. in Philadelphia, appear to be open to objection in this respect, but the Grand Central station, in New York, being purely a terminal station, there is no need for considering any provision for through traffic. As to running past the station and then backing in, so as to avoid reversal, such a plan is very likely to be found inconvenient in many ways, especially as the traffic increases. In fact, we know of one good sized city in England where this arrangement became so troublesome that the entire terminal plan was changed recently, involving great expense, in order to facilitate the train movements. In view of the amount of through traffic at such a place as Omaha, it seems to be eminently desirable to provide through tracks, and not tie up the whole system by a head-house plan, and there should be little difficulty in doing this.

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We occasionally receive letters in which the writers complain that we devote too little space to this or that or the other special department of engineering, in which they are especially interested; and say that they care nothing about any engineering literature aside from that which bears upon the work in which they are engaged. In conversation, too, with young engineers, and sometimes with older ones, we hear them too frequently say—sometimes even with a sort of pride—that they read nothing in engineering literature except what bears directly on their chosen specialty.

This mistake, as we believe it to be, is so serious in its results to the one who makes it, that we have thought it worth while to call attention to it here for the special benefit of any of our readers who may be cherishing some such erroneous ideas respecting the way to succeed in professional life. It is true, that specialization is a necessity at the present day; a man must take up some one subject in the field of engineering and completely master it if he would succeed; but if he allows this subject to absorb his attention to the neglect of all other departments of his profession, he cannot aspire to the highest positions, and it is often the case that a man with the broader talents, gained by a wider study of his profession, will outstrip him in preferment even in his chosen specialty.

The fact is that everybody instinctively distrusts the judgment of the man with one idea, or the man with a hobby; and judgment, it is to be remembered, is the greatest quality a professional man can possess. The young engineer, who, when he picks up an engineering journal or buys a book, reads only that which bears directly upon the particular line of work in which he is engaged, is deliberately narrowing his judgment and unfitting himself for the largest sphere of usefulness.

From another point of view, too, this policy of turning all one's energy in a single channel is a mistaken one. No man knows, and least of all the engineer, what he may be doing a year—five years—ten years hence. Changes come rapidly in the profession. A score of years ago many engineers were devoting themselves to railway construction as if their lives were to be spent in that work; but when the practical cessation of railway construction came, a half-dozen years ago, every one of them grasped eagerly at any knowledge or abilities he possessed that could be put to use in other fields of engineering. Alexander Lyman Holley wrote when a young man: "If there is anything certain in this world, it is, that I will never do anything permanently for a living but just this one thing, namely, build locomotives." And not only was he never engaged in a locomotive works more than a few short months after that time, but he won his fame in the field of metallurgical engineering.

The engineer of the present day is fortunate in having available a great storehouse of information in the technical journals and proceedings of technical societies, of which the engineer of early days knew nothing, and which were comparatively unimportant no more than a score of years ago. The engineer nowadays who gets in a rut or remains in ignorance of what advancement is being made in other departments of his profession, does so from choice and not from necessity; and cannot with justice complain if other men, more wide-awake, enthusiastic and up-to-date, outstrip him in the race.

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The terrible railway wreck at Logan, Ia., with 31 deaths resulting, which is recorded this week, is the most serious disaster due to the system of operating trains by dispatchers that has been recorded in a long time. According to the best information available, the accident was due to the engineer of the excursion train which was wrecked leaving a station either without orders or in disobedience to orders to await the passage of a fast freight. It is of no use to lay the blame upon the engineer. No one supposes that his disobedience was wilful; no one can say what freak of forgetfulness caused him to make his fatal error. The emphatic lesson of all accidents of this class is that, in order to make men obey orders when the consequence of a failure to obey may be so disastrous, something more than written instructions are needed. Experience teaches that men are far less likely to disobey the instruction of a monitor which is constantly visible before their eyes like a semaphore or a train staff than they are the written message on a train order blank.

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The Logan accident and the other serious accident at Altenheim, Ill., make a total of 36 deaths for the week due to excursion trains. In both these accidents it is altogether probable that the fact that the train was an extra was directly responsible for the disaster. The switching engine crew which left the switch open that caused the wreck at Altenheim would probably not have made such a blunder had the train been a regular one which they were accustomed to expect. The engineer of the train wrecked at Logan would have been far less likely to have blundered had he been accustomed to meeting the fast freight every day. Excursion trains are doubtless a necessity; but managers and superintendents should realize the extra hazard that attends their running and put in operation every possible safeguard to protect them.

THE NEEDS AND POSSIBILITIES OF HARBOR IMPROVEMENT AT CHICAGO.

The decadence of the Chicago harbor, or more accurately the growing inadequacy of the Chicago River, to supply harbor facilities to the vessels entering and leaving that port, has from time to time received quite general discussion from the shipping interests of the Great Lakes, and especially from the vessel owners and merchants of Chicago itself. For some years the fact has been gradually forcing itself upon Chicago lake shippers that the city has outgrown its present harbor facilities, and the knowledge has occasioned brief comment in the daily papers and a few discussions of more thoughtful character. Little attempt at general concerted action to improve things has resulted, however, and this inactivity has proved a serious set-back to the Chicago River interests since it has enabled an adjacent harbor to gain considerable prestige, and the apparent favor of the Federal Government as the best, and in fact the only practicable, deep water harbor for Chicago. Whether the injury is to be a permanent one or not, depends very much upon whether a broad and far-sighted solution is sought of the problems involved and upon the energetic action of those having the greatest interest at stake in Chicago's lake commerce. Great engineering and commercial questions are involved, and some space may well be devoted here to a preliminary consideration of the more important of these.

Most engineers outside of Chicago, and probably not a few within that city, are largely ignorant of the straits to which the old Chicago River has come. A prominent daily paper of Chicago recently said in connection with a long discussion of this subject:

> Chicago's supremacy as a shipping center is seriously threatened. In fact the shipping interests do not hesitate to declare that the scepter has passed from the Chicago River; and that were it not for the adjacent Calumet River, the city marine trade would be doomed. The Chicago River, as it exists to-day, is a relic of a glorious and prosperous past. It can accommodate only the second and third class fleets, and is unknown to the modern magnificent lake steamships.

Despite its somewhat turgid rhetoric, this statement is deserving of credence; for if one turns to the reports of the U. S. Government engineer in charge of Chicago harbor for the past few years, substantially the same assertions are found. Indeed, in his latest report, that officer strongly advocates the development by the government of the Calumet River harbor, largely upon the argument that the Chicago River is incapable of accommodating modern lake vessels and affords only limited opportunities for improvement. The advisability of such a policy will be considered further on; but for the present the single fact to be noted is that the expert opinion of the government engineer tallies with that of the newspapers, namely, that the Chicago River is inadequate to the demands for harbor facilities.

The reason of this inadequacy, as hinted above, is the growth in the size of vessels conducting lake commerce. The Chicago River is a narrow, crooked and unutterably foul stream, having a maximum navigable depth of about 14 ft. For the lumber schooner and fourth-class barge such accommodations are reasonably sufficient; but the day of these vessels is past on the Great Lakes. The modern lake steamer has a draft of from 16 ft. to 20 ft., and a net tonnage of from 2,000 to 3,500 tons. Indeed, in many vessels this tonnage is exceeded, and the tendency is every year toward larger rather than smaller vessels. The result is obvious. Either the harbor facilities of Chicago must be improved, or adjacent ports will gradually attract the shipping which naturally belongs to that city. Already, as a matter of fact, the Calumet harbor at South Chicago is drawing the business of the large vessels.

The questions which arise on this showing are these: (1) Is the importance of the Chicago River's lake traffic great enough to warrant any great and costly effort to accommodate and maintain it? (2) If it is sufficiently great, what is the best method of accomplishing the result desired? Evidently the second question is the more difficult, for it involves considerations of engineering, cost and expediency as well as considerations of commercial policy.

Let us consider briefly the question as to the importance of Chicago's lake commerce. According to the report of the Chicago Board of Trade for 1895, the following is the number and tonnage of vessels arriving and clearing at Chicago harbor for each of the past six years:

	Arrivals.		Clearances.	
Calndr. year.	No. vessels.	Tonnage.	No. vessels.	Tonnage.
1890	10,507	5,138,253	10,547	5,150,665
1891	10,224	5,524,852	10,294	5,506,700
1892	10,556	2,966,626	10,567	5,968,337
1893	8,754	5,456,037	8,789	5,449,470
1894	8,259	5,181,260	8,329	5,211,160
1895	9,212	6,329,702	9,363	6,392,497

These figures cover all vessels arriving and clearing at the "Chicago District," comprising the three ports of Chicago, South Chicago and Michigan City. The traffic of each of these three ports in 1895 was:

	Arrivals.		Clearances.	
Port.	No.vessels.	Tonnage.	No.vessels.	Tonnage.
Chicago	7,637	4,602,508	7,687	4,585,834
South Chicago..	1,404	1,682,003	1,504	1,760,838
Michigan City..	171	45,191	172	45,825

That is 72.2% of the total tonnage entered and cleared from Chicago harbor proper.

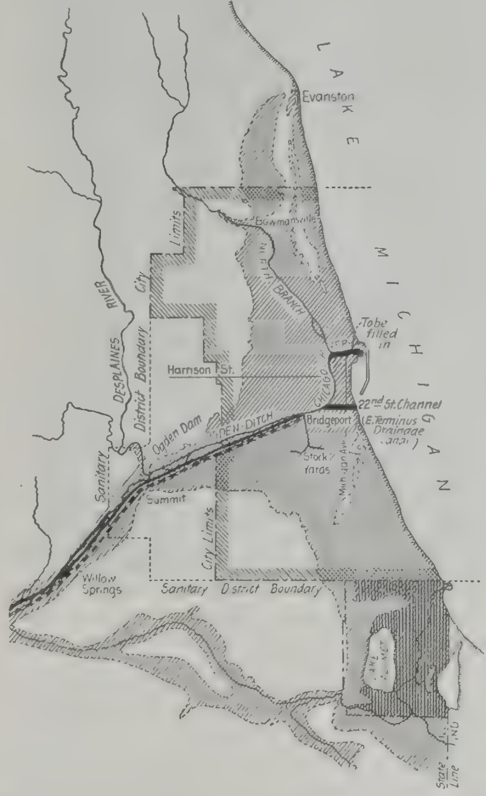
Taking the figures for 1894, the poorest year, and comparing them with similar figures of the traffic of New York harbor for the same year, we have the following results:

	Tonnage of vessels.	
	Entered.	Cleared.
Chicago	5,181,260	5,211,160
New York city	7,819,236	7,514,162

It would seem that a traffic by water only second in volume to that of the chief seaport of the country is well worth great effort and expense to preserve, especially since this traffic is one in which large sections of the country are deeply interested, and it is growing in amount each year despite the notoriously insufficient harbor accommodations.

The first question being thus disposed of, attention may be turned to the methods of accomplishing the necessary improvement. A study of the accompanying map will show that three methods are possible. (1) The construction of an outside or lake front harbor; (2) the construction of a harbor along the Calumet River at South Chicago; and (3) the improvement and development of the Chicago River in connection with the Drainage Canal. The lake front harbor has been placed first, not because of its importance, but because it is the least available solution and the soonest dismissed.

The practicability of a lake front harbor is doubtful for several reasons: (1) The length of lake front available is too small. It has been estimated by a competent authority that the space available for piers inside the present breakwater will give about 7½ miles of dock line or less than 20 per cent of the dock line at present used. If the breakwater were extended from Lincoln Park to Jackson Park, there would be about seven miles of shore line available if unobstructed. But the approach to at least 75 per cent. of this shore line is obstructed by the right of way of the Illinois Central R. R., and its possible riparian rights, and by the Lake Front Park, now under construction. (2) A lake front harbor would necessitate the transfer thereto of the entire business of the port with railway terminals and all the incidents of commerce, or else the cost of doing business would be multiplied by drayage and lighterage from the coal and lumber yards, grain elevators, packing houses, etc., now located from one to three miles inland. Briefly, then, a lake front harbor, if available in every other way, would either revolutionize the whole business and industrial arrangement of the city by its wholesale transfers or else involve a tremendous system of drayage and lighterage with all the increased expenses attendant upon such a system. The engineering questions of a lake front harbor construction need not be considered, for the reason that the business and industrial considerations seem to us to determine effectually the impracticability of such a harbor, except as a matter of last resort.



Map of Chicago Showing Site of Proposed Harbor Improvements.

(The area shaded represents surface below a plane 20 ft. above Chicago datum--low water in Lake Michigan. The area cross-hatched about the mouth of the Calumet River shows the area more than 5 ft. below Chicago datum.)

Before considering in detail the comparative advantages and disadvantages of the two other harbor possibilities, a few general considerations are advisable. On general principles it is certainly advisable to develop the facilities for commerce where the bulk of commerce already exists rather than to take the opposite course, and thus necessitate the destruction of great vested interests already existing, unless there is a paramount reason for the change. As shown by the tabular statement above, the business of South Chicago or Calumet harbor for 1895, estimated in tonnage of vessels entered and cleared, is about one-fourth that of Chicago harbor proper. On the single basis of best accommodating the greatest bulk of existing commerce, then, the improvement of the Chicago River would seem to be demanded rather than the improvement of the Calumet. Are there sufficient superior advantages at Calumet to counterbalance the disadvantages of changing commerce?

To enable a clear understanding of the possibilities of the Calumet River as a harbor, the accompanying map has been so drawn as to show by shading the area south of the mouth of that stream of which the major portion is below the level of 5 ft. above Chicago datum (low water in Lake Michigan). Altogether there are about 30 square miles of this area, of which there are normally under water about 14 miles (0.5 square miles) of river from 7 ft. to 10 ft. deep, with low, sedge-lined banks, and about six square miles comprised in Lakes Calumet, Hyde and Wolf, with a maximum depth of about 3 ft. below Chicago datum and with flat, marshy shores. At times of high water in Lake Michigan about 20 miles of this area are below lake level. Now it is this land that must be the site of a city, for transferring the harbor and commerce to the Calumet means the transfer of the industrial population supplying that commerce, and it behooves us to consider its adaptability to this end.

It is evident that the topography of the land necessitates the raising of a large portion of its area adjacent to the water courses in order to fit it for building, and also that the dredging of a large area to provide the necessary deep water for vessels is necessary. The cost and difficulty of building on such "made ground" overlying a bed of muck and sand are well known. As the level is such that the water courses will be motionless unless flow is induced artificially, it is evident also that the difficulties of drainage, sewerage and general sanitation are very great. In short, commerce and population will bring here their thousand and one problems and difficulties, as great and probably greater than have attended the growth of Chicago itself.

If we put aside these broad commercial considerations and confine ourselves purely to the question of providing a certain area of channel of a certain depth, width and freedom from curves, it can be done more easily at Calumet than anywhere else, perhaps, in the Chicago District. The topography is reasonably favorable to great freedom in such work, and so also are the small number of vested interests to be disturbed. Many things which incommode such constructions in a populous district do not exist here, and in these respects the Calumet has superior advantages over the Chicago River. It is upon these favorable circumstances alone that the claim or superiority for the Calumet River harbor site is based. Doubtless there are advantages to be utilized, but in another way, of which mention will be made further on.

Leaving the Calumet for the present, let us turn to the harbor possibilities on the Chicago River. In the first place we find 75 per cent of the lake business of the "Chicago District" already established along its banks. Quoting from a report of the government engineer in charge: "Along this stream are great lumber and coal yards, grain elevators, meat packing establishments and generally all the means and appliances and paraphernalia of the great commerce by lake centering at Chicago, as well as the facilities for transfer from rail to water transportation." The commerce and all its adjuncts, be it noted, is here; and it only remains to improve the river adequate to its needs. It is not necessary to build a harbor and commerce both, as at Calumet, for commerce surely implies buildings and railway terminals and population, in short a city, and these do not exist in the Calumet marshes. To improve the waterway adequate to the needs of commerce, is then the problem on the Chicago River.

Approximately the present length of the Chicago River and adjacent slips is 21 miles, and the number of lineal miles actually supplied with docks is about 40. These docks, on account of the peculiar Y-shape of the river course, are well distributed for the needs of commerce, being right in the heart of the business portion of the city. The river, however, is crooked and narrow, is crossed by numerous bridges, and its depth over the street tunnels under it is only from 15 ft. to 19 ft. To fit it for the demands of commerce it must be widened, straightened and especially increased in depth. With buildings and docks and railway terminals close to and along the whole length of its banks and with tunnels underneath its bed, such improvement is a large and difficult problem, but difficult more on account of the financial problems than on account of the purely engineering problems. In its most serious phases it is purely a business proposition, and if the proper interests conjoin, it can easily be solved as a business proposition.

Before urging this point further it is desirable to turn to another feature of the Chicago harbor question. Already the city has partly completed in the great Drainage Canal, what is practically an extension of the Chicago River, a distance of 28 miles westward. This channel has a depth of water of 25 ft. and a minimum width of 160 ft. (about one-half its length, and that on the portion adjacent to Chicago is 202 ft. wide). The law authorizing the channel demands that the volume of flow shall be at least 300,000 cu. ft. per minute, and an additional 20,000 cu. ft. per minute for every 100,000 increase in population over 1,500,000. The channel as built will pass 600,000 cu. ft. of water per minute. To provide the minimum flow, the Chicago River may be enlarged at an estimated cost of about $750,000, and to provide the maximum flow it must be doubled in size or else an independent supply channel must be constructed. This supply of water is a practical necessity which confronts the city of Chicago unless the Drainage Canal, costing some $30,000,000, is to be useless. This necessity also at once suggests that the construction of an adequate harbor for Chicago should go hand in hand with it. The same enlargement of the Chicago River or construction of a supply channel that completes the Drainage Canal constructs a harbor for Chicago, or at least can be made to do so without the slightest injury to the canal as a sanitary work, and at no inordinate increase of expenditure.

It may be argued, of course, that the supply of water for the Drainage Canal can be furnished through the Calumet River by extending that stream west to connect with the canal about midway of its length. So, indeed, it can, but with no advantage to Chicago or to the canal, but only an advantage to the Calumet River and the few large property-owners who control the land along its banks. The population tributary to the Chicago River, which has paid the great bulk of the cost of the canal, can hardly be expected to forego the possible commercial benefits of their expenditure for the sole benefit of the population which has paid but a very small part of this cost, and this is to what the development of the Calumet River as a feeder amounts. Above all this, however, is the policy of the Sanitary District of Chicago, which controls the location of the water supply to the Drainage Canal, and this policy as far as it is defined is to take the supply from Lake Michigan through the city of Chicago.

Assuming that the harbor improvement and drainage work is to be done conjointly, the engineers of the Drainage Canal maintain, we believe, that only two alternatives are presented, either (1) all the water for the Drainage Canal must be taken through the Chicago River, or (2) all must be taken through an independent supply channel. The reason for this is because if both routes are used (the river and the new channel each supplying part of the water) the floods coming down the North Branch of the river instead of passing down the South Branch to the canal will in part at least go east into the lake through the main river. Now, to make the river capable of supplying all the water required by the Drainage Canal its cross section will have to be about doubled, which, with all the property interests along its banks means a tremendous expense. On the other hand, if a supply channel be excavated from the lake to the South Branch, the main river mouth must be closed. The preferable plan can be determined only by the determination and detailed comparison of the financial and engineering conditions governing the two routes, and these data are not yet available in detail, although they have been determined for the most part by the engineers of the Drainage Canal.

In a general way the engineers of the Drainage Canal announce that a channel 250 ft. wide and 22 ft. deep from the lake along 22d St. to the South Branch, and thence to the Drainage Canal, will cost about $10,000,000 with all bridges and approaches complete. By filling the river from its mouth to the fork, a strip of land 200 ft. wide and one mile long is regained right in the heart of the city. The value of this, about 26½ acres of land, has been estimated to be from $15,000,000 to $18,000,000, based on real estate values in the business section, which, it is claimed, will probably more than counterbalance the destruction of dock property necessitated by the filling. Of course the main bulk of the dock property, which is along the two branches of the river is not affected at all.

By the arrangement outlined, the city would secure a 22-ft. channel from the lake to Lockport, Ill., nearly 30 miles, both banks of which are available for docks and slips, and also the present river channel undisturbed north of 22d St. except for the closing of the present main outlet about one mile. This river, when dredged, will give a navigable depth of 15 ft. without disturbing tunnels or other structures crossing it. This supplies a harbor equal at least to anything possible at South Chicago, and right in the heart of the commercial development which demands it.

The only doubtful feature in the above plan appears to us to be the proposition to fill in the present main channel of the river. The advantage of eliminating all the bridges and tunnels which now separate the North Side from the main business district of the city, is, of course, an attractive one; but, on the other hand, the opposition to so radical a change is sure to be extremely powerful. As the river is a navigable waterway, Congressional sanction will doubtless be necessary for its abandonment as proposed; and the interests which will oppose the change, including the owners of property, docks, etc., along this two miles of water-front, can be relied on to oppose the proposition at every step of its progress.

It appears to us that the reason given above by the Drainage Canal engineers for filling the present main channel of the river are hardly weighty enough to warrant so enormous an undertaking. If there is danger that with two independent outlets to the Chicago River, one of them would discharge into the lake in times of flood, the proper course to pursue, it would seem, would be to build a lock in the new 22d St. channel, and let the gates be closed whenever floods would cause a flow in this channel toward the lake. As there are very few days in the year when this would occur, the lock gates would be open practically all the time, and would be no obstruction to navigation of any importance. Again, with two channels existing instead of one, obstructions due to a wreck in the channel, a drawbridge out of order or other temporary block to one of the channels would be of comparatively little importance. The current in the channels, also, would be of less velocity if both channels were open than if one had to carry the entire flow. It may be claimed that the engineers have designed the new 22d St. channel of such capacity as to carry the maximum flow of the canal without a velocity of current so great as to interfere with navigation; but if this is the case, would it not be better to save part of the cost of the 22d St. channel by reducing its dimensions?

The value of the land which would be acquired by filling the present Chicago River may be used as an argument for the work; but we should like to see more of the details on which this estimate is based. Would not the depreciation and property damage consequent upon the abandonment and filling up of this waterway amount to more than the value of the area thus acquired? Would not the carrying out of any such work, moreover, be made still more expensive by the delays which interested property-owners would doubtless bring about by prolonged litigation?

But the question whether the present main river should be abandoned or not is only a detail. The chief question under consideration is whether the Chicago or the Calumet shall be the seat of Chicago's shipping trade; and the outline above given seems to point clearly to the former as the common sense solution of the problem. The cost of the work will be great, of course, but that it will be so very much greater than the cost of an equally adequate harbor along the Calumet River is not so very evident. Even if it is greater, expense alone is not germane. The question is rather where the expenditure will make the largest returns in serving commerce. Even if we admit that superior facilities for harbor development exist at Calumet, the people will not ship commodities there unless it becomes the marketing point. If it does become the marketing point, the railways will go there and the population as well, and the burden of commerce will be shifted to a new point and divided. The problem is to be solved on the ground where it exists, just as the track elevation and drainage problems of Chicago have been solved. Amputation is sometimes necessary, but we do it only to save life and only after other resorts have failed. Rather, we try to cure and heal the injured member, knowing that in a partly crippled state even it is better than no member at all. And we never attempt to amputate the body to stick it onto someone else's sound limbs, and this is practically what trying to transfer Chicago's lake business from the at present crippled Chicago River to the youthful Calumet amounts to.

The Calumet River is doubtless one of the several natural advantages which Chicago possesses for developing a certain class of commerce, namely, commerce by water, and it should be improved for this reason. But the Chicago River is a similar and older and at present more important advantage for the same purpose. By accretion—the manner in which all commerce grows—it has developed a water traffic of great and growing dimensions, and now that improvement is necessary to increase and maintain this commerce, it should not be withheld. The opportunity for this improvement and the manner in which it may be brought about have already been suggested, but the facts necessary for a detailed discussion are not yet available, nor indeed are they necessary for the present purpose, which is to point out the broad salient factors entering into the problem of improving Chicago harbor.

To summarize briefly:

(1) The impediments to navigation at Chicago must be removed, i. e., the harbor facilities must be improved and extended, if commerce is not to be burdened in competition with other lake ports.

(2) A lake front harbor cannot be seriously contemplated as practicable with its present encumbrances, and the necessity of transferring business and facilities for business or establishing a vast system of drayage and lighterage.

(3) Facilities for commerce should be provided where commerce exists, for if commerce can be shifted at all, it cannot be shifted without also transferring population and facilities for business, i. e., destroying vested interests. Adjacent possible harbors as at Calumet are useful for developing subsidiary business centers and should be improved as such interests demand, but not to the neglect of the harbor already handling the bulk of the commerce nor with the idea of replacing the main harbor, unless the latter is incapable of improvement.

(4) Chicago harbor is capable of improvement by prosecuting work conjointly with the Drainage Canal work, and with comparatively little disturbance of vested interests.

LETTERS TO THE EDITOR.

Diagram of Frog and Switch Values.

Sir: Refering to your issue of July 2, p. 15, "Diagram of Frog and Switch Values," it might have been well to have added that the formula and diagram refer to track of 4 ft. 8½ ins. gage, and to a switch throw of 5 ins. By some this would be understood, but possibly not by all.

Yours very truly,
H. S. Jones.

Marion, Ohio, July 6, 1896.

Civil Service Examination for Construction Inspector.

Sir: On August 5, 1896, the New York City Civil Service Board will hold an examination for the position of Inspector of Construction, at 10 o'clock a. m. Candidates must have a knowledge of massive masonry in difficult foundations, pile work, sewer work, street work and pipe laying. Any citizen of the United States over 18 years of age is eligible. Applications may be obtained from the undersigned. The examination will be in writing, arithmetic, experience and technical knowledge.

Yours respectfully,
S. William Briscoe, Secy.

New Criminal Court Bldg., New York city, July 14, 1896.

English Sewer Flushing Practice.

Sir: Adverting to your issue of May 21, may we supplement for the interest of your readers, your article on English sewer flushing practice in that number, by giving you the point proved by the Douglas inquiry, viz., that of the syphons used by the 79 corporate bodies asked, 64% are of our own manufacture, as against 36% of all other makers combined. To us, as makers of the original deep trap syphon, such a proof of the superiority of our apparatus is very encouraging.

We are, yours faithfully,
Adams & Co.

York, England, June 23, 1896.

Car Storage Tracks in Railway Yards.

Sir: In referring to that part of Mr. Appleton's letter in your issue of July 9, commenting on the article, in the June 18 issue, on yards and terminals, which states that it is preferable for storage tracks for empty cars to have both ends open: In my own experience I have found that empty-car storage tracks are more likely to give trouble if open at both ends than if closed at one end. In the former case the cars are constantly being crowded toward the lead at the far end, where they often foul in trying to pass a common point. As to empty-car storage tracks being made the length of an ordinary switch engine draft—this would be all right if the cars were always handled in lots of that length.

Respectfully,
W. L. Derr.

Port Jervis, N. Y., July 13, 1896.

Stability of Steep Earthwork Slopes in the Tropics.

Sir: Noting what Mr. Silvanus Miller, M. Am. Soc. C. E., says in your issue of June 25, with regard to steep slopes standing better in some cases in the tropics than flatter slopes, and your comment on the same, I would add that it is not necessary to go nearer the tropics than South Carolina to find instances in which this is the case. On the South Carolina & Georgia R. R., near Aiken, S. C., there are cuts through a red clay in which it has been found that the banks having a slope of less than ½ to 1 stand much better than those nearer the more common slope of 1½ to 1.

The reason in this case seems to be that the surface becomes baked so hard by the sun that on the steep slopes the rain seldom breaks through this crust, while it is much more likely to do so on the flatter slopes.

Respectfully,
C. S. Phelps, Civil Engineer.

Charleston, S. C., June 29, 1896.

Very Low Prices for Reservoir Construction.

Sir: At a bidding this week in a town on the Ohio River, the present tendency toward low prices was well illustrated. Walls 17 ins. thick, of stone laid in cement with the face well plastered to insure a perfect joint, were offered for $2.00, and some stone are expected to be in the excavation. This work is to be done on a very steep hill with no roads leading to it and no water nearer than 1,000 ft. Sand is about the same distance away. The hill has an elevation of 200 ft. above the town. For concrete in the bottom 6 ins. thick with a top coat of Portland cement, $2.40 per cu. yd. was bid.

The settling reservoir, 15 ft. deep, will have 17-in. stone walls and a 17-in. partition wall through the center. It is partly in excavation and partly fill and was let at 12 cts. per cu. yd. and $2.50 per cu. yd. of masonry, the latter including plastering the face of the wall. The concrete bottom in this is to be 6 ins. deep with a Portland cement facing and was let at $2.75 per cu. yd.

Other prices were as follows: Pipe laying, including cost of lead, 10 cts. per ft. for pipe 6 to 8 ins. laid 3 ft. 6 ins. deep. Pipe, $18.65 cts. per ton for 22,500 lin. ft., of which 12,000 is 4-in. Specials, 2⅛ cts. per lb. Hydrants, double-nozzle, 4-in. inlets, $15. Intake well for air-lift pump, 25 ft. deep, 7 ft. diameter, 13-in. brick walls, $300. Yours truly,

A Bidder Who Was Too High.

July 9, 1896.

An Incident of the St. Louis Tornado.

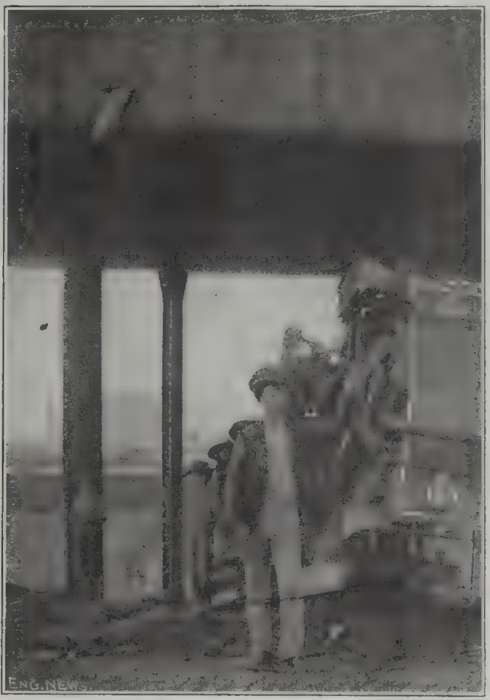
Sir: The enclosed photograph, which shows somewhat faintly a piece of wood driven through the web of a plate girder, is of interest as indicating the high velocity of the wind which prevailed during the St. Louis tornado.

The timber specimen itself, though quite inaccessible, was gathered in early by some enterprising relic hunter, before the writer had an opportunity to examine it closely. As seen from the track above, on the day after the storm, it appeared to be the end of a 2 × 6 in. pine plank that had been driven about 4 ins. through the girder web and then been broken off and somewhat shattered.

The girder shown is on the south side of the through girder span at the east end of the approach to the Eads bridge, in East St. Louis. It had been in use 20 years and is in good condition. The web plate is of 5-16-in. iron and 6 ft. deep.

The hole in the web of the girder is below the level of the track and 15 ins. above the bottom of the girder.

An irregular shaped piece of metal, 9 ins. long and 1¼ to 2 ins. wide has been punched entirely out of the 5-16-in. web plate. The upper and right hand edges of the hole are nearly straight and in the plane of the web sheet. At the bottom and at the left hand corner, the plate is bent inward, irregularly, the maximum distortion being 1¼ ins.



Pine Plank Driven Through a Plate Girder on the East Approach to the Eads Bridge in the St. Louis Tornado.

Yours truly,
Julius Baier.

Turner Building, St. Louis, Mo., June 27, 1896.

Comments on Track Standards.

Sir: It would have added much to the value of table "A" of "Standard Track of American Railways," published in your issue of June 25, if the weights per yard or the sectional area of the angle bars were given. We venture to say that a means of comparison between the sectional area of the joints and the weights of the rails, as used by the different roads mentioned in the table, would form a very interesting subject for study by railway engineers.

It would also have added interest, if, in connection with the bolts used, it was stated whether the figures given were the diameters of the bodies of the bolts, or the diameters of the tops of the threads, or, if the threads were spun on the bodies and raised above them or merely cut in the ordinary way.

It would be interesting to learn why one road—the Chesapeake & Ohio—used 9-16-in. spikes with a 100-lb. rail, and another—the Chicago, Rock Island & Pacific—used ⅝-in. spikes with a 60-lb. rail.

Very truly yours,
R. Hinchliffe & Co.

100 Washington St., Chicago, Ill., June 27, 1896.

(We believe that the weight of angle bars is generally proportioned to the weight of the rail. The bolt diameters we suppose to be in every case the diameter of the body, and spun or raised threads are used little if any on track-bolts. Our correspondent apparently thinks that the weight of spikes should be proportioned to the weight of the rail. We are not clear that this is the case. In a heavy rail with a great deal of lateral stiffness, the spike on adjacent ties help each other. The heavy rail, by reason of its broader base, is less likely to tip, and, as it indents the tie less, it has less up and down motion which tends to loosen the spikes.—Ed.)

Low Charges for Engineering Work.

Sir: Apropos of the efforts of your valuable journal to raise the profession to the high plane to which it is justly entitled and to educate the public up to a just appreciation of engineering services, we submit a clipping from the * * * which is illustrative of the reason why engineering is looked down upon, and why men of brains and experience are compelled to leave the profession or accept carpenters' wages.

(The clipping enclosed is as follows: Ed.)

The water-works committee reported a proposition from * * *, hydraulic engineer, to draw plans and specifications for the new system, including details or working plans with estimates of cost, etc., the work to be done by the engineer for $600. The proposition was accepted by the council by a unanimous vote. Work will commence at once on the plans and specifications, location of pipe line, etc. The completed plans will have everything in shape to advertise for the necessary material, labor, etc., to carry out the entire scheme, and it is expected the work will be well advanced before winter comes.

The work referred to means the procuring of a supply of water from * * *, a distance of about nine miles, and means final surveys and location of route, also surveys for intake, complete detail plans for probably two pumping stations, intake, steam and pumping plant, etc., reservoir, stand pipe, distribution system, estimates, specifications, etc.

This work will cost in the neighborhood of $225,000. (The city of * * * has power to issue bonds to the extent of $250,000). There will be no difficulty in estimating from this what would be a fair percentage for proper engineering service.

The gentlemen referred to in the clipping is City Engineer of * * * and possibly on this account can afford to do the work cheaper than the private engineer; but the fact remains that such men do more real injury to the profession in one year than all the technical journals can counteract in two; and the average town committeeman (not without reason) has come to the conclusion that he can purchase professional skill as he would potatoes and about as cheaply. Can you not give your readers the benefit of your opinion on this subject.

Correspondent.

June 17, 1896.

(We publish the above letter as received, merely substituting blanks for the names of persons and places. As evidence of the fact that the tendency to cheapen engineering service does not come entirely from the beginners in the profession and those who call themselves engineers on a very slim foundation of training and experience, we may remark that the engineer criticised is an Associate Member of the American Society of Civil Engineers. In reply to our correspondent's request for our opinion, we would say that according to our best judgment, in engineering as in other things, people are very apt to get about what they pay for. The city that thinks it is going to get $5,000 worth of engineering work for $600 will be pretty sure to find itself disappointed. No engineer, no matter what his ability or experience, can afford to give an enterprise the study, investigation and examination it should properly receive if his compensation is fixed at a sum barely a tenth of what the work is fairly worth.—Ed.)

An Experience with a Cheap Engineer.

Sir: There are a number of small towns throughout the country which aspire to possess water-works. They appoint commissioners who think a civil engineer ranks about, not quite, with a good mechanic, and if he wants over "twenty shillin" a day it is too much. So they begin to write letters to different engineers and see who will come cheapest and get up their plans and specifications. I am sorry to say there are some "cheap engineers" to be had; and the result is generally disastrous to an honest contractor who wishes to bid on the work and make a fair profit.

He tries to bid according to the specifications, but finds if he does so he will be too high; and if he bids low, according to the way he thinks the work will eventually be done, and he is not the chosen one of the "cheap engineer's" fancy, he will get most beautifully left if he is unfortunate enough to get the work. For an illustration, I would like to give a few extracts from a specification for works recently advertised to be let in your paper. I have a copy of the said specification and shall preserve it as a curiosity. I would send it to you to be printed, but I fear some other "cheap engineer" might see it and learn some new tricks.

I was employed by a contractor to help him make up his bid. We, with about a dozen other contractors, began to ask questions of the "engineer," as the specifications left so much to the imagination, and as for the plans—well, as one of the bidders remarked, "I never seen nothing like it in over 35 years' experience." I will simply remark that the plans, what there was of them, showed how the work was NOT to be built.

I quote from the specifications:

Plain cast-iron pipe shall be, hub and spigot, 12 ft. in length, exclusive of bell (which shall not be less than 3½ ins. in depth), smooth, sound and perfect, and be coated inside and out with coal pitch and oil varnish, and not vary more than 4 per cent from the weights herein specified.

That reads like an "old chestnut," as all pipe is supposed to be made that way, and generally is, regardless of engineers' specifications; but on searching carefully this interesting document we find that there are no weights specified.

On asking the "engineer," he answered: "The usual weights." Then the bidders rally around the commissioners, and they, under pressure, issue a "supplement" (which I enclose), specifying that the weights shall be "as per Radford, Va., Pipe Co. Standard."

Next, specifications call for a "reservoir 125 ft. × 50, and 10 ft. deep, partly in excavation and partly in embankment (by the way, the commissioners said the reservoir was not to be built that way, as any fool would know if it was made that way the concrete lining would crack, so it was going to be made all excavation, no matter if the plans and the 'engineer' did say the contrary). The bottom shall be covered with concrete 8-ins. thick, and the sides with concrete 18-ins. thick, and shall be made water tight. The concrete shall be composed of Portland cement, sand and broken stone to be approved by the engineer and mixed and placed in the work as he directs."

The contractors asked the "engineer" in what proportions this concrete was to be mixed, and he replies, "the usual proportions." On being pressed for his version of "the usual proportions," he said "equal parts, one each of cement, sand and broken stone; you know you can't get concrete too rich."

Some of the contractors left without making a bid, knowing it was of no use, as events proved. The "particular" contractor bid $5.50 per yard for this "rich" concrete, probably knowing if he got the job he would not have to make it quite so rich. These are only a few of the "incidents" in these plans of what was not intended to be built, and specifications that did not specify. I only mention these two as a specimen and to show what engineers and contractors have to contend with.

Respectfully yours,
"Victim."

New York, July 1, 1896.

(We may add to our correspondent's very interesting letter that vexatious as the case is for the contractors who encounter such "cheap engineering," the case is vastly worse for the towns or cities for whom such work is done. The taxpayers there are the sufferers, and in the end will have to pay for every dollar saved in the engineer's fees, many dollars in increased cost of work or work badly designed and improperly carried out. Beware the counsel of a cheap adviser, is a proverb that is true of engineering advice as of any other.—Ed.)

Testing Work at the Massachusetts Institute of Technology.

Sir: I have been very much pleased from time to time to receive in the "Technology Quarterly" the results of tests made in the engineering laboratories of the Massachusetts Institute of Technology, which are referred to in your editorial of July 2.

Assuming them be made with care, I have found them to contain very valuable information for use in my office; in fact, additional knowledge for the profession which I have been unable to find elsewhere.

I must thank the Institute for turning its attention to these practical problems which we need to have solved, and giving us the results as early as practicable; though I agree with you that some of the results should be explained more fully.

Respectfully yours,
Hiram Mills.

66 Broadway, Lowell, Mass., July 8, 1896.

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Sir: Your editorial notes in your issue of July 2, on the pamphlets entitled "Results of Tests in the Engineering Laboratory of the Massachusetts Institute of Technology," seems to call for a few words by way of reply. The objections made are, as I understand the editorial:

1. That there is no index.

2. That the tensile tests of steel and iron have not been classified, but are arranged in the order in which the tests were made.

3. And mainly, "the lack of any summary of results, or of any explanation whatever, as to what the tests are intended to show, and do show."

4. By way of emphasizing the above, you say, "Then why not say, boldly and plainly, just what information of practical value is contained in this labyrinth of tables? In the absence of some guide of this sort, we greatly fear that the busy practising engineer will never attempt a search through this bewildering mass of figures merely on the chance of digging out some valuable piece of knowledge."

It should be observed that these pamphlets are reprints from the "Technology Quarterly," and are published in order to furnish to engineers, as early as possible, the results of tests made in the engineering laboratories, particularly those made on full size pieces, and under practical conditions; so that they may have at hand, at as early a date as possible, the additional knowledge furnished by the individual tests, without waiting until such a complete series should be made as to warrant drawing extensive conclusions of a general nature. It, therefore, seemed unnecessary to provide each pamphlet with an index of its own, as the headings, with the classification of subjects now used, would, of themselves constitute some sort of an index. On the other hand, there certainly will be a classified index when a larger number of pamphlets have been issued. That a good classification is desirable is, of course, true, and efforts will always be made to improve the classification. The persons to whom the pamphlets are primarily intended to be useful, are, precisely, the "busy engineers," and they have not, as a rule, the time to map out the amount of knowledge on a certain subject, and to proceed to deduce theories or formulas; but their special interest is with the particular problem that they have in hand.

Thus, if the "busy engineer" proposes to use a certain timber column with a bolster, the results of a few tests on full size columns with bolsters, such as he will find in the summary given on page 231 of Vol. III., will give him information as to the real strength on which he can rely, such as he cannot obtain elsewhere, as far as I know.

Moreover, I have, a number of times, known "busy engineers" to consult these, or similar tests of full size pieces to decide upon what to do in some important work. I have also had a number of letters from prominent engineers, expressing the opinion that these results will be valuable for reference in their offices.

In giving the results of tests, accompanied by suitable summaries, but without attempting to theorize, or draw conclusions of a general nature, we are following the example of other engineering laboratories, such as that at Munich, that at Berlin, that at Zurich, and that at the Watertown Arsenal. I will add that the tests that have been made on full size pieces, furnish a good deal of opportunity, in connection with tests made at other laboratories, to do a good deal of theorizing, and to overthrow certain ideas that have been handed down by tradition; but such study and discussion is an entirely different thing from a simple record of observed facts, which these pamphlets are intended to be. Moreover, it will be observed that Vol. III. contains more details (accompanied by summaries) than Vols. I. and II., and that it is intended to follow the method pursued in Vol. III. As to the high and low values of moduli of elasticity of certain specimens of steel, quoted in the editorial, I will say that these are not the only high and low ones in the tables, and that such values will be found also in the reports of other laboratories, as that at Munich, and that at Watertown Arsenal; hence, if these results are in error (of which there is no evidence) the error is one prevalent among other laboratories. Moreover, the work of which the results are published in these pamphlets that is performed by students, is done under such close supervision, and so carefully checked by trained instructors that the results have the same degree of reliability as though the tests had been performed by the latter.

One typographical error should be corrected in Vol. I., page 139, line 24 of the table, viz., the modulus of elasticity printed 21,813,000 should be 27,813,000.

As to the case of the pulsometer, possibly it would have been better to have figured both kinds of duty; so as to include both the cases in which the pulsometer is ordinarily used, instead of giving only one.

Very respectfully,
Gaetano Lanza.

Engineering Laboratories, Massachusetts Institute of Technology, Boston, July 8, 1896.

(Perhaps we should have said in our editorial note referred to that the defects against which our criticisms were directed, are by no means peculiar to the publications of the Massachusetts Institute of Technology. On the contrary, they are exceedingly common in engineering literature. This publication of detailed logs of tests without explanation or comment is partly a relic of the times—not so long past—when records of engineering tests of every sort were a rarity and engineers carefully preserved in their notebooks all they found. What we contend is by no means that published tests should necessarily be accompanied by the pet theories or ideas of the one who makes the tests. Our position is merely that if knowledge is to be imparted, it is the duty of the one who gives it to spare no pains in smoothing the path of the learner. Print a mass of figures in a table without explanation, and one engineer may, after difficult toil, find the valuable truth which the figures conceal. Add a word as to what is to be sought in the same table, and ten will benefit by it who could not spare time to hunt it out unaided.—Ed.)

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Regulations of Water Company.

A water company cannot shut off water from a water taker for non-payment of an old, overdue, and disputed installment of water rates, after having accepted payment for a subsequent installment. The water taker may prevent such shutting off by an injunction in equity, and the court cannot, in such proceeding be required to investigate the merits of the unpaid and overdue and disputed installment. The water company must resort to a court at law if it would enforce such claim.—Wood v. City of Auburn (Supr. Ct., Maine), 32 Atl. Rep. 906.

Notice of Defective Streets.

It is not necessary in order to charge a city with negligence or carelessness for defective street crossings, that notice of the defect should be brought to it by actual complaint. If the city carelessly and negligently permits defects to exist in its street crossings, no matter how caused, for so long a time that notice is presumable, then it becomes liable if a person is injured thereby, without fault or negligence on the part of such person.—Junction City v. Blades (Ct. of App., Kan.), 41 Pac. Rep. 677.

Prior Establishment of Street Grades.

The acceptance of a city charter by a town does not impliedly work an adoption by such city of street grades established by the town, so that the city cannot change such grades, without complying with a statute, forbidding a city to change a grade of a street which has been legally established unless damages are first assessed and tendered to the abutting owner.—City of Huntington v. Griffith (Supr. Ct. Ind.), 41 N. E Rep. 589.

Measure of Damages for Land Taken for Sewer.

The fact that the proximity of a sewer has a detrimental effect on land, part of which was taken for the construction of the sewer, so far as the injury is due to proximity secured by the taking of such part, and would not have resulted but for such taking, should not in determining the owner's damages be excluded as harm merely anticipated from the future use of the sewer.—Lincoln v. Commonwealth (S. J. Ct., Mass.), 41 N. E. Rep. 489.

Reasonableness of Water Company Regulations.

A corporation which has a franchise for supplying water to a city, and the use of the streets, becomes affected with a public use and assumes a public duty, and has a right to establish reasonable rules regarding payment of rates and to decline to furnish water to any one who refuses to comply with such rules; but to make such rule valid it must, in itself, be lawful and just, and must not be discriminatory in its nature.—American Water-Works Co. v. State (Supr. Ct., Neb.), 64 N. W. Rep. 711.

Assessment for Sewer.

Under Act May 16, 1891, providing for the appointment of viewers to assess the cost of a sewer on the property benefited, the cost of a main sewer can be assessed only on abutting property, and not on that of non-abutters having no present sewer connections, but whose property may be drained by future branches to be made. Where an abutting owner was assessed under such act, with the cost of a 15-in. main sewer, where a 10-in. local sewer would have been sufficient, the excess in the cost between a 10-in. and 15-in. sewer must be borne by the municipality.—Park Ave. Sewer (Supr. Ct. of Pa.), 32 Atl. Rep. 574.

Finalty of Engineer's Estimates.

An action was brought upon a written contract to recover a balance claimed to be due for work done in constructing a section of the defendant's roadbed. By the provisions of the contract, payments were to be made, during the progress of the work, on monthly estimates furnished by the engineer, 15% being retained until the completion. Upon the completion of the work, and its acceptance by the engineer, he was to make a final estimate of its quantity, character and value, and the amount ascertained by him to be due was to be paid to the plaintiffs. The estimates thus made by the engineer were to be final and conclusive as to both parties, subject to the right of the president to revise and alter them. Whether the last estimate furnished was final and fixed the rights of the parties was the principal question at issue. It was contended that it was because it was furnished after the completion of the work and was not revised or altered by the president. In form it was not a final estimate, nor such an estimate as was contemplated by the agreement. It was similar in form to the preceding monthly estimates, and was made, as they had been, at the end of the month, to show the amount of work done since the last estimate. But, like the preceding estimate, it showed the total allowances and payments. By agreement of the parties, expressed or implied from their acts, the court says this estimate might have become a final one, but neither party could arbitrarily make it such. It was competent for the defendant to show that a final estimate had been made by the engineer, fixing the quantity, character, and value of the work, and the amount due therefor, and testimony tending to prove this should have been admitted. The defendant should have been allowed to prove, also, that the engineer, at the instance of the plaintiffs, in order to enable them to meet their payments, had increased the amounts of the monthly estimates beyond what was justly due, with the understanding that, in the final estimate, a reduction of the proper amount should be made. The fact that the engineer was in the employ of the defendant, the court further holds did not commit it to the consequences of his misconduct while acting as an arbiter for both parties, and an award which was the result of collusion with the plaintiff was not binding upon it. It was the right of the president, under the agreement, to revise and alter the estimates made. This right he did not exercise, and his approval or disapproval of an estimate submitted did not affect its character as a final award of the engineer.—Gonder v. Berlin Branch Ry. Co. (Supr. Ct. of Pa.), 33 Atl. Rep. 61.

Engineer's Lien on Work Performed.

A civil engineer who makes field notes, maps, charts, and drawings, while employed by a corporation in and about the construction of an irrigating canal, on books and papers furnished by the corporation, the court of appeals of Kansas holds, is entitled to a lien on such field notes, maps, charts, and drawings, and has a right to retain possession of the same until he is paid for making the same.—Amazon Irrigating Co. v. Briesen (41 Pac. Rep. 1116.

Rights in Use of Tracks.

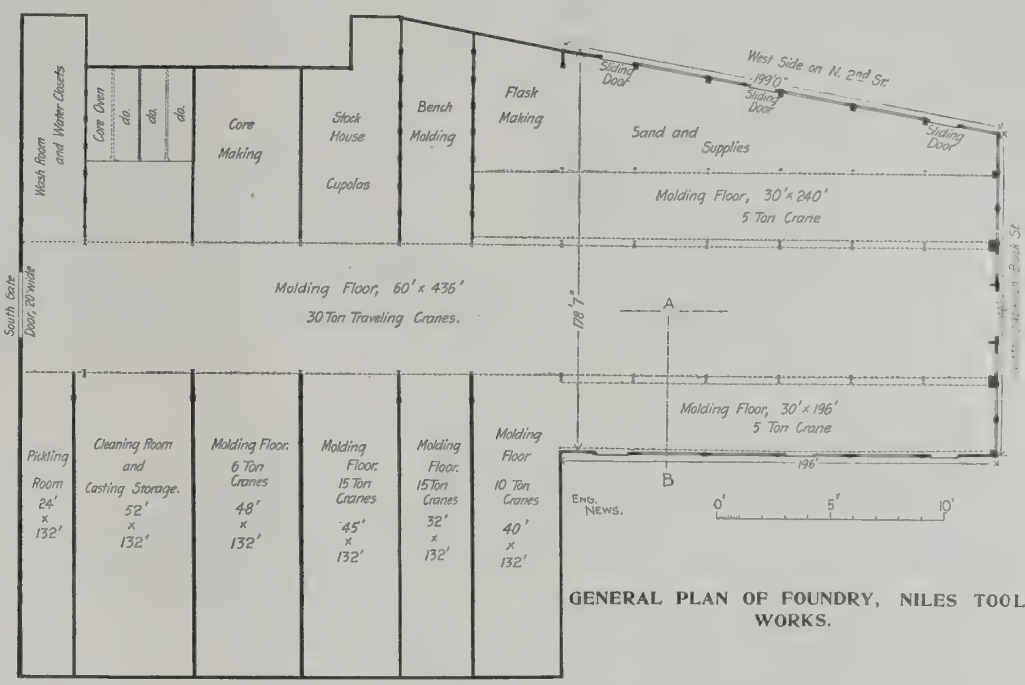
Railway companies with franchises to use the same street may be required to use one track, and in the exercise of this power a company may acquire the right to use the tracks laid by another, but compensation for such use must be made. If the tracks thus subjected to the common use of two companies are unfitted by age, long use or other cause, to serve the purposes of these companies, an action may be maintained by one against the other to compel the repair or reconstruction of the tracks at the joint expense of the companies.—New Orleans & C. R. Co. v. Canal & C. R. Co. (Supr. Ct. of La.) 17 So. Rep. 834.

NEW FOUNDRY OF THE NILES TOOL WORKS, HAMILTON, O.

The Niles Tool Works moved from Cincinnati to Hamilton, O., in 1871, erecting at that time what was considered one of the most complete shop plants of the day. It consisted of a machine shop, 65 × 400 ft., one section 40 ft. wide being used for erecting heavy work, and being served by overhead traveling cranes, operated by hand, and a foundry building, 50 × 200 ft., placed at right angles to the machine shop. The minor buildings need not be mentioned. As the business of the company grew, additions were made from time to time. To the north of the original machine shop and parallel to it was first built an erecting shop, with an overhead traveling crane, and a wing for tools, the whole covering an area of 75 × 400 ft. A little later another erecting shop, 50 × 400 ft., also served by overhead traveling cranes, and a two-story building, 50 × 400 ft., were erected. The second floor of the two-story building was used for milling machines, gear cutters and small lathes.

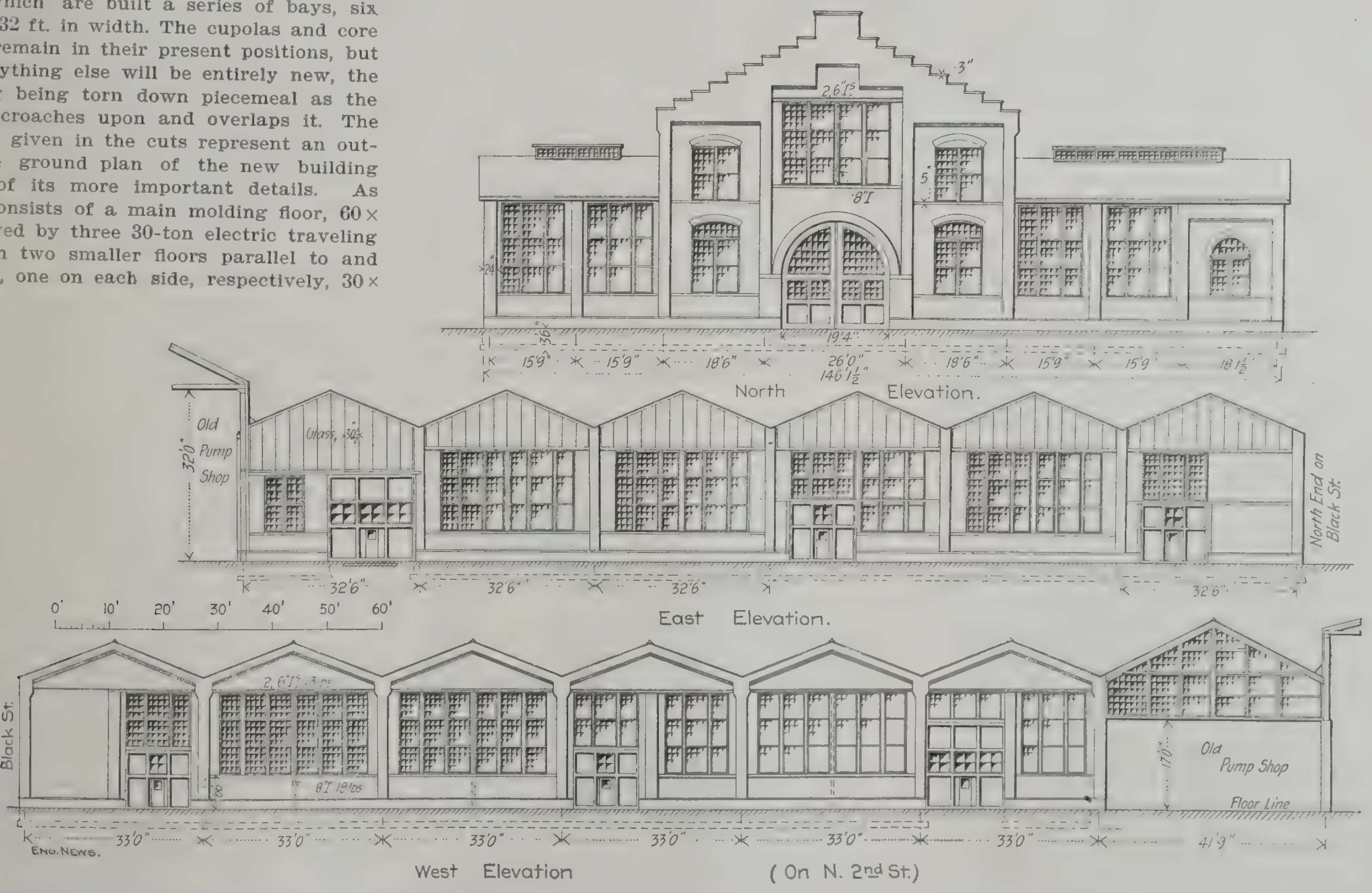
From time to time, while the above work was going on, additions were made to the foundry to meet the new demands being made upon that department. These additions were made in the form of bays, varying in width from 30 ft. to 48 ft., and in length from 300 ft. to 400 ft., and extending at right angles from the main building. Altogether six of these bays were constructed, each with an overhead traveling crane. Finally, it became necessary to enlarge still further and reconstruct the foundry, and the plan was adopted of building over the original foundry and extending north, with a central building 60 ft wide by 437 ft. long, the span to be served by two 30-ton overhead electric traveling cranes, with four motors each. This construction retained the bays which had been added from time to time, extending east and west from the original foundry building, and the same idea was carried out on the extension of the center building, on each side of the increased length of which are built a series of bays, six in number, 32 ft. in width. The cupolas and core ovens will remain in their present positions, but almost everything else will be entirely new, the old building being torn down piecemeal as the new one encroaches upon and overlaps it. The illustrations given in the cuts represent an outline of the ground plan of the new building and some of its more important details. As shown, it consists of a main molding floor, 60 × 436 ft., served by three 30-ton electric traveling cranes, with two smaller floors parallel to and adjoining it, one on each side, respectively, 30 × 240 and 30 × 196 ft., each served by 5-ton cranes, and in addition a series of bays extending at right angles to the main floor and on each side of it, some used for molding floors, others for cupolas, core ovens, core making, etc. Besides this there is a room of trapezoidal shape 199 ft. in length on its longest side for the storage of supplies. The whole area under roof is nearly two acres.

The building is constructed chiefly of iron and glass, as shown in the illustrations. It was designed by Mr. F. Felkel, Civil Engineer and Architect, of Pittsburg, Pa. The framework is unusually massive, the supports being designed for the double purpose of carrying the roof and of resisting the strains caused by the weight and the motions of the traveling cranes, and the roof trusses are built with reference to the possibility of some corrosion caused by the foundry gases as well as for mere strength. Much attention has been paid to the lighting of the foundry. A ridge lantern, 8 ft. high, extends the whole length of the main roof, and there are also roof skylights on each side. Altogether there are 32 skylights varying from 12 × 16 ft. to 16 × 16 ft. in size. Smaller skylights are placed in the roofs of the bays. All steel used has an ultimate strength between 65,000 lbs. and 75,000 lbs. per sq. in.


Wash Room and Water Closets
Core Oven
do.
do.
do.
Core Making
Stock House
Cupolas
Bench Molding
Flask Making
Sliding Door
West Side on N. 2nd St.
199'0"
Sliding Door
Sand and Supplies
Sliding Door
Molding Floor, 30' × 240'
5 Ton Crane
South Gate Door, 20' wide
Molding Floor, 60' × 436'
30 Ton Traveling Cranes.
178'7"
A
Black St.
Molding Floor, 30' × 196'
5 Ton Crane
196'
B
Pickling Room 24' × 132'
Cleaning Room and Casting Storage. 52' × 132'
Molding Floor. 6 Ton Cranes 48' × 132'
Molding Floor. 15 Ton Cranes 45' × 132'
Molding Floor. 15 Ton Cranes 32' × 132'
Molding Floor 10 Ton Cranes 40' × 132'
Eng. News.
0'
5'
10'

GENERAL PLAN OF FOUNDRY, NILES TOOL WORKS.

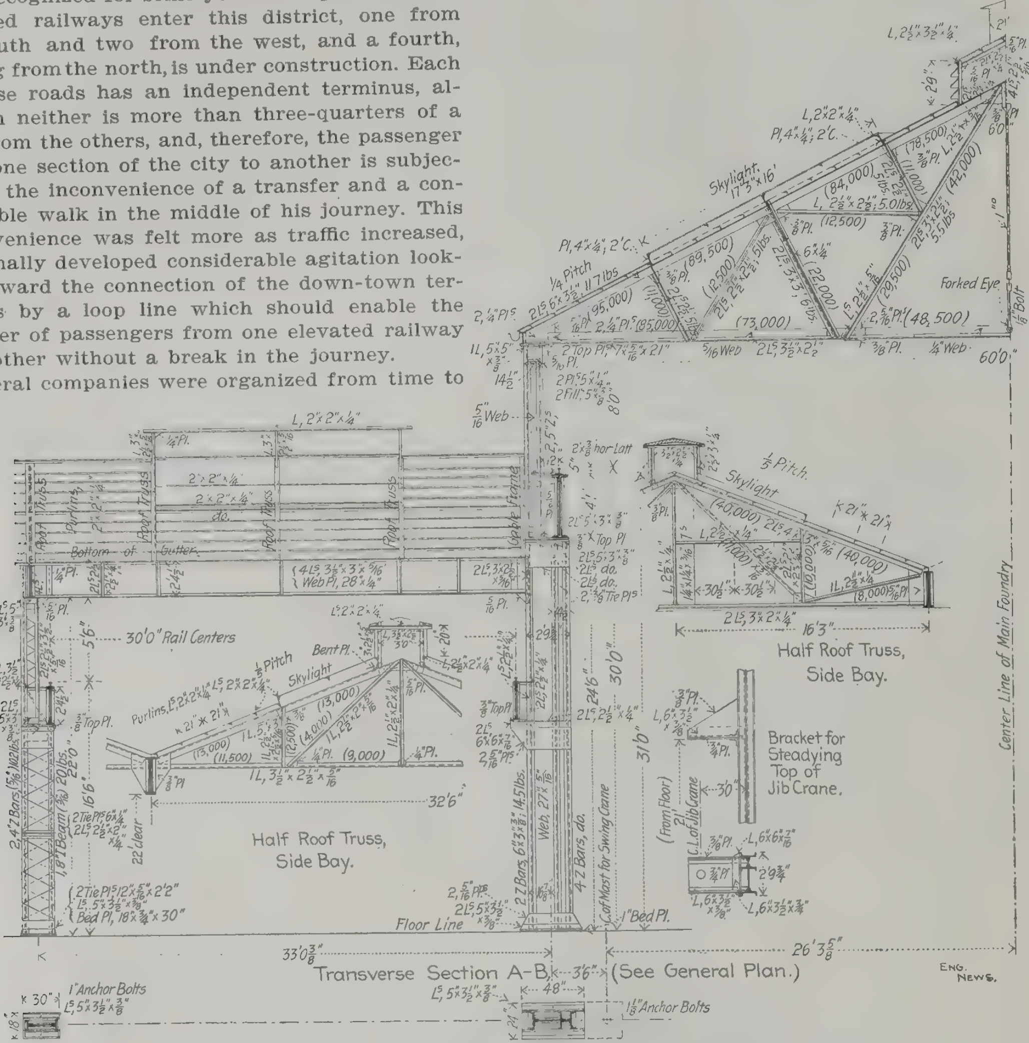
Besides first-class foundry machinery there are eight overhead traveling cranes having capacities of from 5 tons to 30 tons, and a large number of jib cranes. There are four large core ovens 12 ft. wide by 40 ft. long, and four small core ovens with rotary stands for shelf work. The main foundry cranes deliver all castings under the cranes of the machine shop without a second handling. For the drawings and information from which this article has been prepared we are indebted to the Niles Tool Works.



ELEVATIONS OF FOUNDRY, NILES TOOL WORKS.

A UNION TERMINAL FOR CHICAGO'S ELEVATED RAILWAYS.

The desirability of a union terminal line to connect the several elevated railway lines terminating in the central business district of Chicago has been recognized for some years. At present three elevated railways enter this district, one from the south and two from the west, and a fourth, coming from the north, is under construction. Each of these roads has an independent terminus, although neither is more than three-quarters of a mile from the others, and, therefore, the passenger from one section of the city to another is subjected to the inconvenience of a transfer and a considerable walk in the middle of his journey. This inconvenience was felt more as traffic increased, and finally developed considerable agitation looking toward the connection of the down-town terminals by a loop line which should enable the transfer of passengers from one elevated railway to another without a break in the journey.

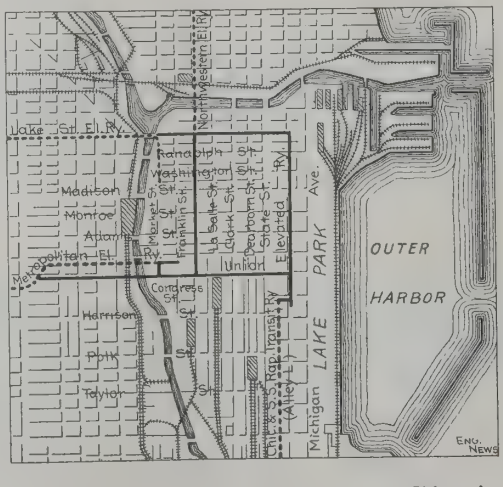


DETAILS OF ROOF CONSTRUCTION, NILES TOOL WORKS FOUNDRY.

Several companies were organized from time to time in the few years past to build this loop line, but none of them promised much until the Union Elevated R. R. Co. was formed by men interested in the various elevated lines to be served by the loop line. In October, 1895, an ordinance was granted to this company authorizing it to build an elevated railway along Wabash Ave., from Lake St. to Harrison St., and the work of construction was begun early last winter. Turning to the accompanying map it will be seen that this line connected the Lake St. Elevated Ry. at Lake St. with the Chicago & South Side Rapid Transit R. R. (Alley L) at Congress St. As soon as this ordinance had been secured the company began work to secure an ordinance for a second line along Van Buren St., from Wabash Ave. west to near Halstead St., and after considerable trouble with property-owners along the route it was finally obtained, by action of the City Council, on June 30, 1896. These two ordinances provide for the east and south sides of the loop, and efforts, it is expected, will now be made to get power to build a connecting link along Ffth Ave., to form the west side of the loop and complete the connection throughout.

In the accompanying maps the broken lines show the termini and routes of the four elevated railways to be served by the loop, and the solid lines show the route of the loop proper. All the elevated lines have two tracks, and the loop line will have two tracks on Fifth Ave. and Wabash Ave. and along Van Buren St., as far west as Market St. From Market St. west the Van Buren St. line will be single tracked. It should also be noted that a branch from the Van Buren St. line will run north on Market St. one-half block to a connection with the Metropolitan West Side Elevated R. R. This branch will be double tracked as will also undoubtedly be the west side of the loop along Fifth Ave.

According to a reported interview with one of the officials of the loop line, the manner in which the several elevated lines will use the loop is as follows: The Northwestern Elevated R. R. will connect with the loop at Fifth Ave. and Lake St., run east on Lake St., south on Wabash Ave., and north on Fifth Ave. to the starting point, using the outer of the two tracks. The Lake St. Elevated R. R. will use the same route as the Northwestern. The Metropolitan West Side Elevated R. R. comes in on the inner track at Van Buren St. and Fifth Ave., runs east along Van Buren St. and around the loop. The Chicago & South Side Rapid Transit R. R. will use the inner track north on Wabash Ave., and thence around the loop, but just how the connection will be made is not stated.



Map Showing Union Terminal Loop for Chicago's Elevated Rys.

The foregoing gives the general purpose and the method of using the union loop line. The ordinances which empower its construction regulate in a broad way the type of construction and motive power, and specify with some detail the compensation to be paid the city, and the extent to which the company shall maintain city property affected by its structure. Briefly, after the company has deducted $250,000 from its annual gross receipts for fixed charges, it shall pay to the city out of the remainder 5% per annum for the first five years, 10% for the second five years, 15% for the next ten years, 20% for the succeeding 15 years, and 25% for the remainder of the 50 years for which the franchise is granted. It should be noted that as first passed by the City Council, the ordinance provided for no compensation to the city, bribery of the Council being freely charged as being the means to this end. By threat of a veto and an array of the better class of aldermen, however, the Mayor was able to secure the agreement outlined, and on July 6 it was accepted by the Council and the railway company.

The ordinance requires that trains shall be operated by electricity or an equally clean and noiseless power, and it is generally known that electric power will be used. Two of the elevated roads which will use the loop now use electric power, a third is being constructed with this end in view, but the fourth, the Chicago & South Side Rapid Transit R. R. will have to change from steam to electricity. For this change the ordinance allows three years from the date of its passage.

In regard to the style of structure, the ordinance requires that it shall obstruct light and street traffic as little as possible, and to this end lattice girders, open floors and the wide spacing of columns are required. Street crossings are to be spanned by single spans when less than 70 ft. wide. The supporting columns are to be located at least 35 ft. apart longitudinally, and transversely just far enough apart to allow a double track street railway to pass between them. Minor details of construction are also specified, but as they require nothing unusual to ordinary first-class elevated railway construction they need not be mentioned.

The structure is required to be completed and in operation by Jan. 1, 1898, and, as already stated, construction is in progress; the Wabash Ave. line being well on toward completion and the Van Buren St. line just begun. According to the reports of the company's officials, the rapid prosecution of the work to completion depends only upon delays over which they will have no control. A five-cent fare will take the passenger to or from any point on the loop on any one of the lines connecting with it, but will not include transfer from one line to another.

* * *

A NEW HOISTING AND CONVEYING APPARATUS.

A new form of hoisting and conveying apparatus, known as the Temperley transporter, invented by Joseph Temperley, of London, England, has come into extensive use abroad, and the American patents on the system have recently been acquired by the Lidgerwood Manufacturing Co., of New York City.

The Temperley transporter employs an I-beam as a trackway, along which the load hoisted is carried by a carriage in either direction to the point desired. The beam is suspended either horizontally or at a moderate incline, and is provided along its bottom flange with a series of stops, at any of which, at the will of the operator, the carriage may be arrested and the load raised or lowered. These stops may be set as near one another as desired; 5 ft. is the usual standard. The beam or trackway may be of any desired length, and arranged, together with its support, in a variety of ways to suit the exigencies of the case.

A special feature of the Temperley transporter is the novel form of traveling carriage employed, the operation and mechanism of which will be readily understood from the accompanying cuts. It consists of two side frames, bolted together, with four wheels for traveling along the lower flange of the I-beam, a large sheave for the lifting rope mounted on the same pin as the suspender, a suspender for holding up the load when the traveler is moving, a pawl to prevent the suspender being lifted prematurely, a guard to keep the ball on the suspender hook when the traveler is moving, a double cam for locking the traveler to the beam when the load is being lifted or lowered, a single cam for locking the double cam, or securing the suspender when carrying the load, a sliding bolt passing through slots in the cams and frames for alternately locking the cams, a toggle to cant the tooth of the double cam into stops on the beam, and, finally, a check plate to prevent movement of the single cam when lifting or lowering.

Fig. 1 shows the traveler locked to the beam by the double cam, which is in gear with a stop. The double cam is prevented from moving by the sliding bolt, which is hard over to the right and within the straight part of the slot in this cam. The single cam is unlocked and the suspender hanging down and the rope free for lifting and lowering.

Fig. 2 shows the traveler moving down the beam with the load carried by the suspender. The suspender is held up by its bolt being in gear with the gab in the single cam. The single cam is prevented from moving by the sliding bolt, which is hard over to the left and within the straight part of the slot in this cam. The double cam is unlocked, and in such a position that the traveler is free to move up or down the beam. When one cam is locked, the other is always free. The double cam when free is actuated by contact with stops on the beam, the single cam is actuated by the movement of the suspender. The slots in the cam are so designed that the movement of the free cam causes the release of the locked cam, and the release of one effects the locking of the other. This reciprocal action of the cams automatically and simultaneously arrests the traveler and releases the load, or releases the carriage and secures the load. Figs. 3, 4 and 5 illustrate the most novel features of the carriage and explain the action of the double cam, whereby the carriage may be arrested by any stop along the beam. As will be seen the toggle in Fig. 3 is pointing upwards, but in passing the stop is turned to face down, and is cocked in that position, as illustrated in Fig. 4. Fig. 5 shows the cam in position for the carriage being lowered to a stop that it has passed. The toggle comes in contact with a notch of its own, which rocks the cam so that the tooth is projected up into the notch. This resists the further motion of the carriage, releases the load, and the carriage is locked. The beam is usually set at an angle so that the carriage travels in one direction by gravity. If, however, circumstances do not admit of the incline beam, then a counterweight rope is attached to the rear of the carriage and the carriage is pulled back by the falling counterweight.

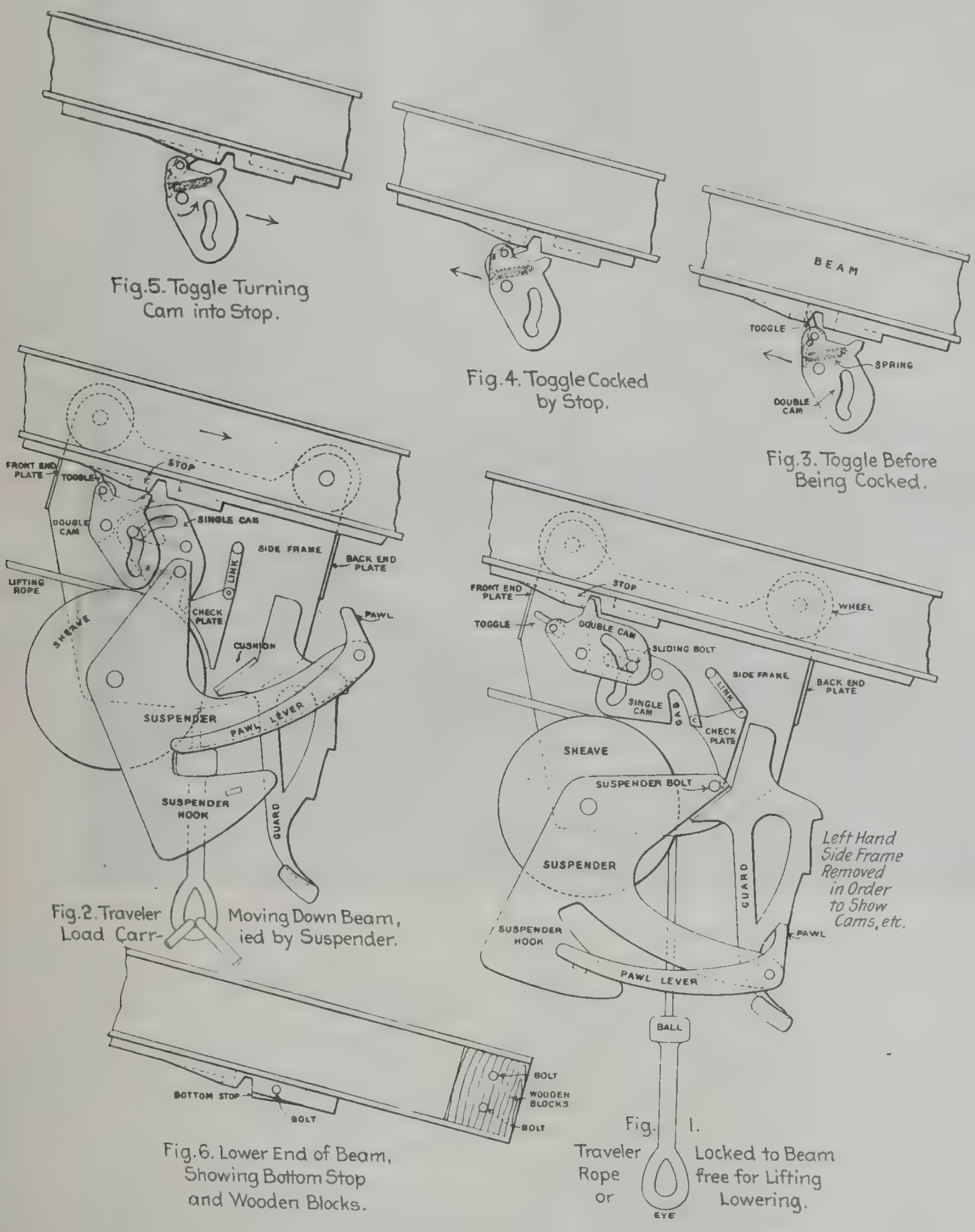


Fig.5. Toggle Turning Cam into Stop.

Fig.4. Toggle Cocked by Stop.

Fig.3. Toggle Before Being Cocked.

Fig.2. Traveler Moving Down Beam, Load Carried by Suspender.

Fig. 1. Traveler Locked to Beam Rope or Eye free for Lifting Lowering.

Fig.6. Lower End of Beam, Showing Bottom Stop and Wooden Blocks.

FIGS. 1 TO 6.—DETAILS OF CARRIAGE OF THE TEMPERLEY TRANSPORTER.

The great outreach of the transporter makes it particularly well suited for work along rivers where wharves are not provided. It has been put to a number of uses in England, notably for handling coal, both on wharves and vessels, also for stacking timber, discharging cargo, handling ore, coke, baled hay and cotton, and many other kinds of material which are conveniently handled in packages. It has also been used for coaling war ships at sea with great success, many transporters having been supplied to the British Admiralty, and also to the German, French, Austrian, Italian and Russian governments for that purpose. The illustration in Fig. 6 shows an installation recently completed for the carrying out of some public works at Clichy, on the river Seine, near Paris. A temporary wooden jetty has been constructed over the roadway and a timber structure put up to support the beam of the transporter. This beam is 53 ft. long.

The transporter is worked by an electric winch placed under a wooden shelter at the outer end of the jetty. A line of rails connects the jetty with the works, and the method of working is as follows: A set of six Decauville wagons are run on to the jetty under the transporter and these wagons are filled consecutively, the stops on the beam being so arranged as to plumb the center of each wagon. The material hoisted and conveyed consists of stone, gravel, cement, etc., and arrives in lighters which are moored immediately below the outer end of the transporter. The material is filled into tubs, which are hauled up by the transporter and dumped into the wagons, or the wagon bodies are removed from their wheels and lowered into the lighters to be filled. As soon as one set of wagons is filled, it is removed and another set shunted on to the jetty. This transporter has a lifting capacity of 3,000 lbs., and can discharge 50 tons per hour. The electric winch is operated by current from the generating plant at the works some distance away. The electrical energy required by the transporter when at full work is about 60 amperes at 200 volts. The installation at this place has proved very successful.

THE EARLY HISTORY OF STREET PAVING AND STREET CLEANING.

In his "History of Inventions and Discoveries," John Beckmann, Professor in the University of Gottingen, devotes a chapter to the paving of streets, and from this historical sketch the following more interesting points are taken:

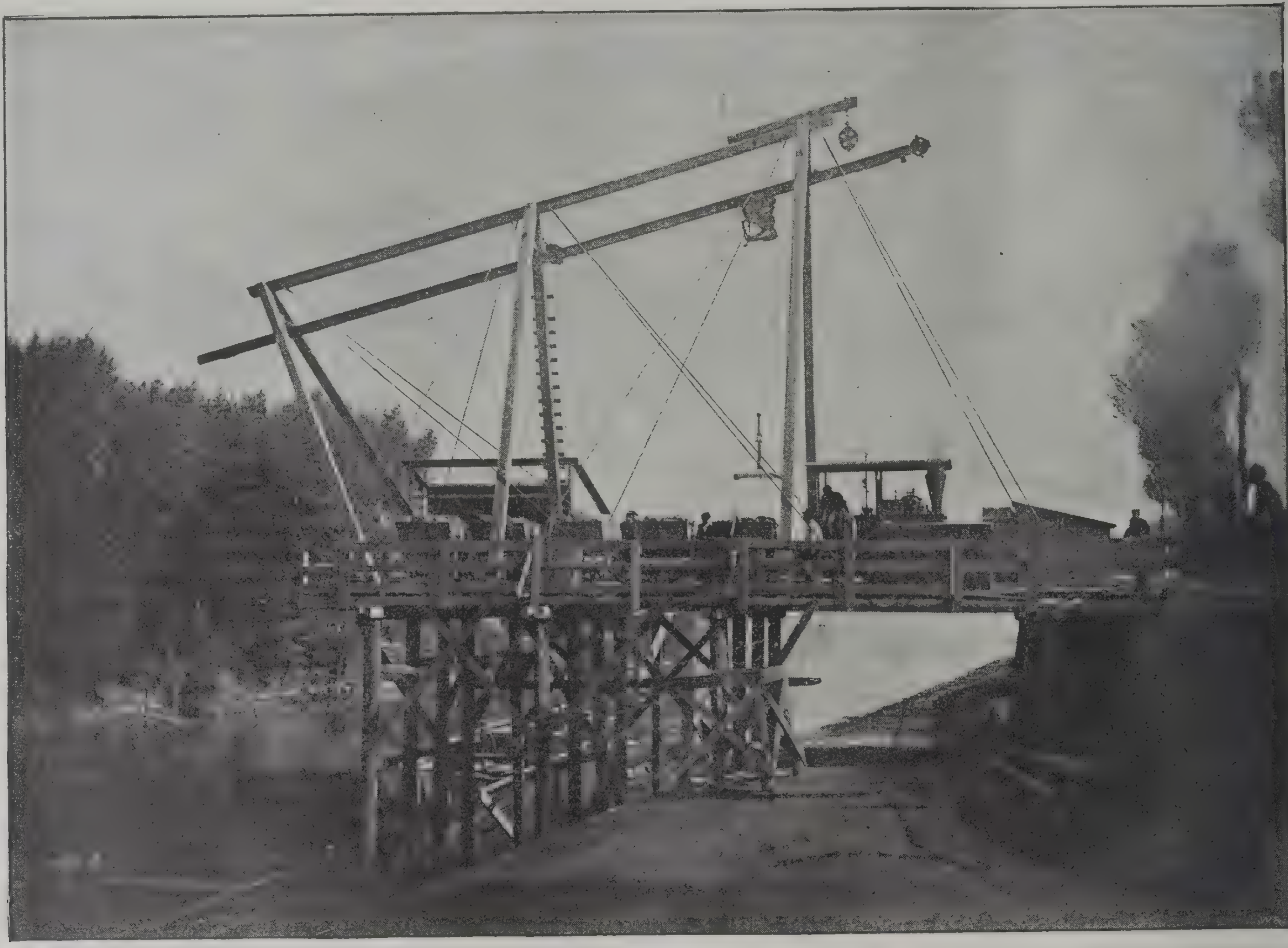
While Roman writers of early date often refer to paved highways and especially describe the famous Appian Way, of 565 B. C., there is comparatively little reference to the paving of streets in cities. The streets of Thebes were regularly cleaned under the inspection of the telsarchs, and it is to be assumed that they were paved; and the Talmud says that the streets of Jerusalem were swept every day, which undoubtedly implies a hard and solid pavement. There is no record of the first street pavement in Rome; but Livy mentions that certain streets were ordered to be paved in 169 B. C., and as early as 530 B. C. the Emperor Heliogabalus paved the streets around his palace with foreign marble. The streets of Pompeii and Herculaneum still show their paving blocks of lava, cut into deep ruts by the wheels of passing chariots.

Passing to later times, we find the streets of Cordova, in Spain, paved as early as A. D. 850, by order of the Caliph, Abdorrahman II. The first record of any street paving in Paris is dated in the year 1184, when the name of the city was changed from Lutetia, the dirty, to Paris. This innovation is said to have arisen from the fact that the King, Philip II., was annoyed by the offensive odors produced by the agitation of the mud in front of his palace by passing vehicles. He resolved to remedy the intolerable nuisance by ordering the streets paved, and succeeded in having this done, in part, at least, notwithstanding the heavy cost, which had deterred his predecessors.

In 1090 the streets of London were soft earth only; but when the first pavement was introduced is not known. Holborn was paved for the first time, by royal command, in 1417; Henry VIII. ordered other streets paved, and the great market square of Smithfield was first paved in 1614. Augsburg, in Germany, seems to have been the first city in that country to introduce footways and street pavement, in 1415, but the extension of the improvement to other towns was slow, and the streets of Berlin were not all paved even in 1679.

Street cleaning was only rendered possible by first providing some manner of hard surface to work upon. Rome had its "tribuni verum intentium" at an early date, officials who were charged with the care and cleaning of the streets, markets, temples, baths and other public places. Ordinances were framed, and more or less severely enforced, forbidding the throwing of any manner of filth into the river or into the streets of Rome. For some centuries after Paris was paved every citizen was compelled to repair the street before his house and to clean it at his own expense, in accordance with an edict of Philip the Bold, issued in 1285. This law was practically unobserved, however, and in the 14th century the streets of Paris are described as in a horrible condition. Later laws made street cleaning compulsory, for nobles as well as for the common citizen, and in 1501 a company was formed for cleaning streets by contract with individuals. Street cleaning at public expense, in Paris, was inaugurated in 1609, and the sum of 70,000 livres was appropriated for this purpose from the public fund. In 1704 the city collected 300,000 livres for cleaning streets and maintaining lamps.

A pig figures prominently in the first Parisian ordinances forbidding the deliberate dirtying of the streets. The young King Philip, son of Louis the Fat, was killed, in 1131, as the result of a fall from his horse brought about by a pig in the streets. As a consequence of this accident an order was issued forbidding swine running loose on the streets of the city; but this order was bitterly opposed by the monks of the Abbey of St. Anthony, who resented this affront to the charges of their patron saint, and demanded liberty for the swine to go where they pleased. After some time spent in controversy, the pigs belonging to this abbey were granted a special dispensation and permitted to wallow at will, provided that they had bells attached to their necks.



TEMPERLEY TRANSPORTER AT CLICHY ON THE RIVER SEINE.

Up to the 14th century, in Paris, and as late as 1750 in Edinburgh, citizens were permitted to throw from their windows any manner of slops into the streets before the house, provided that they called out three times before doing so. This privilege, so inconvenient to the passer-by, was strictly forbidden in Paris in 1395, and from this time may be dated the first introduction into that city of sanitary conveniences. It is interesting to note that when Columbus sailed for the Indies, the palace of King Ferdinand of Spain was destitute of any conveniences of this nature. The Parisian Code of Laws of 1513 expressly orders that every house should have a privy, and severe penalties were imposed for non-compliance with this order; but even as late as 1700 the police were compelled to use the utmost vigilance to prevent infraction of the law and to keep those in use in a fairly sanitary condition.

In Germany the cleaning of streets was at first considered as a most dishonorable employment, which in some places was assigned to the Jews and to the servants of the public executioner. Up to the beginning of the 17th century the streets of Berlin were never swept, and pigs ran at large throughout the city. In 1624 the Elector desired the Council to have the streets cleaned; but the Council replied that it was impossible, as the citizens were busy on their farms. The dirt in the public market place accumulated to such an extent that in 1671 a law was passed compelling every countryman to take out of the city one load of dirt every time he came to market. Pig-sties in the streets were common until 1681, when an order was issued forbidding the feeding of swine within the city limits. The Germans are said to have introduced privies at an earlier date than the French ordinances referred to, as mention of them is made in the annals of Frankfort-on-the-Maine in 1477.

Mr. Beckmann wrote in 1846, and the account he gave of the sanitary conveniences of Berlin, at that date, will surprise some readers. He says that in most of the houses small closets are located on the landings of the stairs, which must be emptied every other night with most unpleasant consequences. In the streets, large puddles of filth were allowed to collect even before the doors of the best houses, and in the summer these puddles emitted "a horrible stench." While the streets were spacious and straight and fairly well paved with flagstone, the footways were divided from the carriage drive by open kennels, "telling the nose unutterable things." Our author closes by remarking of this city that, "If bronze and marble could smell, Blucher and Bulow, Schwerin and Liethen, and duck-winged angels and two-headed eagles unnumerable, would be found on their pedestals, holding their noses instead of grasping their swords."

◆

THE SUM OF $100,000 FOR SLUDGE DISPOSAL at Worcester, Mass., was appropriated a few days ago by the city council. Since the sewage precipitation plant was put in operation at Worcester in 1890, the sludge has been spread on beds to dry, or partially dry. Its final disposition has been more or less troublesome from the start. It is now proposed to put in a pressing plant, by means of which a large percentage of the moisture will be removed.

◆

A CHEMICAL LABORATORY FOR THE STREET Department of Brooklyn, N. Y., has recently been established for use in connection with asphalt paving work. It is in charge of Mr. W. Homer Broadhurst, a graduate of the Brooklyn Polytechnic in 1894.

◆

THROUGH TRAINS ACROSS THE BROOKLYN Bridge are again being urged by President Ullman of the Brooklyn elevated railways. At the meeting of the bridge trustees, on July 13, he presented a report by Mr. Geo. B. Cornell, M. Am. Soc. C. E., answering the objections presented by Messrs. Martin and Leverich of the bridge staff to the operation of through trains.

◆

A CRITICISM OF THE DESIGN accepted by the Commissioners of Fairmount Park for the new bridge over the Schyylkill River, and shown on p. 13 of our issue of July 2, has been presented to the commissioners by Mr. Percival Roberts, Jr., M. Am. Soc. C. E. Mr. Roberts urges that the bridge should contain three arches instead of four; that the masonry of the piers should be carried to the level of the roadway, and that as the roadway has a 1.2% grade, the arches will be out of the horizontal and will look badly if constructed according to the accepted design. He also claims that the design is for a lighter structure than that called for by the specifications of the chief engineer.

◆

SHIP BUILDING IN THE UNITED STATES was fairly active during the year ending June 30, 1896, according to statistics just issued by the Bureau of Navigation. There were 709 vessels of 204,000 gross tons built, against 682 vessels of 133,000 tons in the previous year. There were 322 steam vessels built of 135,000 tons, against 283 of 75,700 tons in the preceding year. The tonnage of steel vessels built was 106,900 against 47,700 in the previous year. On the Great Lakes 104 vessels of 92,000 tons were built as compared with 93 vessels of 38,000 tons in the year preceding.

◆

THE BOSTON PNEUMATIC TRANSIT CO. is seeking a charter for a general system of pneumatic delivery pipes in the streets of Boston, and is to have a hearing before the Board of Aldermen July 20. A similar charter was applied for a year ago, and was granted by the Aldermen, but was vetoed by the Mayor.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXVI., No. 4.

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PROPOSED EXTENSIONS TO THE MANHATTAN Elevated system were outlined at a meeting of the New York Rapid Transit Commission on July 16, by the President, Geo. Gould. It was proposed to build surface trolley roads along the streets of the annexed district, with an agreement to build elevated lines in their place whenever the earnings would pay the interest on the cost of an elevated structure. It was stipulated, however, that the Manhattan Ry. Co. must be protected against substantially all claims for damages on the part of owners of abutting property. Under the law the Rapid Transit Commission would have no power to grant guarantees of this sort nor, in fact have they any power to grant franchises for surface railways at all. No action was taken upon the application by the Commission, nor does any action appear likely at present.

A NEW RAPID TRANSIT ROUTE was proposed by Chief Engineer W. B. Parsons at the above meeting, which it is believed could be built under the authority granted to the previous commission, provided the legislature amended the present law which makes obligatory the construction of the road by the city. The proposed system would comprise a four-track road from City Hall Park to 42d St., and an east side and west side branch, each of two tracks, extending to the Harlem River and 135th St., respectively, with elevated railway extensions from these points north. The estimated cost of such a system on the basis of the unit prices approved by the Board of Experts some years ago would be $21,000,000, or adding 20% to 40% for contingencies on the various items, $26,500,000. One mile sections of third track on these branches north of 42d St. would be included to permit the running of express trains. The proposal will be considered at a meeting of the Commission July 30.

A TUNNEL UNDER UNION SQUARE, New York city, is proposed by the Metropolitan Street Ry. Co. to eliminate the dangerous curve at 14th St. The tunnel would be about 520 ft. in length with masonry portals of ornate design. It would be roofed with iron beams and lined with enameled bricks, and its cost is estimated at $150,000 to $200,000. Consent to the construction of such a tunnel is doubtful, as it would interfere with the construction of a rapid transit railway on the Broadway route. If its construction is not permitted, the Metropolitan Traction Co. will put in a special slow cable to haul its cars around the 14th St. curve. The experiments now in progress with compressed air motors may also lead to an entire change of motive power, though this is considered hardly probable.

DANGERS OF FIXED POSTS NEAR MOVING CARS are illustrated by a column of the Kings Co. Elevated Ry. on Fulton St., Brooklyn, which is said to have injured 20 men during the past few months. The course of the cars is now to be changed to pass it on the other side.

AN ELECTRIC LOCOMOTIVE of 75 tons weight is to be built jointly by the Baldwin Locomotive Works and the Westinghouse Co., and will use the Wheless current collecting system controlled by the Westinghouse Co. In this system there is neither an overhead wire nor a conduit, the current is led to contact boxes projecting ⅝-in. above the pavement, and an electro-magnetic device on the car switches the current onto each box as the car passes over it. At all other times the boxes are dead. The 30-ton electric locomotive exhibited at Chicago in 1893 by the General Electric Co. has been purchased by the Manufacturers' Street Ry. Co., of New Haven, Conn., to haul freight cars from Cedar Hill, a point on the main line of the New York, New Haven & Hartford R. R., one mile from the New Haven passenger depot, to the works of the Bigelow Co., the National Pipe Bending Co., and other large manufacturers. The total length of the branch is nearly two miles, and the maximum grade 2½%. The locomotive has a rated draw-bar pull of 7,000 lbs.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred July 15, at Quincy, Ill., on the Chicago, Burlington & Quincy Ry. It was a head collision between a switch engine and freight train. Two men of the engine crews were killed and two injured, one fatally. Both locomotives were demolished. On July 16, near Littleton, N. H., a logging train consisting of locomotive and three loaded cars ran away on a grade of 400 ft. to the mile; on rounding a 10° curve the cars left the main track and ran onto a siding. Two persons were killed by jumping and two were injured. An account has been received of an accident on the Jamaica Ry. which occurred July 11, about ten miles from Anato Bay. A locomotive with six flat cars loaded with laborers was descending a steep mountain grade when the air brakes failed. The train kept the track but ran into a locomotive at the bottom of the grade; 17 persons are reported killed and 33 injured.

THE OVER-CROWDING OF TROLLEY CARS in Brooklyn, N. Y., still continues, notwithstanding the orders of the Chief of Police. On July 19 a crowded car on the Nassau line while making up time, left the track at a curve and ran into the ditch. Seven persons were injured, the conductor seriously. President A. L. Johnson is quoted as saying that there have been 2,400 trolley accidents in Brooklyn since last April.

A SODA FOUNTAIN TANK EXPLODED, July 15, in the factory at 331 East 26th St., New York city. One man was killed and two injured; 25 tanks were being charged by an automatic filling device. The tanks are of iron and the pressure used is 150 lbs.

A WOODEN HIGHWAY BRIDGE, at Canton, O., collapsed July 13. Two men with a traction engine attempted to cross, the failure occurring when the engine was at the middle of the bridge. One man was killed and the other injured.

A FALLING WATER TANK wrecked a six-story brick building at 241 Jefferson St., Chicago, July 11. The tank was located on the roof. It contained 5,000 gallons of water and fell through to the basement. The damage to the building is estimated at $7,900.

BOILER EXPLOSIONS in Great Britain during 1895 numbered 44, according to the records kept by the Manchester Steam Users' Association. In these explosions 40 persons were killed and 54 were injured. Of these explosions 29, killing 36 persons and injuring 43, were steam boiler explosions proper, while the remainder were explosions of steam pipes, heaters, kiers, etc. Only one of these explosions was of a boiler insured in the Association, and this was of trivial importance, being merely a steam launch boiler, which fractured the neck of a cast-iron chest to which the safety-valves were attached. The fracture was due to the use of the vessel as a ram to crush ice in the Manchester ship canal.

AN AMERICAN LOCOMOTIVE BUILDING PLANT is to be erected at Nijni-Novgorod, Russia, by a corporation known as the Russian-American Manufacturing Co. Mr. H. H. Hollister, of New York city, is the President of the company, Mr. E. D. Smith, of Philadelphia, is the Vice-President, and Mr. W. F. Dixon, late chief draftsman of the Rogers Locomotive Works, at Paterson, is the General Manager. The works are to be built adjacent to the Sormovo works, a large manufacturing establishment about five miles from the town of Nijni-Novgorod. Contracts for machinery for their equipment to the value of about half a million dollars have already been placed with the principal American builders of machine tools. Five buildings are being erected, from designs made by Mr. Dixon, assisted by Julian Kennedy, M. Am. Soc. M. E., of Pittsburg, and are expected to be completed this fall, and it is intended to have the shop equipment completed and ready for use by the following spring. The works are designed for an output of about 150 locomotives per annum and will employ about 1,000 men. Besides Mr. Dixon, who will have the general management of the works and an assistant, the foremen of the various departments and some of the draftsmen will be Americans, about a dozen men in all will be engaged. We are indebted for the above information to our contemporary "The Railroad Gazette."

THE GREAT SIBERIAN RAILWAY is now completed to Krasnoyarsk. During the season of 1895, 918¼ miles were built. This gives a direct route from Petersburg to the Yenesei River, a distance of 3,056½ miles. The proposed length of the Great Siberian Ry. from Cliuliabinsk to Vladivostok on the Japan Sea is 4,547 miles, of which more than one-third is now completed. A large amount of work has also been done on the branches. There are now engaged upon the actual work of construction over 70,000 workmen, beside engineers and officers. Up to 1896 $32,488,000 had been expended. The plan of building across the mountains and canyons on the south of Lake Baikal, which was the most difficult feature of the whole enterprise, has been abandoned and trains will be ferried across the lake, by transfer steamers, a distance of about 20 miles.

THE IMPROVEMENT OF NAVIGATION at the Iron Gates of the Danube has been practically completed and is to be celebrated with appropriate ceremonies in connection with the thousandth anniversary of the foundation of Hungary next month. The inauguration ceremonies are to be held at Orsova, and will be attended by the sovereigns of Austria, Germany, Roumania, Servia, Bavaria and Bulgaria. The work has been in progress about five years and was described in our issues of July 11, 1891, and April 2, 1892.

THE GREAT U. S. LOCK at Sault Ste. Marie is expected to be ready for the passage of boats early next month.

NOTICE TO STOP POLLUTING THE CANISTEO River has been served upon Hornellsville, N. Y., by the town of Canisteo. The notice declares the discharge of sewage into the river by Hornellsville a nuisance.

LEGAL STEPS TO PREVENT THE DISCHARGE OF coal dust into the Schuylkill River have been taken in the name of the attorney general of Pennsylvania and the city of Philadelphia. Complaint is entered and injunctions asked against the Philadelphia & Reading Coal & Iron Co., the Lehigh Coal & Navigation Co., and four other companies. The bill alleges that the trouble arises from washing the coal as it comes from the breakers and also from washing culm from old banks. The protection of the water supply of Philadelphia is the main object of the action.

THE FILTER BEDS CONNECTED WITH THE WATER supply of Poughkeepsie, N, Y., are being enlarged by adding an area of ⅔ acre. The present beds were built with the water-works some 25 years ago, and have an area of 0.675 acre.

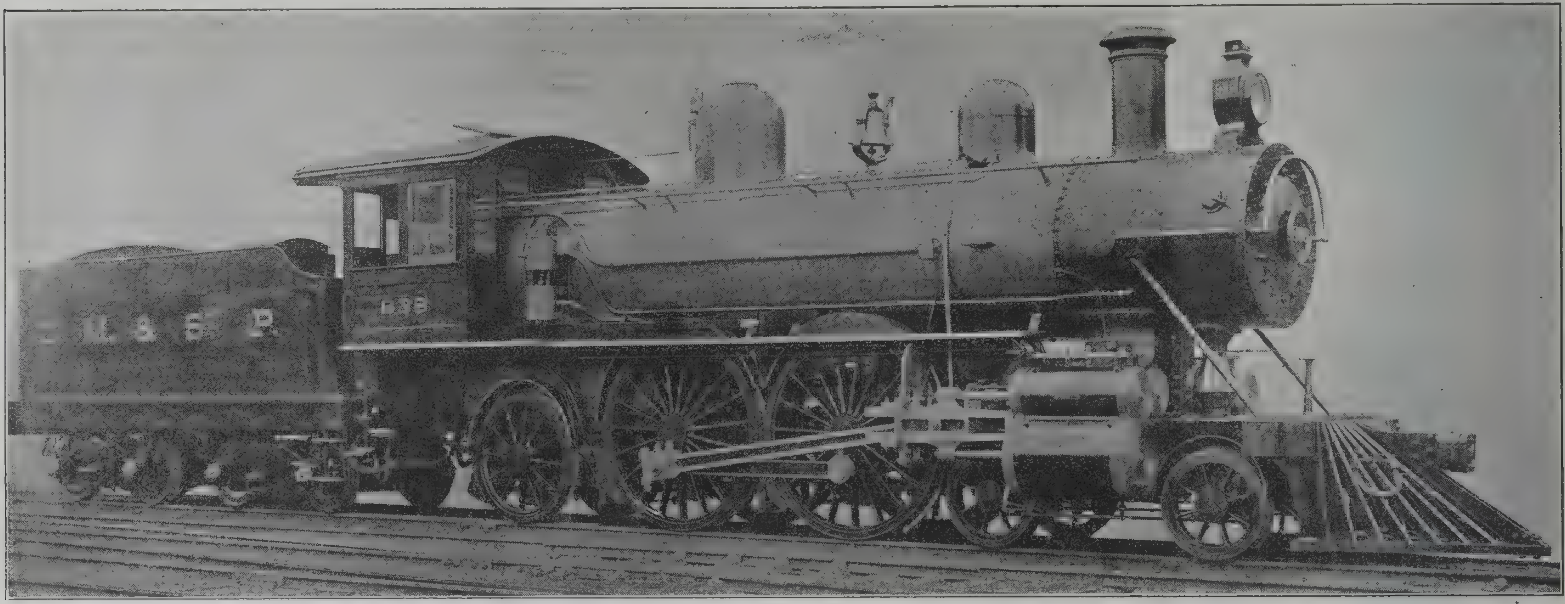
A SINGLE 48-IN. CAST-IRON MAIN has been recommended for the new water supply conduit for Brooklyn rather than the acceptance of either the bid for a double line of 48-in. cast-iron pipe or a single line of 66-in. steel. This recommendation has been made by both Mr. I. M. de Varona, M. Am. Soc. C. E., Engineer in charge of the Water-Works, and Mr. Peter Milne, Chief Engineer of the Department of City Works. Both of these gentlemen base their decision on uncertainties connected with the future water supply of the city and the additional cost of the steel conduit. Of course the steel conduit is the cheaper of the two, carrying capacity considered, but Mr. de Varona urges that the city is near the limit of its bonded indebtedness. The final decision of the matter rests with Mr. Theo. Willis, Commissioner of City Works, who is reported as favoring the steel, or larger main, since it can be secured at $780,000 with asphalt, and $802,000 with Sabine coating, against $677,000 for the cast-iron pipe.

THE LOWEST BID FOR TWO 48-IN. CAST-IRON water mains on Fifth Ave., New York, from 4th to 80th St., a distance of about 3¾ miles, was $452,460. This bid was made by Mr. Wm. T. Baird, of New York. There were nine other bidders. Details of the bids will be published in our next issue.

WATER POWER to the amount of 10,000 HP. is being developed at Columbia, S. C., by the Columbia Water Power Co., a concern backed by New England capital. Aretas Blood, of Manchester, N. H., well known in railway circles in connection with the old Manchester Locomotive Works, is the President; A. F. Sortwell, of Cambridge, Mass., President of the Montpelier & Wells River R. R., is Vice-President, and W. M. Upham, of Baltimore, is Secretary. The power is being developed from a water-power canal which was begun many years ago by the state of South Carolina, and was recently turned over to the city of Columbia. The power-house, 184 × 31 ft., is being built by W. A. Chapman & Co., of Providence, R. I. It will contain eight pairs of 51-in. McCormick turbines, built by the Rodney-Hunt Machine Co., of Orange, Mass., and eight large generators built by the General Electric Co. The work is expected to be completed by Oct. 1. The water-power company proposes to sell its power at $15 per HP. per annum delivered anywhere in Columbia, the above price being for units of not less than 500 HP. used 66 hours per week.

BALDWIN COMPOUND LOCOMOTIVE FOR FAST PASSENGER SERVICE; C. M. & ST. P. RY.

The Baldwin Locomotive Works has recently delivered to the Chicago, Milwaukee & St. Paul Ry., two large compound locomotives designed for fast passenger service. The accompanying illustration is reproduced from a photograph of one of these engines, for which we are indebted to the courtesy of the builders.



FOUR-CYLINDER COMPOUND LOCOMOTIVE FOR FAST PASSENGER SERVICE, CHICAGO, MILWAUKEE & ST. PAUL RY.
Baldwin Locomotive Works, Builders. J. N. Barr, Supt. of Motive Power, C., M. & St. P. Ry.

The locomotive is of the "Columbia" type with a trailing pony truck in the rear of the drivers, a design originated by the Baldwin Works in 1893 and used since on the Philadelphia & Reading, Chicago, Burlington & Quincy and other railways. The principal dimensions are as follows:

Gage of road	4 ft. 8½ ins.
Cylinder, diameters	h.-p., 13 ins.; l.-p., 22 “
Stroke	26 “
Driving wheels, diameter	78 “
Total wheel base	25 ft. 6 “
Rigid wheel base	13 “ 9 “
Driving wheel base	6 “ 9 “
Weight, total	140,700 lbs.
“ on drivers	71,600 “
“ on trailing wheels	29,100 “
“ on trucks	40,000 “
Boiler diameter	60 ins.
No. of tubes	264
Diameter of tubes	2 ins.
Length of tubes	15 ft.
Firebox length	103 3-16 ins.
Firebox width	42⅛ “
Firebox depth	front, 71½ ins.; back, 69 ins.
Heating surface, firebox	171.0 sq. ft.
“ “ tubes	2,073.5 “ “
“ “ total	2,244.5 “ “
Truck wheels, diameter	36 ins.
“ journals	5½ × 10 “
Trailing wheels, diameter	54 “
“ journals	7 × 12 “
Tender tank capacity	4,500 gallons
“ wheels, diameter	33 ins.
“ journals	4½ × 8 “

On July 3, this locomotive hauled a train of 14 cars from Chicago to Milwaukee in 115 minutes, the distance being 85 miles. The train consisted of 4 baggage and express cars, 4 day coaches, 4 drawing room cars and 2 sleeping cars. The total weight hauled by the locomotive was estimated at 1,000,000 lbs. The train made two stops, at Western Union Junction and National Ave., and had a delay of five minutes at the first, which was made up in the next eight miles of the run, the train speed reaching at times, it is claimed 80 miles per hour. On another trip over the same run with 11 cars, one of which was the private car of Jos. Barker, General Passenger Agent of the Missouri, Kansas & Gulf R. R., a speed indicator on that car is said to have shown a speed of 77 miles per hour.

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RULES FOR LOADING LONG STRUCTURAL MATERIAL ON RAILWAY CARS.

The Master Car Builders' Association at its recent meeting at Saratoga appointed a committee to report a set of rules for loading long lumber and timber, and also to govern the loading and carrying of long structural material such as plates, rails, beams, girders, trusses etc. The report of this committee has just been submitted to letter ballot for adoption, as the practice recommended by the Association for use on all railways. It is altogether probable that the letter ballot will result favorably, and that all railways will require shippers of long timber and structural material to conform to these rules. We reprint herewith in full the rules for loading structural material. As the rules for loading long timber are still more voluminous and contain several large tables, we do not reprint them, but any of our readers desiring copies of these rules can obtain them of the Secretary of the Association, Mr. John W. Cloud, Rookery Building, Chicago, after the result of the letter ballot is ascertained.

General Instructions.

1. On account of the great variety of form and weight of long structural material, no general rules can be made to suit all cases. The following regulations are, therefore, intended to cover only the most common forms. When material cannot be loaded in accordance with these regulations, special instructions must be asked for.

2. Cars to be used for shipments of this character must be carefully examined before loading, and all defects must be remedied before the cars are loaded. Great care must be taken not to overload cars, and in the case of very long or very heavy material the truss rods should be screwed up tight. The weight of the lading carried on any car must be governed not only by the marked capacity of the car, but also by its general construction, as well as by the number and location of the bearing pieces upon which the load rests. The regulations covering these points are given in Detail Instructions for each form of loading, and must be strictly adhered to. The only exceptions are cars which have been specially prepared for the shipment of particular forms of material.

3. Material over forty feet long carried on two or three cars must always be examined by a competent inspector before the cars are moved from the loading point. If no inspector is stationed at the loading point, the local agent must give notice to the proper authority when the cars are loaded, so that proper inspection can be arranged for. The object of such inspection is to see that these regulations have been complied with.

4. Standing room of at least 18 ins. must always be left around brake shaft at one end of the car to permit the proper operation of the brake, and at the other end of the car, when a single car is used, the lading must not project beyond the end sill, except in the following case: When the lading is too long to go inside the car, but will not extend more than 6 ins. beyond the end sill, such method of loading will be permitted, providing the projecting ends of the material will clear 6 ft. 6 ins. above the rail.

5. In all other cases when the lading extends beyond the end sill of the car, an idler must be used or the material must be loaded on two or three cars, as the case may demand, and as explained under Detail Instructions below.

6. Long iron, rails, bridge material, channels, angle irons, etc., should, whenever possible, be loaded on single gondola cars inside the end gates, which must in all cases be raised and securely fastened. Single flat cars must not be used for rails or bar iron, unless furnished with substantial end boards to prevent shifting of the load.

7. Whenever the lading is carried by more than one car, all slack between cars must be removed by the use of spacing blocks in the manner described in Detail Instructions. Cars must also be chained together in order to prevent parting in case of failure of the couplings. When cars are used which are not permanently equipped with safety chains, chains made of not less than ¾ in. iron must be passed around the body bolsters and across under sills, forming a loop back of bolster and doubling to point of coupling between the two cars, and so tie them together. These long chains must only have a sufficient amount of slack to permit the cars to curve. At interchange points chains will either be removed, or the receiving road will furnish the delivering road with chains of the same quality and dimensions as those received.

8. When either one or two bearing pieces are required, they must never be placed between the bolster and the end of the car, but either between the bolsters or directly above the bolsters. When only one bearing piece is used on a car, as in Figs. 13 and 14, it must be placed at a distance of at least 12 ins. from center of bolster toward center of car.

9. All spacing blocks between cars, bearing pieces, spacing blocks between material, clamping pieces, bolsters and all braces must be of hard wood and sound in every way. Dimensions given are, however, intended to be general only, and any material that may be suitable for blocking, but which differs in dimensions from figures given, but which is of equal strength or stronger, may be utilized.

10. Height and width of lading must be governed by tunnel and bridge limits of roads over which lading is destined.

11. When two or three cars are used, cars carrying load must be considered of the same capacity as the one of lesser capacity.

Detail Instructions.

Loading of Single Cars Without Idlers.

12. Large girders loaded on flat side on flat cars must always be carried upon bearing blocks not less than 4 × 12 ins., which must be placed one over each bolster and secured to the floor with two ⅞-in. bolts. When two or more large girders are carried on a flat car, the bearing blocks must not be less than 6 × 12 ins., and fastened in the same manner to the floor. In addition, spacing blocks not less than 3 × 12 ins. must be placed between each girder. Lateral motion must be prevented by means of upright iron stanchions, driven into holes in the bearing pieces and held together at the top by not less than 2 × 6 in. planks, as shown in Fig. 2, or it may be prevented by fitting planks between flanges of the girders, as shown in Fig. 3. To prevent longitudinal motion, angle plates, 5 or 6 ins. wide by ½ in. thick, must be bolted firmly to the lower girders close to the bearing pieces, as shown in Fig. 1, or if rivet holes are not available, it may be prevented by clamps, as shown in Fig. 4. The upper girder must be held to the lower girder by diagonal flat-iron braces bolted to both girders, as shown in Fig. 1. If, however, girders are clamped together, as shown in Fig. 4, the diagonal flat-iron braces need not be applied.

Loading of Single Cars With Idlers.

13. When the lading is too long to go inside of a car and extends more than 6 ins. beyond the end sill, such loading will be permitted if an idler or idlers are provided to protect the overhanging part of the loads, as in Figs. 5, 6 and 8; but in these cases the length of the permissible overhang must be governed by the width of the lading and its height above the rail, and it must in no case exceed the figures given below, which are based on clearance required on a 20° curve, it being understood that the

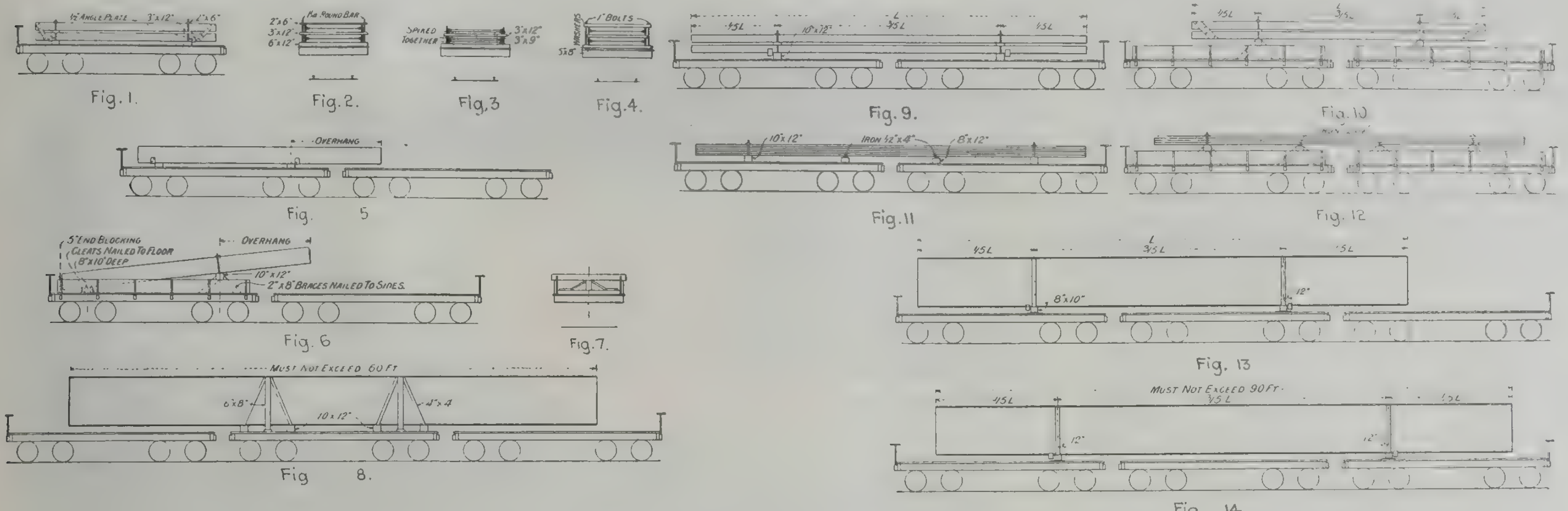
load must be placed centrally on the car and the amount of overhang measured from center of bolster on the carrying car.

For loading in accordance with Figs. 5, 6 and 8:

8 ft. wide	10 ft. overhang.
7 ft. wide	14 ft. overhang.
6 ft. wide, or less	18 ft. overhang.

14. To prevent overloading of the truck under the overhanging end, as shown in Figs. 5 and 6, the carrying capacity of the car will decrease in the following manner as the length of the overhanging increases:

For overhang not exceeding 5 ft., car may carry full marked capacity; for overhang not exceeding 10 ft., car may carry three-fourths of the marked capacity; for overhang greater than 10 ft., car may carry one-half the marked capacity.

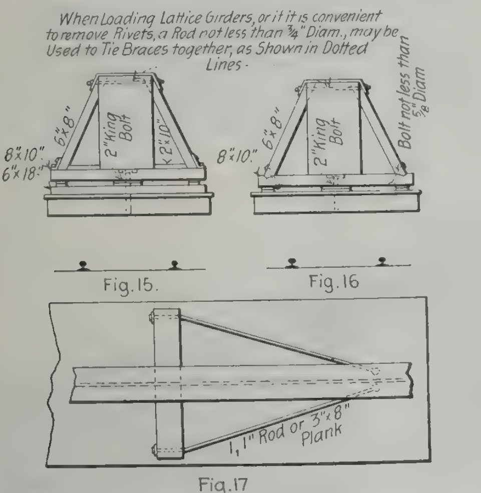


FIGS. 1 TO 14.—METHODS FOR LOADING STRUCTURAL MATERIAL ON CARS PROPOSED FOR ADOPTION BY THE MASTER CAR BUILDERS' ASSOCIATION.

15. (a) The idlers used with loads as shown in Figs. 5 and 8 must be flat cars, unless the width of the overhanging part of the lading is at least 3 ft. less than the width given for each length of overhang in the table in paragraph 13, in which case drop-end gondola cars may be used.

(b) The idler used with loads as shown in Fig. 6 may be a low-side gondola car, but must not be a high-side gondola car.

16. The idlers may be loaded with any suitable material, provided the consignee and the destination of the material on all the cars are the same. There must be, however, a space of at least 2 ft. between ladings on the carrying car and on the idler. The carrying capacity of the idler depends upon how far the overhang extends over the idler, and must not exceed the following figures, except with ladings as in Fig. 6, in which the overhang may be so far above the floor of the idler as not to interfere with its lading. In such cases the idler may carry full marked capacity:


When Loading Lattice Girders, or if it is convenient to remove Rivets, a Rod not less than ¾" Diam., may be Used to Tie Braces together, as Shown in Dotted Lines.
6"x8"
2" King Bolt
2"x10"
8"x10"
6"x18"
6"x8"
2" King Bolt
8"x10"
Bolt not less than ⅝" Diam
Fig. 15.
Fig. 16
1, 1" Rod or 3"x8" Plank
Fig. 17

Figs. 15 to 17.—Swivelling Bolsters for Supporting Long Girders.

When overhang does not extend over idler more than 5 ft., full marked capacity; when overhang does not extend over idler more than 10 ft., three-fourths of the marked capacity; when overhang extends over idler more than 10 ft., one-half of the marked capacity.

17. When large girders are loaded, as shown in Fig 5, they must be secured to carrying car, as explained in paragraph 12.

18. When material is loaded on gondola cars and is longer than the body of the car, as shown in Fig. 6, one end must rest on a bearing piece not less than 10 × 8 ins., placed on the floor above the bolster and extending the width of the car. It must in all cases be of sufficient depth to prevent the lading at this end from touching the floor of the car. It must be secured from shifting by cleats nailed to the floor. The end boards at this end of of the car must be protected by blocking not less than 5 ins. thick, fitted snugly between the side boards and extending upward to a height sufficient to prevent all parts of the load from touching the end boards of the car. The other end of the load must rest upon a bearing piece, square or round, preferably square, not less than 8 × 10 ins. if square cornered, nor less than 10 ins. in diameter if round. This bearing piece must rest upon the side boards of the car directly above the bolster, and it must be securely braced to prevent both lateral and longitudinal motion, and if round it must also be braced against rolling; it must also be supported from bending. Figs. 6 and 7 show substantially how both bearing pieces are to be secured. To prevent the load from shifting in a lateral direction on the bearing piece, iron stanchions tied together with a plank at their upper ends must be used as described in paragraph 12.

19. A method of loading especially adapted to long lattice girders, which may be injured if loaded on more than one car, is shown in Fig. 8. For loads of this character four bearing pieces must be placed in pairs on the carrying car each pair being placed centrally above the bolster, with a distance apart of not over 5 ft. nor less than 3 ft.; they must be fastened to the floor with bolts, as explained in paragraph 12, and the upright supports must have side braces. Braces or tie-rods must be secured to the overhanging ends and to the bearing pieces, as shown in Fig. 17. Longitudinal motion must be prevented by the use of plates or clamps, as explained in paragraph 12.

Loading of Two or Three Cars With or Without Idlers.

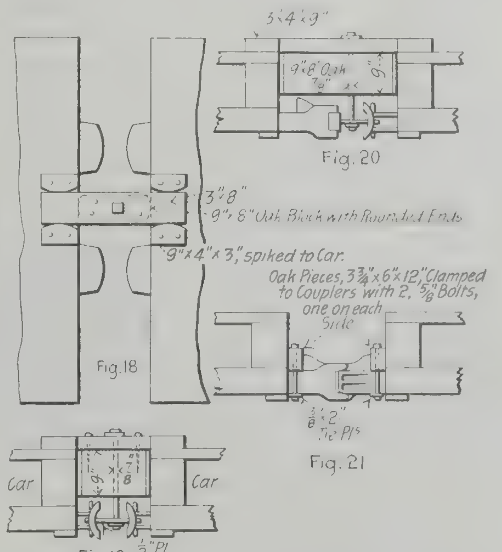
20. Material which in length exceeds the limits given for the loading of one car must be loaded on two or three cars, as shown in Figs. 9, 10, 11, 12, 13, 14. 15 and 16. With loads of this character the lading must never exceed maximums given in paragraph 26. The carrying cars must always have all slack between them removed by the use of spacing blocks, as described in detail in paragraph 28, and the cars must be chained together, as explained in General Instructions, paragraph 7.

21. Material loaded on gondola cars with drop ends or open ends or on flat cars, as shown in Fig. 9, must have one bearing piece not less than 10 ins. wide by 12 ins. deep secured to the floor of each car with two ⅞-in. bolts. Lateral and longitudinal motions must be prevented in the manner described in paragraph 12. In the case of gondola cars, a clearance of at least 18 ins. between the load and car sides must always be provided for curving.

22. Material loaded on gondola cars without drop end doors, as shown in Figs. 10 and 12, must have bearing pieces placed on the top of the side boards, of the same size and secured in the same manner as described in paragraph 18. The lading must be secured from lateral and longitudinal motions as described in paragraph 12.

23. Long flexible material, like plates, etc., must be loaded on four bearing pieces, as shown in Figs. 11 and 12. The two center bearing pieces must, however, be 2 ins. lower than the end pieces and have the flat iron ½ × 4 ins. secured on their upper side, either with spikes having countersunk heads or with two ½-in. lag-screws at each end; these iron pieces, which are intended to facilitate curving, must extend at least 1 ft. beyond each side of the lading and must be coated with grease. The bearing pieces must be secured to the car, and the material clamped together to prevent it from shifting, in the manner described in paragraphs 12 and 18. If loaded in gondola cars with drop end doors, the same clearance must be provided between the lading and car sides as specified in paragraph 21.*

24. Large girders loaded on edge, as shown in Figs. 13, 14, 15 and 16, on two or three cars, either with or without idler, must be supported on two swiveling bolsters, which may be constructed either as a double bolster (Fig. 15) or a single bolster (Fig. 16). The double bolster is preferable for wide and heavy loads on account of the better distribution of the load over the car stringers, and must always be used when the width of the lading exceeds 3 ft. or its weight exceeds one-half the marked capacity of the car. Deep girders which cannot be loaded on double bolsters without exceeding the limit in height in paragraph 13, and low girders less than 3 ft. wide, may be loaded on single bolsters, provided that the weight carried by each car does not exceed one-half of its marked capacity. When double bolsters are used, the lower piece must be securely fastened to the car floor, as described in paragraph 12, and must be not less than 6 ins. deep by 18 ins. wide. King bolts, center bearings and side bearings must be used for either kind of bolster and both center bearings and side bearings for the upper bolster must move on corresponding bearings, secured either to the lower bolster or to the floor of the car, as the case may be. When wrought iron plates are used for side bearings with single bolsters, the lower plate must be fastened to the car floor with countersunk screws or with two lag-screws at each end placed at least 12 ins. away from sides of bolsters. The girders must also be secured to the upper bolster with diagonal tie-rods or braces, as shown in Fig. 17; if braces are used they must not be less than 3 × 8 ins. Diagonal side braces must be used between the top flange of the girder and the outer ends of the top bolster, as shown in Figs 15 and 16. When the lading consists of two or more girders standing side by side or lying on their sides, they must be securely fastened to each other as described in paragraph 12.


3"x4"x9"
9"x8" Oak
⅞"
9"
Fig. 20
3"x8"
9"x8" Oak Block with Rounded Ends
9"x4"x3," spiked to Car.
Oak Pieces, 3¾"x6"x12," Clamped to Couplers with 2, ⅝" Bolts, one on each Side
⅜"x2" Tie Pls
Fig. 21
Fig. 18
Car
9"
⅞"
8
Car
Fig. 19.
½" Pl.

Figs. 18 to 21.—Methods for Blocking Cars Apart.

25. The location of the bolsters depends upon the length and width of the girders, as well as upon their stability, and they should, if possible, be so placed that the length

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*If more than four bearing places are required to properly support the lading, the center pieces on each car must be provided with upright stanchions, as in paragraph 12.

of each overhanging end is not more than one-fifth, and the distance between the bolsters not less than three-fifths, of the total length of the girder. The following table gives locations of bolsters for girders of maximum length and width, based on clearance required on a 20° curve:

60 × 8 ft., or less, bolsters not less than 36 ft. bet. centers
70 × 7¼ ft., or less, bolsters not less than 42 ft. bet. centers
80 × 6½ ft., or less, bolsters not less than 48 ft. bet. centers
90 × 5½ ft., or less, bolsters not less than 54 ft, bet. centers

In case of material of less width than 5½ ft. but of greater length than 90 ft., applications must be made to the proper authority for special instructions.

26. To prevent overloading the following regulations must be adhered to:

(a) When only one bearing piece is used and its location is near the center of the car, as in Fig. 9. Flat cars having only two truss rods, weight of lading must not exceed one-half of marked capacity of car. Flat cars having more than two truss rods, and low side gondola cars, weight of lading must not exceed two-thirds of the marked capacity of car.

(b) When only one bearing piece is used and it is located about equal distance from center of car and center of truck, as on end car in Fig. 13. Flat cars having only two truss rods, weight of lading must not exceed two-thirds of marked capacity of car. Flat cars having more than two truss rods, also low-side gondola cars, weight of lading must not exceed three-fourths of marked capacity of car.

(c) When only one bearing piece is used, and it is located at or near the center of the truck, as on center car in Fig. 13, and on end car in Fig. 14, or on top of sides on high-side gondola cars in Fig. 10, the weight of the lading must not exceed one-half of the marked capacity of the car.

(d) When more than one bearing piece is used on each car as in Figs. 11 and 12. Flat cars and low-side gondola cars, weight of lading may equal marked capacity of car. High-side gondola cars, weight of lading must not exceed three-fourths of marked capacity of car.

27. The selection of cars to be used as idlers with loads, as shown in Figs. 13 and 14, must be governed by paragraph 15 (a).

28. The method of blocking cars apart, to be used when a load is carried on two adjacent cars, or when it is carried on two cars separated by an idler, is shown in Figs. 18 and 21, inclusive. Figs. 18 and 19 represent both the cars with ordinary drawheads. Fig 20 represents one car with M. C. B. coupler and the other car with ordinary drawhead. Fig. 21 represents both cars with M. C. B. couplers. In blocking cars apart they must first be separated by means of jacks until all the slack in the springs, couplers or links, if the latter are used, has been taken up; the spacing blocks must then be neatly fitted between the cars and secured in the manner shown. All wood used must be sound oak.

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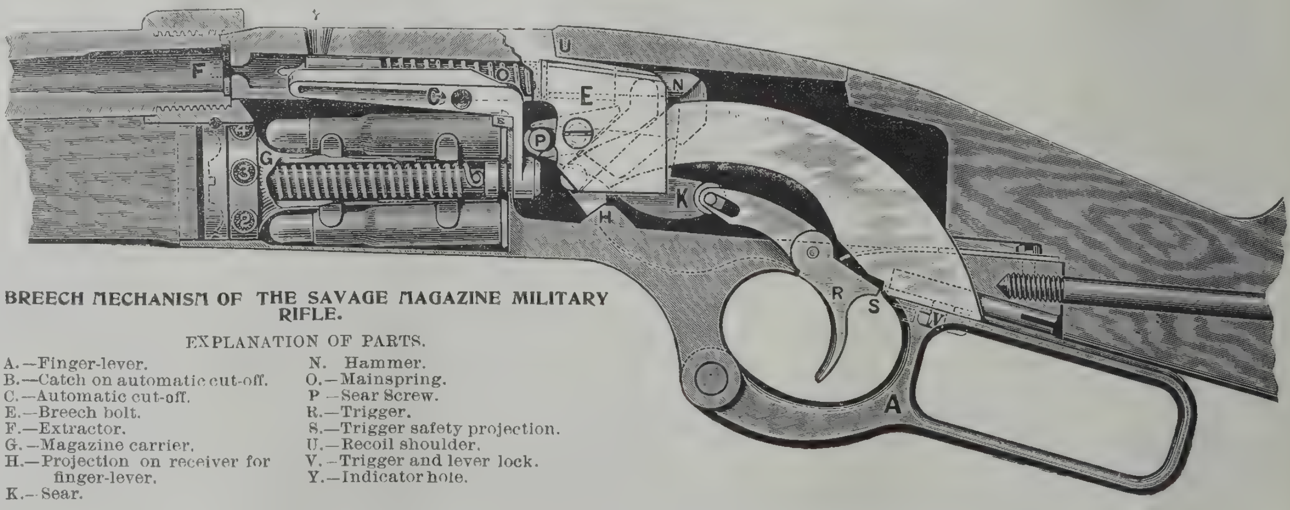
THE NEW RIFLE FOR THE NEW YORK MILITIA.

We show in the accompanying cut the breech mechanism of the Savage military rifle, which, as we stated last week, has just been selected by an able commission appointed to recommend an arm for the use of the New York State Militia. Twelve guns were submitted to the Commission for examination and tests, including such well-known weapons as the Lee and Winchester rifles. In reporting its decision the Commission gave the following high praise to the Savage gun:

> The Savage magazine rifle, lever action, magazine holding five cartridges, in strength and fineness of parts, very close compliance with the eleven "salient points" mentioned in the instructions for the consideration of the Board by the Adjutant-General, ease of manipulation and general all-round excellence, won the unanimous decision of the Board of Examiners as being clearly the best military magazine rifle submitted for their examination. We feel confident that with the Savage magazine rifle placed in the hands of the National Guard of the State of New York, a new life will be imparted to the art of target practice, great pride in the accuracy and beauty of the arm developed, and the very best weapon in the world for military purposes secured for their use.



BREECH MECHANISM OF THE SAVAGE MAGAZINE MILITARY RIFLE.

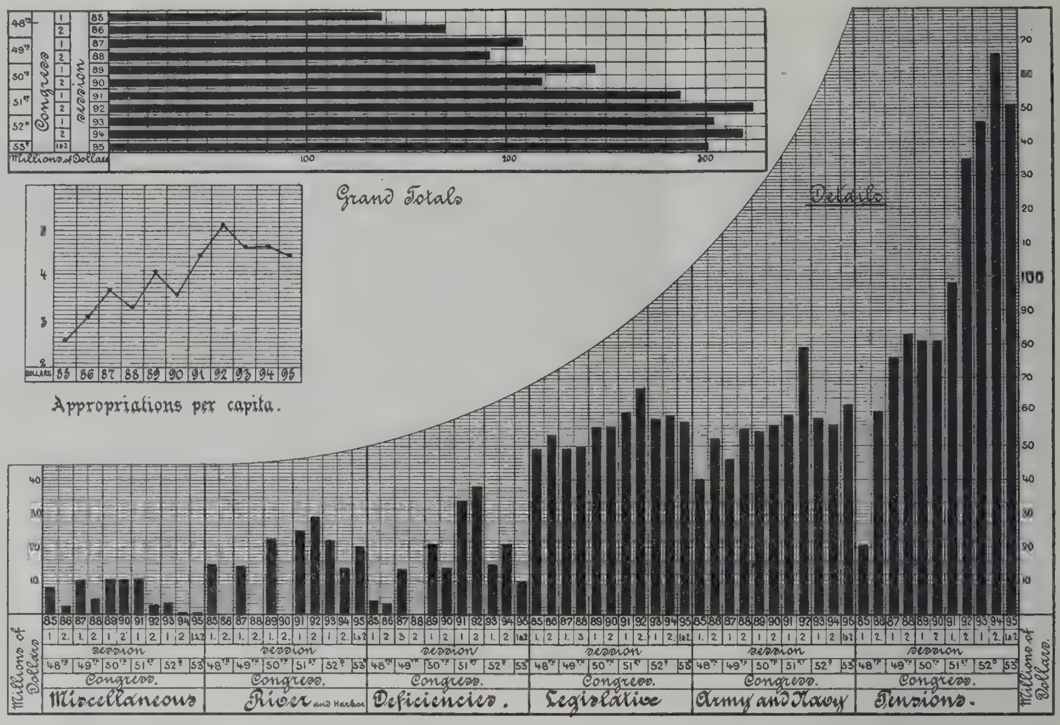
EXPLANATION OF PARTS.

A.—Finger-lever.
B.—Catch on automatic cut-off.
C.—Automatic cut-off.
E.—Breech bolt.
F.—Extractor.
G.—Magazine carrier.
H.—Projection on receiver for finger-lever.
K.—Sear.
N. Hammer.
O.—Mainspring.
P —Sear Screw.
R.—Trigger.
S.—Trigger safety projection.
U.—Recoil shoulder.
V.—Trigger and lever lock.
Y.—Indicator hole.

Our readers familiar with small arms will, we presume, be able to understand the construction of the Savage gun from the accompanying drawing, which shows the lever closed. The gun can be used either as a single loader or a magazine rifle as desired. Throwing down the lever opens the breech and permits the insertion of the cartridge directly into the chamber, when the gun is used as a single loader. The lever is then pulled up, forcing the cartridge home, closing the breech and cocking the firing pin. The trigger cannot be pulled to release the firing pin until the lever is forced to its seat and the breech is entirely closed. After the piece is fired the lever is pushed down, which extracts the empty shell and throws it to the right.

The magazine arrangement is remarkably compact and simple. The bulge or protuberance below the stock, which has been a feature of most magazine rifles, has been eliminated. An index shows at a glance the number of cartridges in the magazine. For military use it is believed that a magazine containing a small number of cartridges is better than one with a large number as with the former the soldier will not be as likely to waste his stock of ammunition.

The gun is made by the Savage Arms Co., of Utica, N. Y., to whom we are indebted for the illustrations given herewith.



APPROPRIATIONS MADE BY CONGRESS FOR THE FISCAL YEARS, 1885 TO 1895.

◆

THE EXPENDITURES OF THE UNITED STATES IN ELEVEN YEARS.

We believe that most of our readers will be interested in an examination of the accompanying diagram, which we reproduce from a recent publication of the Bureau of Statistics of the Treasury Department. It shows at a glance the increase in national expenditures from $140,000,000 in 1885 to over $280,000,000 in 1891; and also the fact that since 1892 this increase has been very properly checked, although there are no signs that the total outlay or the expenditure per capita will be reduced to where it was in the early 80's.

The most interesting part of the diagram is that which shows the amount of the appropriations for different purposes. Unfortunately, the distribution is not complete, there being no means of telling, for example, to what the "deficiency" or the "miscellaneuos" appropriations are applied. The different colors which in the original showed the proportion of the Legislative appropriation devoted to the Agricultural Department, the Consular Service, the District expenditures, etc., we have been obliged to omit in our reproduction.

It will be remembered that under the continuing contract system now in force, the River and Harbor appropriation represents, perhaps, a half of the present expenditure for works of this class. Even with this increase, however, it will be seen that the money spent on public works is less than half the amount required to carry on the various departments of the government, which are covered by the term "Legislative." The next division to the right represents the amount spent for national defence, which will be seen to constitute nearly a fifth of the total national expenditures. Pensions, however, are responsible for the great bulk of the increase in our national expenditures during the past decade, having risen from $20,000,000 to a present annual payment of $150,000,000 in that time. It seems practically certain that this item of expenditure will rapidly decrease from now onward, though, with the chances of future pension legislation and the possibilities of superannuation pensions being established in the civil service, it is doubtful whether the pension bill will be reduced to the figures of 1885 for many years to come, if at all.

RECORD OF STEAM SHOVEL WORK; ANN ARBOR R. R.

In a paper on "Improvement Work on the Ann Arbor R. R.," *presented at the meeting of the Michigan Engineering Society, in 1895, Mr. H. E. Riggs described the improvement work which has been carried out by that railway, and the most generally interesting part of the paper was the record of work done by steam shovels in cutting down the grades. This work has been done by the company direct, using steam shovels of various makes, all having dippers of 1½ cu. yds. capacity, while the material was plowed off the cars by a Barnhart center unloader hauled by the engine of the work train. The following is an extract from the paper, and the discussion thereon. The first part of the table is the record of work done in 1894, by the Toledo, Ann Arbor & North Michigan Ry., while the second part is the record of work done during the season of 1895, when the road was reorganized as the Ann Arbor R. R.:

The past season has been one of great activity, six shovels being at work, and for a greater part of the time we have worked both day and night shifts. This fact has rather impaired the value of our statistics, as all of our measurements are based on actual pit cross sections, and it was absolutely impossible to separate day and night work. In making up the statement, a night's work is counted as a day, thus affecting the average hourly output of the shovel. Another feature of uncertainty is the fact that the number of locomotives in attendance on the shovels varied from time to time, and the record of such movements was difficult to keep. The additional fact that no form of report was used, all data being compiled from daily telegraphic reports, made it impossible to secure as complete a record as was desired.

With this general outline I would submit the table of cost. All figures represent cost of earth under the track, including all labor of shovel crew, train crew and trackmen, fuel and supplies, but do not include any figures for rental of plant, repairs, or any charges for service of telegraph, station or other employees; nor do they include engineering or superintendence (other than foreman).

It is to be regretted that there is not more literature on steam shovel work, the work of Mr. E. A. Herrmann, in Engineering News, some two years ago, being the most complete discussion I have seen. (This is now published in book form.—Ed.) Records of cost of such work, however, are rare, and these are the most valuable information that can be had, for any one about to begin work of this nature. The steam shovel and its relation to railway reconstruction has been but little discussed, but this machine has a great future of usefulness in the work of railways, as will be seen by the work done on the Ann Arbor R. R.

The average cost for moving the material for the entire time will be about 14 cts. per cu. yd. The average haul was 2½ to 3 miles. On one piece of work we hauled as high as 20 miles, and very little was hauled less than half a mile. The average haul would be fully three miles. The cost of the work would have been much reduced if we had had the advantage of a double-track railway, instead of working on a single track. It is hard to say what per cent., but the greater portion of our delays were caused by the interference of regular trains on the road. On the south end of the road, particularly south of Dundee, where we have the trains of our own road and those of the Cincinnati, Jackson & Mackinaw Ry., we have had about 50 trains per day and the delay was considerable. We had one or two instances in the district where we did not average over 3½ hours work out of a ten-hour day.

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*"Michigan Engineers Annual;" 1896. Published by the Michigan Engineering Society; Secy., F. Hodgman, Climax, Mich.

RECORDS OF STEAM SHOVEL WORK.
(Toledo, Ann Arbor & North Michigan Ry.) Season of 1894.

LOCATION AND DATE.	TOTAL CAR LOADS.	TOTAL CUBIC YARDS.	Average yds. per Car.	Total Time W'rk'd, Days	Average Car Loads per Day.	Average Cu. Yards per Day.	Net Time W'rk'd, Days	Net Average Car Loads per Day.	Net Average Cu. Yards per Day.	TOTAL COST.	Av'ge Cost per yd., Cts.	REMARKS.
SHOVEL No. 1.												
Yuma ....April 12 to May 21	4200	34706	8.26	37	113.50	938.0	25.60	164.06	1355.0	$ 3655.16	10$\frac{53}{100}$	Sand; Short Haul
Park Lake...May 21 to June 29	2759	23185	8.40	34	81.14	681.9	21.23	130.00	1092.0	2912.82	12$\frac{56}{100}$	Gravel.
Dickinson's ..June 30 to Aug. 6	3559	20655	5 80	31	114.81	666.0	23.87	149.10	865.3	3280.22	11$\frac{04}{100}$	Clay. long haul.
Lake George.Aug. 7 to Oct. 3	4143	30428	7.34	48	86.31	633.9	28.66	144.56	1061.6	5118.78	16$\frac{82}{100}$	Sand. Clay. Quicksand.
Howell Gravel Pit...Oct. 9 to Nov. 23	2898	25731	8 88	44	65.87	585 0	23 87	121.40	1078.0	4403.71	17$\frac{11}{100}$	Long Haul.
	17559	134705								$19392.79		
SHOVEL No. 2.												
Oak Grove...April 2 to May 19	3911	26681	6 82	42	93 12	635.2	28.88	135.42	923.80	$ 3657.05	13$\frac{70}{100}$	Sand and Clay.
Pettysville ...May 20 to July 19	4512	31801	7.05	50	90.24	636.1	32.00	141.00	993.80	4782.32	15$\frac{03}{100}$	Cost Divides with
Howell Gravel Pit...July 20 to Aug. 8	1947	13527	6.95	17	114 53	795.7	11.55	168.57	1171.20	1508.32	11$\frac{14}{100}$	[New Line, Chilson
Pittsfield.....Aug. 9 to Oct. 31	5935	33534	5.65	63	94 20	532.2	44.57	133.16	752.36	6359.48	18$\frac{96}{100}$	Clay.
Clare .... Nov. 14 to Nov. 30	1753	......	......	....	......	......	......	......	......	......	......	......
	18058	......								$16307.17		
SHOVEL No. 3.												
Byron .... May 2 to June 10	1609	6000	3 72	30	53.63	200.00	11.10	144.95	540.55	$ 2754.28	45$\frac{9}{10}$	Wet Clay in Ditch.
Vernon.......June 11 to Aug 4	3341	19811	5 92	45	74.24	440.20	19.60	170.45	1010.76	4439.89	22$\frac{4}{10}$	Hard Pan and Clay
Corunna......Aug. 6 to Sept. 27	3787	25322	6 68	46	82.32	550.40	24.60	153.98	1029.34	5157.11	20$\frac{3}{10}$	" " " "
Monroe Junc..Oct. 1 to Oct. 16	407	4170	10.25	11	37.00	379.00	3.35	121.49	1244.75	654.08	15$\frac{6}{10}$	Sand.
Temperance .Oct. 15 to Nov. 12	1438	12984	9 02	26	55.30	499.38	9.10	158.02	1426.81	1859.66	14$\frac{3}{10}$	Sand.
	10582	68287								$14865.02		
SHOVEL No. 4.												
*Elsie Gravel Pit....July .. to Nov. ..	7122	62480	8 77	98	72 67	637 55	53.42	133.32	1169.59	$13356.80	21$\frac{3}{10}$	Long Haul.

Records of Steam Shovel Work (Ann Arbor R. R.) Season of 1895.

LOCATION AND DATE.	Total Car Loads	Total Cu. yds	Aver'ge yds. per car.	Total Time, Days.	Aver'ge Car l'ds per day	Aver'ge Cu. yds per day	Actual Time of Shovel hrs	Aver'ge Loads pr. hour	Aver'ge Cu. yds pr. hour	TOTAL COST.	Cost per yd. Under Track.	Character of Material.	REMARKS.
SHOVEL No. 1 (BUCYRUS S. S.)													
Millersville ....April 3 to June 20	6676	55934	8.37	68	98.19	822.56	......	......	......	$5509 59	$0.0984	Sand	......
Harrietta..........June 20 to July 13	2164	20017	9.25	19	113.90	1053.52	......	......	......	1773 35	.0886	Sand	......
Pittsfield ....July 15 to Aug 31	4913	32928	6.70	59	83.27	558.10	......	......	......	4377 61	.1331	Clay	......
Ann Arbor..........Sept. 2 to Sept. 29	2362	16910	7.16	46	51.35	367.61	......	......	......	3355 64	.1981	Gravel	Long Haul.
Milan..........Sept. 30 to Oct. 24	2490	23527	9.45	44	56.60	534.70	......	......	......	3266 29	.1388	Sand	......
Monroe Junction..........Oct. 25 to	......	......	......	......	......	......	......	......	......	......	......	Sand	Long Haul.
SHOVEL No. 2 (BUCYRUS S. S.)													
Farwell, 1st Cut ....April 1 to May 14	5028	31786	6.32	38	132.31	836.47	259.83	19.35	122.33	3095 04	.0973	Sand	......
Clare Clay Cut ....May 15 to June 21	3112	16415	5.27	31	100.39	529.52	200.50	15.52	81.87	2897 78	.1765	Clay	Hard Pan.
Farwell, 2d Cut..........June 22 to July 29	3176	29346	9.24	32	99.25	917.90	195.50	16.24	150.24	2669 55	.0908	Sand	......
Clare Sand Cut ....July 30 to Aug. 7	1359	8476	6.24	15	90.60	565.00	85.50	15.89	99.13	827 59	.0978	Sand	......
Lake George ....Aug. 7 to Sept. 18	4518	39724	8.79	66	68.45	601.88	323.50	13.96	122.79	4160 13	.1049	Sand and Clay	......
Clutes ....Sept. 19 to Sept 29	1205	13260	11.00	19	63.42	697.90	71.66	16.81	185.04	1354 12	.1021	Sand	......
Temple Clarence..........Oct. 2 to Nov. 2	2309	17652	7.64	40	57.72	441.30	123.66	18.67	142.74	2815 33	.1595	Quicksand	......
Temple, 2d Cut..........Nov. 3 to Nov 12	1124	9788	8.70	16	70.25	611.25	57.75	19.46	169.49	803 97	.0821	Sand	......
Howell Gravel Pit ....Nov. 14 to	......	......	......	......	......	......	......	......	......	......	......	Gravel	......
SHOVEL No. 3 (MARION S. S.)													
Samaria ....April 8 to April 20	717	6114	8.53	12	59.75	509.50	57.00	12.58	107.27	651 17	.1065	Sand	......
Howell Fair Grounds..........April 22 to July 17	5570	38514	6.56	74	75.27	493.43	414.33	13.44	88.12	5117 89	.1401	Clay	......
Howell Junction Gravel Pit ...July 18 to Aug. 2	2289	15905	7 10	33	67.85	481.97	115.50	19.37	137.70	2286 44	.1437	Gravel	......
Pettysville ....Aug. 2 to Aug. 27	1314	10233	7.78	21	62.60	487.30	114.25	11.50	89.56	1430 56	.1398	Quicksand	Very light face
Sexton's Cut ....Aug. 28 to Sept 23	1763	14175	8.04	34	51.85	416.91	126.33	13.95	112.20	2444 29	.1724	Sand	......
Howell Junction Gravel Pit ...Sept. 24 to Oct. 1	627	......	......	14	44.78	......	45.50	......	......	......	......	Gravel	......
Chilson, at Station .... Oct. 1 to Oct. 4	302	2231	7.38	7	43.14	318.71	26.67	11.32	83.65	386 12	.1731	Sand & Gravel	Very light face
Howell Junction, 1 mile south.Oct. 5 to	......	......	......	......	......	......	......	......	......	......	......	Clay	......
SHOVEL No. 4 (MARION S. S.)													
Samaria, South of ....April 22 to April 26	325	3595	11.06	5	65.00	719 00	21.83	14.88	164.68	914 66	.2544	Sand	All work lowering by hand chgd. against this cut.
Temperance ....April 27 to May 29	2874	23571	8.20	28	102.64	841.82	183.75	21.49	176.23	2546 62	.1080	Sand	
Pittsfield ....May 30 to July 12	3058	24378	7.97	37	98.70	658.86	174.17	17 56	140.00	2339 98	.0960	Clay	
Churchill ....July 15 to July 27	1184	7938	6.70	12	98.67	661.50	44.00	26.91	180.41	1074 20	.1353	Sand	
Bagnall ....July 29 to Aug 12	1788	16450	9.20	23	77.74	715.20	82.20	21.75	200.21	1066 63	.0648	Sand & Gravel	......
Dairs Creek ....Aug. 12 to Aug. 21	1026	8897	8 67	15	68.40	593.13	58.40	17.57	152.34	872 65	.0980	Sand	......
Betsey River, north { ....Aug. 21 to Aug. 30	3152	32489	10.30	32	98.50	1015.28	156.58	20.18	207.49	2444 31	.0722	Sand	......
" " { ....Oct. 21 to Nov. 5													
Crystal Lake Outlet ....Aug. 31 to Sept. 21	2181	20244	9.28	37	58.95	547.13	130.66	16.69	154.93	2384 86	.1178	Clay	......
" " ....Sept 23 to Sept. 30	834	16258	7.52	13	55.60	481.38	55.53	15.02	112.69	829 70	.1325	Sand	Light face
" " ....Oct. 1 to Oct. 12	1164	13066	11.22	19	61.26	687.68	73.17	15.90	178.57	1166 86	.0893	Gravel	......
Betsey River, south ....Oct. 13 to Oct. 20	835	8851	10.60	14	59.64	632.21	56.00	14.91	158.05	777 90	.0879	Sand	......
Frankfort..........Nov. 6 to Nov 12	562	4999	8.90	10	56 20	499.90	27.50	20.44	181.77	578 19	.1156	Sand	......
Homestead ....Nov. 13 to Nov. 17	495	4814	9.72	9	55.00	584.89	22.91	21.60	210.12	412 99	.0858	Sand & Gravel	......
" 2d Cut..........Nov. 18 to Nov. 28	595	5070	8.46	14	42.78	363.14	35.56	16.84	142.55	743 58	.1289	Sand	......
Temple ....Nov. 27 to	......	......	......	......	......	......	......	......	......	......	......	Quicksand	......
SHOVEL No. 5 (MARION S. S.)													
Dickinsons ....May 14 to June 20	1549	14630	9.44	19	81.53	770.00	......	......	......	1747 65	.1194	Clay	......
Park Lake..........June 21 to Aug 4	3601	36919	10.24	39	92.33	946.64	......	......	......	3775 61	.1022	Sand & Gravel	......
McBain ....Aug. 5 to Aug 9	505	4009	7.94	10	50 50	400 90	......	......	......	410 04	.1022	Clay	......
Cadillac ....Aug. 10 to Sept 1	2504	24152	9.64	31	80.77	779.10	......	......	......	1931 00	.0800	Clay	......
Lucas ....Sept. 2 to Oct. 31	6665	66563	9.98	102	65.34	652.58	......	......	......	7250 60	.1089	Sand	......
SHOVEL No. 6 (BAY CITY IND.)													
Durand..........July 22 to Sept. 21	4295	35206	8.20	84	51.13	419.12	......	......	......	5044 38	.1432	Clay	......
Oak Grove..........Sept. 24 to Oct. 2	499	3500	7.01	13	38.39	269.23	......	......	......	1076 26	.3075	Clay	......

* * *

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Right to Trim Overhanging Trees.

A traction company authorized by the city to erect its trolleys has the right to top the branches of trees overhanging the street when such act is reasonably necessary for the passage of its wires.—Dodd v. Consol. Traction Co. (Supr. Ct. of N. J.) 31 At. Rep. 980.

Liability of Municipal Officers.

Municipal officers will not, in the absence of malice or culpable negligence, be personally liable for damages caused by constructing a sewer across private premises under the authority of the city.—Parks v. City Council of Greenville. (Supr. Ct. of So. Car.) 21 S. E. Rep. 540.

Contract for Street Lighting.

A city, before the expiration of its contract with a gaslight company for street lighting, discarded the use of gas, and adopted electric light. The gas company continued to light its street lamps and sued for the gas so consumed. Held that it could not recover, its remedy being only for the breach of the contract.—City of Newport v. Newport Light Co. (Ct. of App. of Ky.) 30 S. W. Rep. 606.

Damages Not Limited to Bill Presented.

Where a party having sustained a personal injury for which he claims that a city is liable, presents his bill to the city council for allowance, and is by it disallowed, he may sue for and recover all damages sustained, though such damages exceeded the amount claimed in the bill, and on such judgment recover also costs.—Oklahoma City v. Walsh (Supr. Ct. Ok.) 41 Pac. Rep. 598.

Removal of Snow by Street Railways.

A city ordinance providing that when snow falls of a sufficient depth for sleighing, no snow plow shall be allowed on the tracks of a street car company, and that it shall not remove snow from its track without the consent of the superintendent of streets or mayor, does not prohibit the use of snow plows when the consent of the proper officer has been obtained.—Ovington v. Lowell & S. St. Ry. Co. (Supr. Jud. Ct. of Mass.) 40 N. E. Rep. 767.

What Must Be Shown to Recover Damages.

Where the evidence shows that one's premises abutting on an elevated railway had increased in value since the road was built, he cannot recover for damages to such premises caused by construction and operation of the road, unless he shows that there has been a general advance in the value of property in the neighborhood, not attributable to the road, of which he was deprived by the construction of the road.—Beck v. Brooklyn El. R. Co. (Supr. Ct., Gen. Term, 2d Dept.) 33 N. Y. Sup. Rep. 764.

Liability of City for Failure of Duty by Board of Health.

The duty of keeping the streets clear of putrid and other substance offensive to the sense of smell, and which tends to imperil the public health, devolves, under the charter of the city of Atlanta, upon the board of health of that city; and the functions of this department of the city government being governmental, and not purely administrative in their character, it follows that if, in the exercise of such functions, and in the discharge of the duties devolving upon this department, a private citizen is injured by the negligence of one of its servants in and about such work, no right of action arises against the city. In order to exempt a city from liability, it is not sufficient to show that the particular work from the negligent performance of which by the servants of the city a citizen was injured was being performed under the direction of the health authorities, but it must be shown that the particular work so being done was connected with or had reference to the preservation of the public health. If the health department were engaged in clearing away or removing obstructions from the street which in no way endangered the public health, the responsibility of the city then would rest upon the rule of liability for the work connected with repairing and keeping in order the public highways. It can make no difference in principle as to the character of the agents employed in the discharge of this duty with respect to the public health. The principle of non-liability rests upon the broad ground that in the discharge of its purely governmental functions, a corporate body to which has been delegated a portion of the sovereign power is not liable for torts committed in the discharge of such duties and in the execution of such powers. It can be no more liable because of the fault to select competent drivers of garbage carts than a city could be held liable for failing to elect a wise, conservative and discreet mayor.—Love v. City of Atlanta. (Supr. Ct. of Ga.) 22 S. E. Rep. 29.

* * *

BURNSIDE SHOPS, ILLINOIS CENTRAL R. R.

(With inset.)

III.

Car Shops.

In the two preceding articles describing this railway shop plant the track and ground constructions, minor buildings, buildings common to both locomotive and car work and the locomotive shops have been described and illustrated. In this article the car shops and heating system are described.

The car shops at the Burnside plant comprise six buildings as follows: Mill Building, Passenger Car Repair Shop, Freight Car Repair Shop, Passenger Car Paint Shop, Dry Kiln, and Dry Lumber Storage House. All of these buildings are grouped at the north side of the plant, and each will be described in such detail as its structural features seem to warrant.

Mill Building.—The mill building is 362 ft. 2 ins. long and 160 ft. wide, with a 45 × 100 ft. annex on the east side for the power plant, which runs the various wood working machines. Fig. 18 shows a transverse and a part longitudinal section, which give the roof trusses and other iron work in outline. A row of columns, 40 ft. apart, extends the length of the building at the center and carries a longitudinal truss. The roof trusses are spaced 20 ft. apart and connect at the center alternately with the columns and with the longitudinal truss. Fig. 19 shows the details of both styles and connections, and the column construction. At the outer ends the roof trusses rest on the walls to which they are anchor-bolted through oblong holes to allow of motion due to expansion. The purlins are 8 × 12 ins. × 22 ft. timbers, placed at panel points, and the jack rafters are 2 × 6 ins. timbers spaced 2 ft. c. to c. and covered with 6 × 1⅛ in. matched sheeting covered with "Actinolite" composition roofing. Fig. 20 shows the construction of the longitudinal truss and also the longitudinal ridge truss of the skylight frame. Other details of the skylight framing are shown by Fig. 21. The trussed purlins indicated by Fig. 18 in outline are of the same character of construction as the longitudinal center truss.

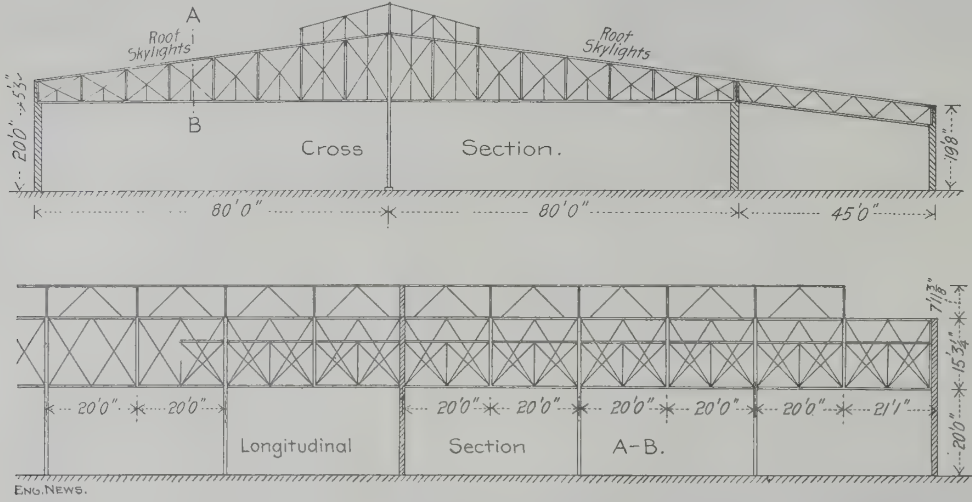


FIG. 18.—TRANSVERSE AND PART LONGITUDINAL SECTIONS OF MILL BUILDING SHOWING FORM OF FRAMING.

Besides the lantern or ridge skylight there is a row of smaller roof skylights on each side and occupying the space between panels three and four of the roof trusses, as shown by Fig. 18. The design and construction of one of these roof skylights are shown by Fig. 22. This drawing gives the construction in such detail that further description of that feature is unnecessary. This form of skylight was adopted on account of the flatness of the roof which made the ordinary form of flat skylight undesirable. Experiments showed that a slope of 1 in 4 at least was necessary to prevent the gathering and dripping of condensed moisture on the under side of the glass, and these skylights were designed to avoid such trouble.

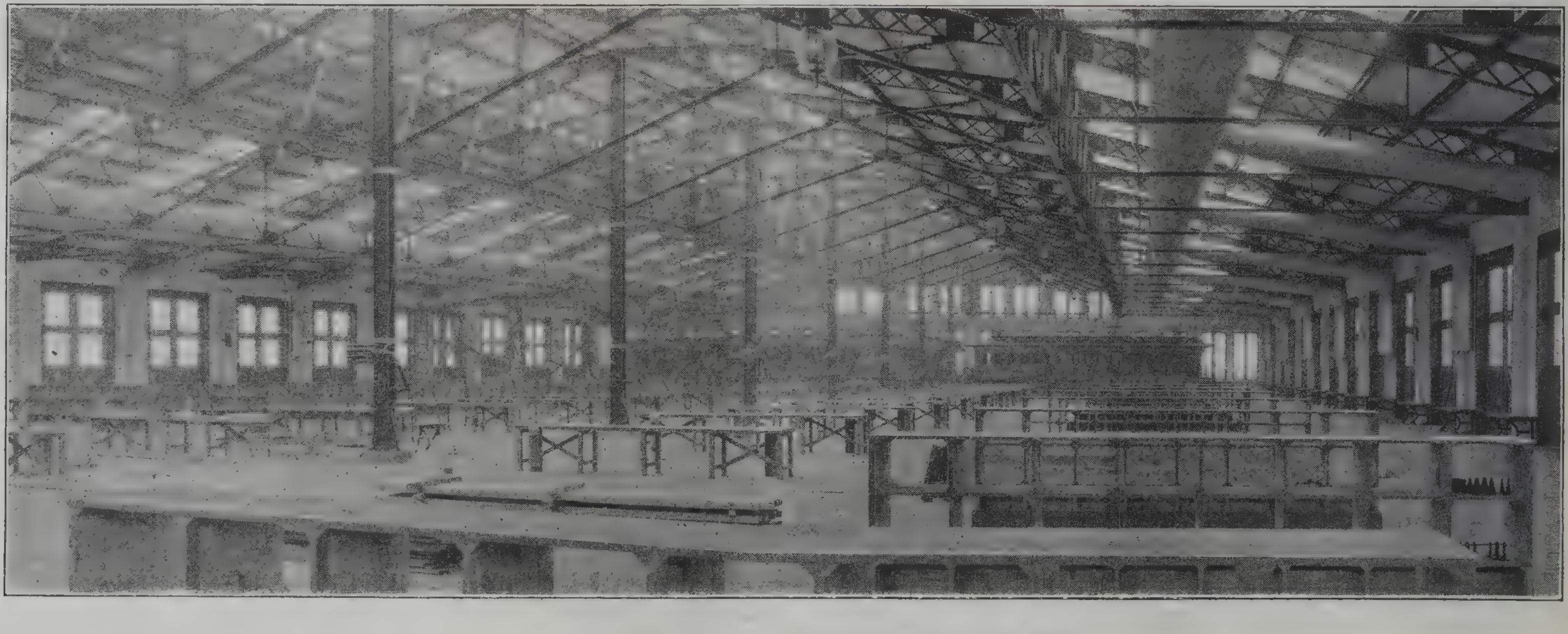


FIG. 24.—INTERIOR VIEW OF PASSENGER CAR REPAIR SHOP.

The interior arrangement of the building is simple. At a distance of 120 ft. from the south end, the building is divided by a transverse brick firewall, having double doors of ⅛-in. sheet iron. This portion of the building is divided by wooden partitions into a truck shop, 120 × 60 ft., a cabinet shop, 120 × 60 ft., and an upholstering shop, 120 × 40 ft. North of the fire wall the building is devoted to general wood working machinery. In the annex or engine house are a 400-HP. Sioux City Corliss engine for running the machinery, and a 20 × 30 ins. duplex Rand air compressor, capable of furnishing 1,800 cu. ft. of free air per minute compressed to 150 lbs. pressure with 80 lbs. steam pressure. This air is piped to all parts of the shops and grounds for various purposes. The heating apparatus for the building is also located in the engine house.

It may be noted before leaving the description of this building that the location and arrangement of the tracks entering it and all the other buildings as well, were shown on the general plan of the whole shop plant, published in our issue of June 18. Details of the track and floor construction for the mill building, however, are shown by Fig. 24, this floor being the same in its general features as that for the passenger car repair shop described further on.

It is almost unnecessary to say that this building is used for preparing all timber used in the car repairs, it being sawed, planed and otherwise worked into shape here. Push car tracks connect it with the dry kiln and dry lumber storage house which are described further on.

Passenger Car Repair Shop.—This building is the same size as the mill building, 362 ft. 2 ins. × 160 ft., and, as in the mill building, a center row of columns carries a longitudinal truss, which, together with the columns, support the roof trusses at the center. The columns are spaced 40 ft. apart and the roof trusses 20 ft. apart. Fig. 23 shows the general design of the roof trusses, longitudinal trusses and longitudinal trussed purlins, and the interior view, Fig. 23, will aid to an understanding of the general arrangement and construction of the same parts.

The top chords of the roof trusses have a triangular lateral bracing and carry Z-bar purlins upon which are the wooden jack rafters, sheeting, and "Actinolite" composition roofing as in the mill building. The building also has the ridge lantern and side skylights, but the latter instead of being raised as in the mill building are flat. Altogether 2-7 of the roof area is glass and as a consequence the interior of the building is very light, as will be seen from Fig. 24.

The interior of this building is not subdivided, it being devoted entirely to one use, namely, passenger car repairs. A series of 18 parallel tracks with a capacity of 36 cars at one time cross the building transversely and onto these the cars are run for repair. Fig. 25 shows the track and floor construction. Between each pair of tracks the floor space is given up to racks and benches and to the use of the workmen, as shown by Fig. 24. This view also shows the piping for the heating system, the system of side doors, and minor details of construction and equipment.

These side doors are deserving of further mention, and in Fig. 26 are shown one type of double door and a push car door. The doors of the second type are of the same dimensions, but the construction is different, they being divided transversely about midway up, so that the bottom half can be opened independent of the top half. Owing to this construction the suspension rods extend from the top outside corners to the bottom inside corners of the upper doors only. The bottom windows also, instead of being the same size as the top windows, 4 ft 6½ ins. × 4 ft. 6½ ins., are only 2 ft. 5½ ins. × 4 ft. 6½ ins. There is also no wicket door in the main doors. Altogether there are 21 doors of this type, 14 of which are in the mill building.

Passenger Car Paint Shop.—This building is located just east of the passenger car repair shop, and is of the same size. A transfer table between the two buildings provides for the easy transfer of cars from one to the other. The framework of the building is also very similar in all respects to that of the passenger car repair shop. About one-half of the roof area is glass, making it very light.

At the north end of the shop there are three small rooms, devoted, respectively, to cleaning brass work and car fittings; to the storage and mixing of paints, and to the storage and preparation of varnish. The main portion is crossed transversely by 17 parallel tracks, on which the cars are stored for painting. The track and floor construction are shown by Fig. 27. Owing to the

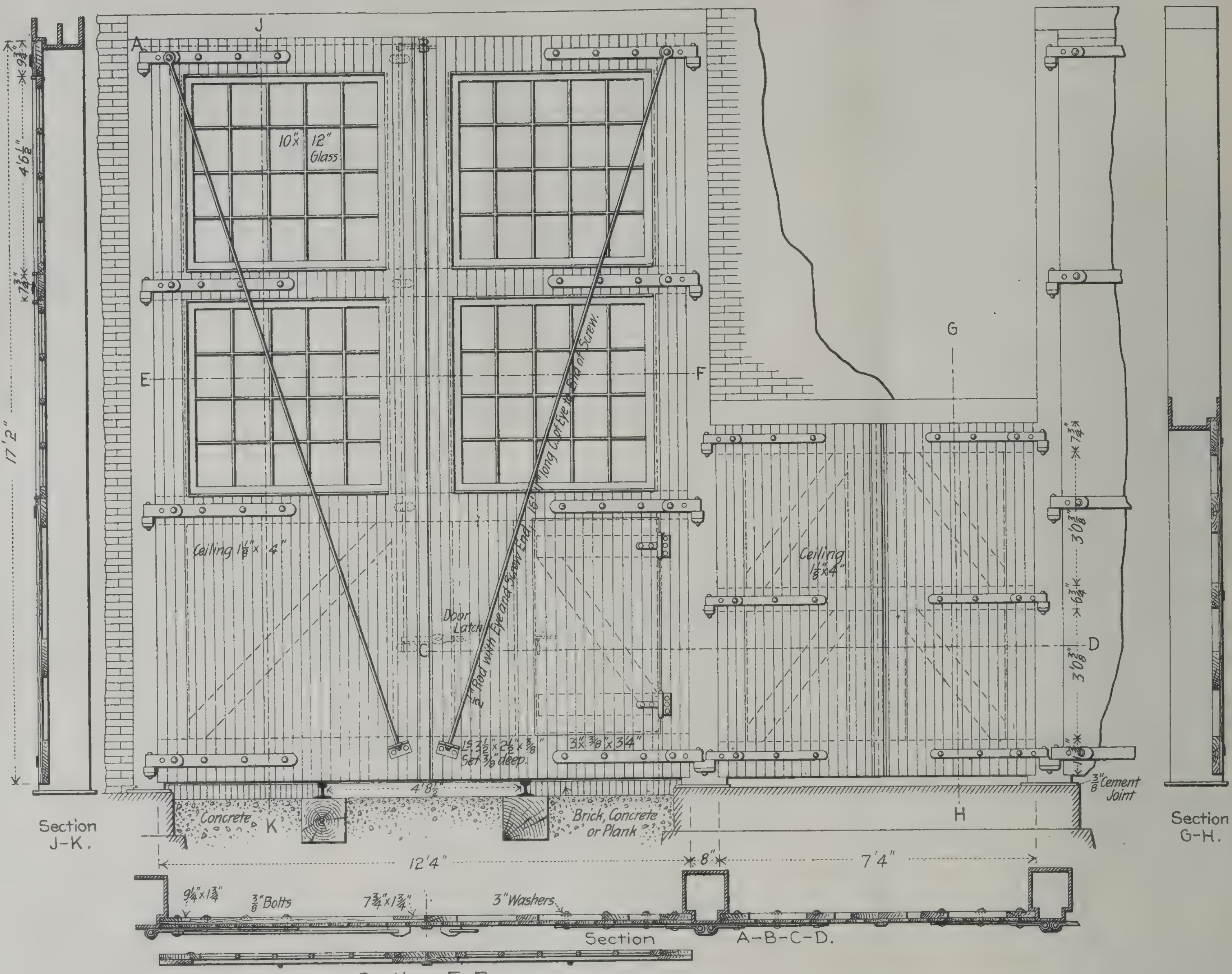


FIG. 26. DETAILS OF STANDARD DOUBLE DOORS.

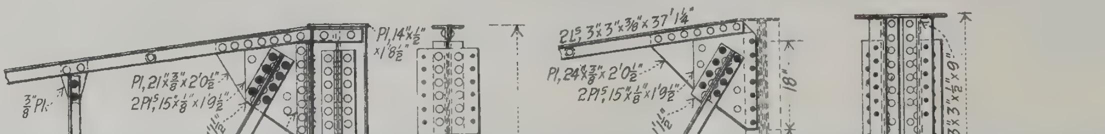


FIG. 19.

DETAILS OF CONNECTIONS BETWEEN ROOF TRUSSES AND LONGITUDINAL CENTER TRUSSES.

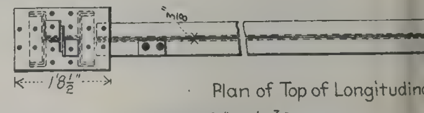


FIG. 20. DETAILS OF LONGI

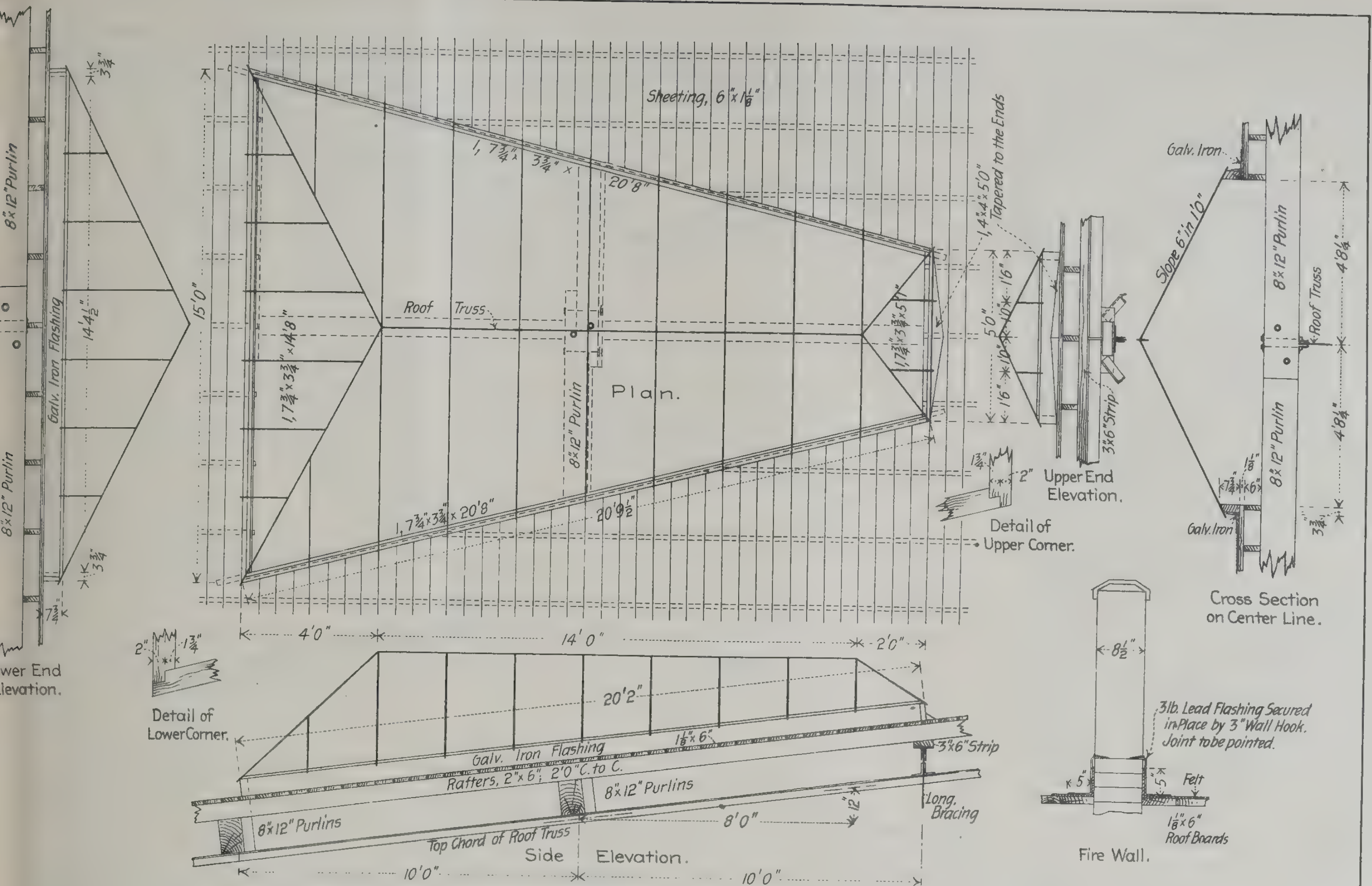


FIG. 22. DETAILS OF FRAMING FOR ROOF SKYLIGHTS.

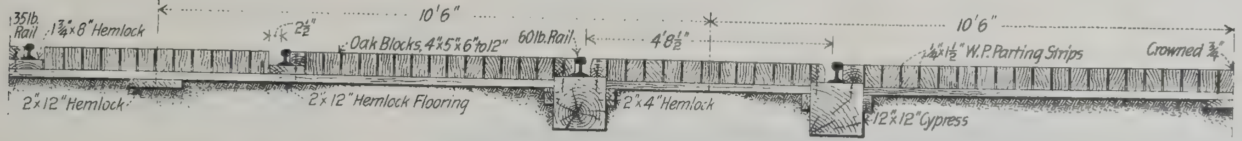
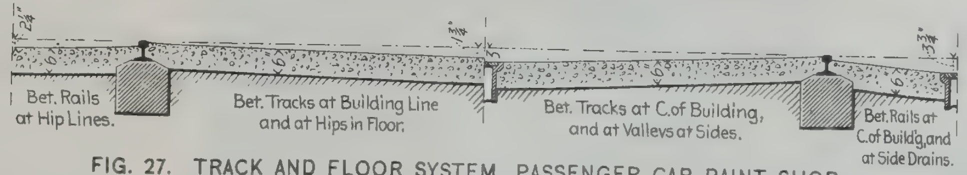
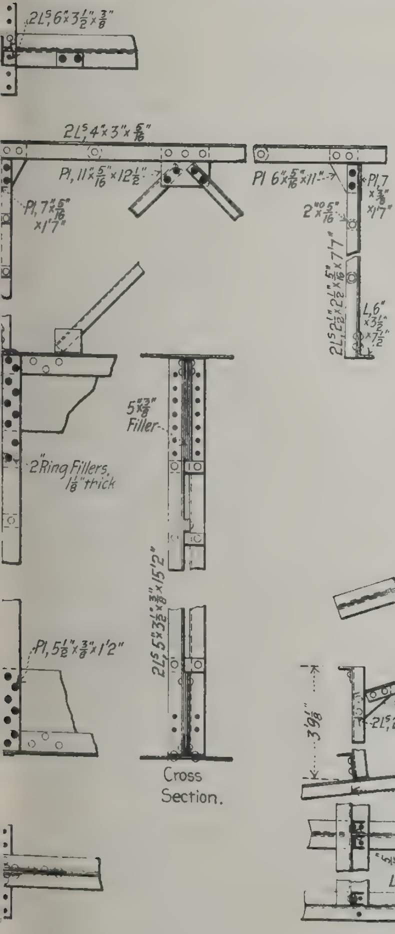


FIG. 29. TRACK AND FLOOR CONSTRUCTION, FREIGHT CAR REPAIR SHOP.



Bet. Rails at Hip Lines.
Bet. Tracks at Building Line and at Hips in Floor.
Bet. Tracks at C. of Building, and at Valleys at Sides.
Bet. Rails at C. of Build'g, and at Side Drains.

FIG. 27. TRACK AND FLOOR SYSTEM, PASSENGER CAR PAINT SHOP.



TRUSS.

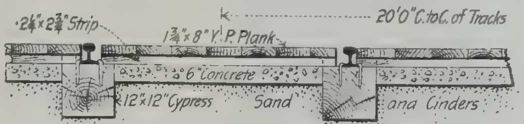


FIG. 25. TRACK AND FLOOR CONSTRUCTION,
PASSENGER CAR REPAIR SHOP.

GENERAL SHOPS

ILLINOIS CENTRAL R. R.,

BURNSIDE, ILL.

John F. Wallace, M. Am. Soc. C. E.,
Chief Engineer Illinois Central R. R.

H. W. Parkhurst,
Engineer Bridges and Buildings,
Illinois Central R. R.

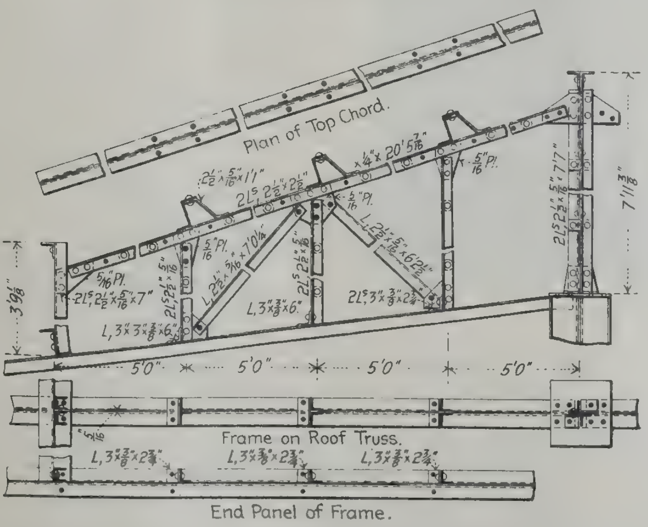


FIG. 21. DETAILS OF FRAMING FOR LANTERN SKYLIGHT.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

large amount of water used in washing and the drippings from the cars this floor is of concrete and so troughed that drainage is rapid to the sewer pipes underneath it. These sewer pipes run lengthwise of the building, one near each side and one at the center. On the lines of these pipes there are open gratings and connecting pipes between the rails of each track, and also at the center of the floor spaces between tracks. Midway between the side and center lines of pipe the floor is crowned.

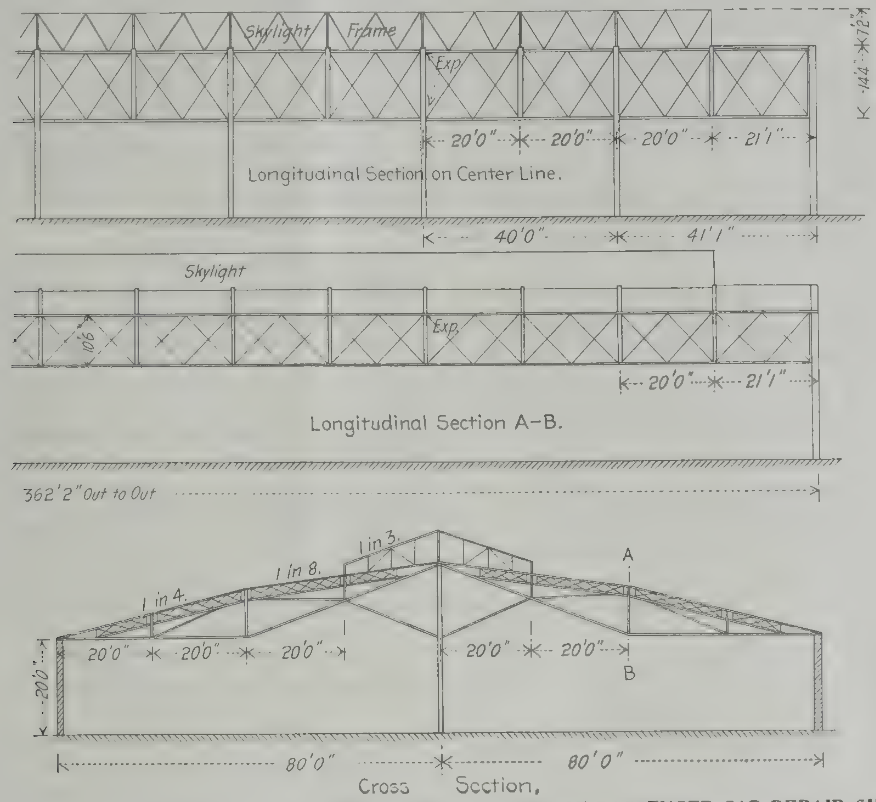


FIG. 23.—TRANSVERSE AND PART LONGITUDINAL SECTION OF PASSENGER CAR REPAIR SHOP.

Freight Car Repair Shop.—This building is 502 ft. 2 ins. long and 100 ft. wide, and the roof trusses span it from wall to wall without intermediate columns, as is shown by the interior view Fig. 28. The ridge lantern is the same as for the other buildings described, and the roof skylights are of the raised trapezoidal type already described for the mill building. Four tracks run lengthwise of the building which is not subdivided. Fig. 30 shows the track and floor construction.

The tracks in the building have a capacity of 44 35-ft. cars at once, and here all of the heavy repair work will be done. The yard tracks at the west end of the building will also be used for cars needing light repairs. Both this shop and the passenger car repair shop are thoroughly fitted with pipes for compressed air, which will be used to operate jacks, hoists, and such other power appartus as may be used.

Dry Kiln.—This building calls for attention chiefly on account of the system of drying used. At one side of the building is a small annex in which are located a Sturtevant heater and fan of the construction described farther on under the head of Heating System. From this heater a large supply pipe passes transversely across the building underneath the floor near one end. Right angle branch pipes, six in number, convey the hot air from the main pipe and discharge it through the eighteen 15-in. openings in the floor. At the opposite end of the building the hot air is exhausted into ducts which lead it back to the heater again, or it is sent to the outside—if rapid drying is desired. The lumber is run into the building on special tracks, and then subjected to the circulating hot air until seasoned. It will be seen that the system described is the well-known "Sturtevant Patent Progressive Lumber Dry Kiln," of the B. F. Sturtevant Co., of Boston, Mass.

Dressed Lumber Storage House.—This building calls for no extended description. It is used to store seasoned and dressed lumber and is 100 ft. long and 75 ft. wide.

Steelwork.—The general design of the steel framework for the different car shops has been described. Two classes of material were called for by the specifications, soft steel for rivets and medium steel for all other parts. All steel was required to be made by the open hearth or Bessemer process, and to contain not more than 0.1 of 1% of phosphorus or 0.6 of 1% of sulphur. In tests of ¾-in. diameter bars it was to show the following results:

	Ult. strength, lbs. per sq. in. Max.	Ult. strength, lbs. per sq. in. Min.	Min. elastic limit, lbs. per sq. in.	Per cent. Elong.	Per cent. Reduc.
Medium steel	66,000	58,000	38,000	20	44
Soft steel	58,000	50,000	30,000	28	50

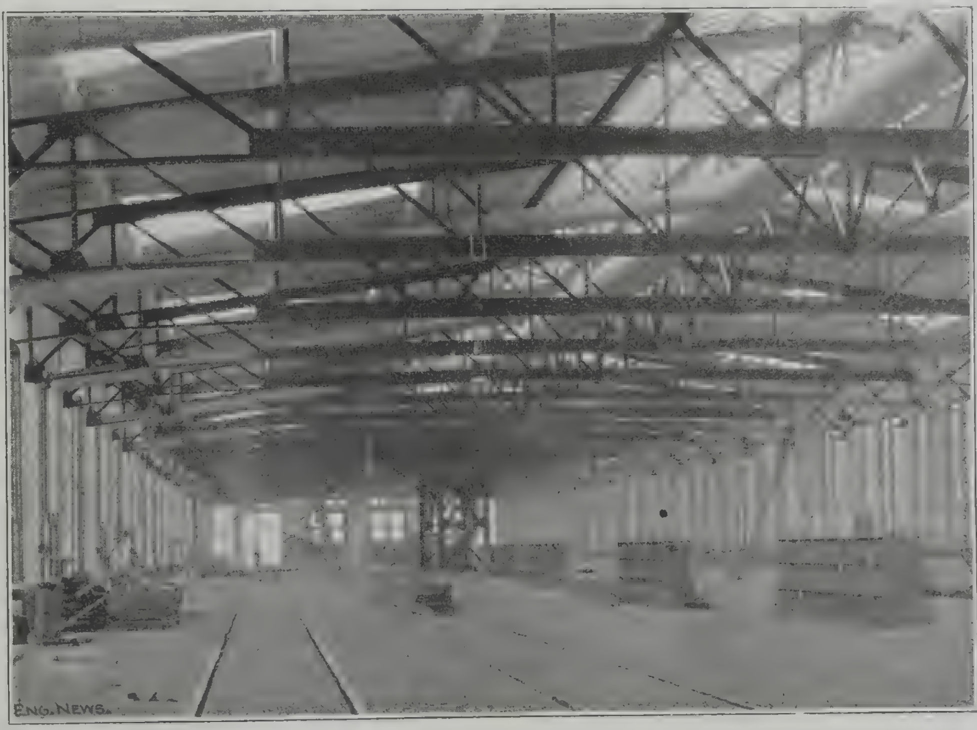


FIG. 28.—INTERIOR VIEW OF FREIGHT CAR REPAIR SHOP.

The usual bending and drifting tests and a chemical analysis were also required. All material was inspected before shipment. Before leaving the mill all material was cleaned and given a coat of raw linseed oil, and after erection it was given two coats of paint.

The steel was furnished by Carnegie and manufactured by the American Bridge Works, of Chicago, Ill.

Heating System.—The immense areas of these shops introduce a problem in heating which could be solved only by a very extensive and efficient plant. After full consideration it was decided to adopt the B. F. Sturtevant Co.'s hot blast system, the essential features of which is well-known consist of the steam coils, the air duct leading all over the building to be heated and the blower or fan for forcing the hot air through the duct. The advantage claimed for this system is that the air is kept in motion and does not become robbed of its heat by coming into contact with cold walls, and other large exposed surfaces. The hot air is discharged near the floor, and in ascending is claimed to give an even temperature.

The details of the heating system differ somewhat in each building, but the general design is the same for all. Referring to Fig. 23, showing the interior of the passenger car repair shop, it will be seen that two large air pipes pass lengthwise of the building, one on each side of the roof. These two pipes are carried by the roof trusses, and from them at intervals pipes extend at right angles along the roof slope to the side walls and then bend down by means of an elbow. Hot air from the two main pipes is thus discharged near the floor at the side walls.

The heating apparatus proper consists of a rectangular system of steam coils inclosed in a box, one end of which is open for the entrance of air, and at the other end of which is placed the fan or blower. This blower is operated by an independent engine which exhausts into the steam coil and supplies the heat necessary to warm the air. The operation is obvious. Air is sucked into the box between the steam coils and then forced into the system of supply pipes. In the paint shop the air is taken from the outside to secure the best possible conditions for drying paint, but in the other buildings it is taken from within and thus is simply circulated about therein. In the freight car repair shop the fan is 20 ft. 5 ins. high and 5 ft. wide, and is run by a 8 × 20 ins. engine. The coil has 12,000 ft. of 1-in. pipe. In the other three car shops the fans are 20 ft. 5 ins. high and 6 ft. wide, and are run by 11½ × 16 ins. engines. The heating coils each have 14,500 ft. of 1-in. pipe. In a previous paragraph the heating plant for the dry kiln has been described.

In the foregoing paragraphs, and in the two articles preceding the various structural features of the great shop plant of the Illinois Central R. R., at Burnside, Ill., have been described. The study of the drawings presented furnish many suggestions for thought which have not been mentioned, however, and in our editorial columns some of these have been considered.

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The deficient force of the city engineering departments of many of our cities is brought to mind by some comments in the "Call," of Newark, N. J., regarding the size of the engineering corps in that city. Recent severe storms in Newark have greatly overtaxed the facilities for the removal of surface drainage. The "Call" states that the lack of proper drainage facilities has caused much loss to individual property owners and the city as a whole, and discusses the demand for larger storm sewers, the overhauling of gutters, and the protection of walks and cellars. In speaking of the work that should be done it calls attention to the need of a larger engineering staff as follows:

> The real obstacle to this is in the engineering department. There are excellent workers in this branch of the city government, but it is absurdly inadequate in the number of men and in the amount spent for engineering purposes. The city is, for instance, required at the present time to maintain a constant engineering supervision over the water-works, both as regards the old construction and the new. This will continue after the city has acquired full control, and is likely to grow greater. It now takes most of the time of the chief engineer and one assistant. For the rest of the force there is the sewerage system, the paving, the grading and opening of streets and a thousand and one details. How the two or three men available now manage to get through with the work it is hard to guess. That they could do more, yet do it thoroughly, no one believes. The city has never been willing to spend enough money in this line, and it is proving an expensive economy. More liberal ideas should control, and with the enormous amount of work under way or impending, the subject can not be considered too soon.

When a daily paper urges an increase in the engineering force of a city it may be pretty generally assumed that such an increase is needed, but it is only fair to say that this particular paper discusses public improvements with unusual discernment.

We shall not venture to discuss the needs of Newark, but the representations made by the "Call" are entirely in accord with the conditions in many other localities. Happily there are a growing number of instances where the economy of employing a sufficient number of competent engineers is recognized, and where it is also perceived that the only way to get and keep good men is to pay them ample salaries. Where large sums are being paid out yearly for public improvements a thoroughly competent engineer will save a city daily the difference between the yearly cost of his services and those of an incompetent man. Where not enough engineers, even of an indifferent character, are employed, the saving might be even more marked if such folly were abandoned and the right course pursued.

Vast improvements are being made in methods of carrying out all classes of public works. The municipality that does not employ engineers thoroughly abreast of the times is continually liable to adopt discredited methods. These will lead to heavy yearly charges for a time, and then have to be abandoned, where the proper course would have meant light annual cost for maintenance and long years of useful service. In engineering, if anywhere, "the best is none too good." There is here, as elsewhere, a limit to what one man can do and do well.

Possible further economies in railway operation and in railway service are the subject of a good deal of discussion at the present time, when competition and bad financial conditions are combining to reduce railway earnings, and such conditions are a spur to good managers to devise new methods by which they may legitimately reduce expenses and work the equipment more economically without reducing the efficiency of the service. The Erie R. R. has recently introduced two somewhat notable improvements in operation which may be expected to produce a decided economy. In the first place it has adopted the system of rating freight trains on a tonnage basis, instead of by the number of cars. This system has been very much discussed of late and the discussion has shown that under the ordinary practice there is no uniformity in the train loads, since a large proportion of the cars contain but a very small percentage of their freight carrying capacity, so that an engine hauling its full complement of cars may be loaded far below its economical capacity, while the dead load of the train is out of all proportion to the paying load which it carries. Under the new system the cars are, as far as is consistent with prompt and efficient service, loaded to the proper capacity, and the weight of the freight in each car is made out on the way bills, so that the men in charge of making up the trains can readily see how many cars may be attached to a certain class of engine. This system is found to work very well and very smoothly, even with connecting roads, and it not only tends towards economy in general operation, but also enables the locomotives to be worked under conditions more favorable to economy and efficiency of the motive power equipment.

The second improvement above noted is directly in connection with the economical operation of the motive power equipment, and consists in doubling the run of the passenger engines from Jersey City. Formerly one engine hauled a through train from Jersey City to Port Jervis, 88 miles, and then another engine took the train on from Port Jervis to Susquehanna, 104 miles. Now, however, one engine makes the through run of 192 miles, and it is easy to see that a considerable economy in fuel consumption may be expected, since the longer the engine is kept in regular service on the road (that is to say, the longer its straight run) the less will be the amount of fuel lost in banking and rekindling the fires. If an engine makes a run of 88 miles and then goes into the yard or round-house to wait for some hours before going on the road again, it will manifestly be handled to less advantage as a machine than if it makes a run of 192 miles before laying up. As to the question of repairs, there seems to be no reason why these should be increased; in fact the boiler is likely to be less severely strained if worked uniformly for a greater period of time between the banking of the fire. A few years ago, when the Strong locomotive, with double corrugated flue furnaces, was being tried on different roads, one of the claims made for it was that the use of two independent fires enabled the fires to be kept bright and the grates clean for a much longer run than was practicable with the ordinary locomotive having but a single fire. This engine, on one occasion, made the through run of over 400 miles, from New York to Buffalo, over the Erie R. R., hauling the regular day express, and returning with the eastbound express on the next day. The number of men required to feed the fires, to tend the doors, and to pass the coal down to keep a supply on the tender deck, made the run of little moment from an economical point of view, the experiment being mainly with a view to showing the practicability of increasing the direct run of locomotives. If an ordinary engine with its regular crew can successfully make a run of 192 miles instead of 88 miles, it probably means that another element in economical operation has been introduced. It is not improbable that the runs of freight engines on the Erie R. R. may be increased in the same way.

We are informed that the bridge which fell under an electric car of the Dayton Traction Co., on July 1, as noted in our issue of July 9, was not a wooden structure but a new steel bridge. What the merits or demerits of the structure may have been, we do not know; but it is evident that a steel truss is not proof against the impact of a derailed car, and that this accident ought not to be passed over merely as another case of a weak and flimsy bridge falling under a load. The lesson which these and other recent accidents ought to carry to engineers is that proper guard rail protection should be provided on all through-bridge spans crossed by electric railways to prevent a derailed car from running into and wrecking the trusses.

THE ARRANGEMENT AND CONSTRUCTION OF RAILWAY SHOP PLANTS.

Division of labor is to-day recognized as an essential characteristic of manufacturing. It has been found that in no other way can production be made so rapid and so economical in material and labor. To produce a manufactured article a number of processes are required, each different from the other, in the appliances used, and the character of skill required of its working force, but all co-operating to the same end—the production of a single, complete, marketable article. In designing a manufacturing plant, then, it follows that this differentiation of appliances and manual skill must be recognized if the best use is to be made of the mechanical power and the cunning of workmanship, of its equipment of machines and men. The railway shop plant is a kind of manufacturing plant, and the same principles which apply to the successful operation of other manufacturing plants apply to its operation.

On another page we conclude the description of the shop plant of the Illinois Central R. R., at Burnside, Ill., one of the largest and most modern plants of the kind in this country. In view of these facts it has seemed profitable to consider briefly some of the salient features of good construction and arrangement which that plant seems to exemplify, and to draw from them such lessons as may be profitable in the light of the conditions usually governing the construction of such plants.

Perhaps the first question which comes up in the construction of a railway shop plant is its location. We have already discussed this question at length in relation to general manufacturing plants, in our issue of April 9, but the conditions with railway shop plants are somewhat different. Their products are not for the general market. Like the repair shops of a manufacturing establishment, railway shops are merely an accessory to the various processes necessary to produce the marketable material, which is for railways safe and rapid transportation of passengers and freight. The location of the plant, then, has to be considered only in respect to the question as to how it will best subserve the demands of the railway to which it is an adjunct. Only in so far as that location affects its ability to produce marketable transportation is the railway company concerned with the industrial and market conditions of the country in general in selecting the location for its shops.

How to subserve best his own particular conditions is then the thing which the railway manager has to consider. The factors which enter into this problem are many, but we think they may be gathered under the following heads: (1)

Convenience of location in respect to the accommodation of the system as a whole; (2) Convenience of location in respect to the centers of supply of material and labor; (3) Advantages of location in respect to cost of land and buildings, facilities for extension, taxes, etc.

The relative importance to be given to each of the above considerations will evidently be different for almost every railway. If traffic were equally dense and important on every part of the system, a central location of the shop plant would theoretically, accommodate best the system as a whole. But traffic is not equally dense and important on all parts of hardly any railway system. Moreover a central location may be very inconvenient to the centers of supply of labor and material. Again, in the infancy of the system the headquarters of the officials and the earlier shops may have been located at a point far from the center of the system as it now exists. These considerations may be important enough to determine the location of the general shops at the extreme end of the system, even to the extent of compelling a greater expenditure in establishing division shops.

The consideration of the advantages of location with respect to cost of land and buildings, facilities for enlargement, etc., needs to be kept separate from the others, for there are certain factors in the construction of railway shops which remain constant irrespective of location as determined by other conditions. Perhaps the most important of these is space. Great space is a necessity in railway shop plants: (1) because the things to be handled—cars and locomotives—are of large size, and (2) because their weight and size prohibit the use of multiple storied buildings. Single story buildings are a practical necessity, and increase of floor space in them means absolutely an increase in their ground area. The bearing of this condition upon location is obvious. The shop plant must be situated where land is cheap and taxes low. This means, aside from exceptional cases, that the location must be outside of our larger cities. There may be cases, of course, where the railway company has ample space for shops within a large city, space secured when the city was young and land cheap, but this is not often the case. The area of high priced city land available to most railways is too valuable for freight yards and terminals to be given up to shop plants which can just as well and perhaps better be located elsewhere.

A case in illustration of this is the Illinois Central Ry., whose new shop plant we have been describing. This company holds property within the city of Chicago, the extent and value of which is exceeded by the city land held by few other railways. Until 1892, a part of this land had been occupied by car and locomotive shops, but increased traffic demanded larger terminals, and larger terminals required the use of the land occupied by the shops. The result was that the shops were removed outside of the city a dozen miles. The gain was a better location for the shops and the freedom of the land once occupied by them for more valuable purposes.

Let us consider this location in the light of some of the other considerations which have been mentioned above. Chicago is at the extreme limits of the Illinois Central Ry. system—at the extreme north of its southern line and at the extreme east of its westward line. General shops at Chicago were equally available to both lines. This city was, moreover, the headquarters of the official force of the road, it is a great center of supply for coal, lumber and iron, and the home of numerous men skilled in mechanical pursuits.

This consideration of questions affecting the location of railway shop plants might be prolonged, but it is our purpose here to discuss more particularly the principles governing the arrangement and construction of such a plant after the location has been decided upon. The best arrangement and construction to be adopted in a particular plant depends, of course, upon the character of the work it has to do, but a certain broad principle governs the arrangement and construction of all plants, and it is the concentration and grouping of buildings and equipment to secure a systematic and efficient division of labor. In a general repair shop for a railway there are two classes of work widely different in many respects, but at the same time having many points of similarity, viz.: the repair of locomotives and the repair of cars. There are also certain processes and kinds of work equally common to both classes. It is known that in locomotive work there are several processes, viz.: blacksmithing, boiler making, machine work, erecting, and several minor processes. Likewise in car work there are blacksmith work, wood work, carpentry, erecting, painting and minor processes. It is evident that the similarity between any two processes of locomotive work is generally closer than between the processes peculiar to locomotive work and those peculiar to car work. Further, it is evident that the different processes of boiler work are more closely related than the processes of boiler work and machine work in their entirety. Applying the broad principle stated above, the first point to be considered then is the differentiation of the various structures of the plant to suit the conditions of the various processes. The first broad differentiation is the grouping of the buildings, the second is the selection of the proportionate space and arrangement of the buildings in each group, and the third the interior arrangement of each individual building to suit the work to be done in it. Equally important with the above is the arrangement of the track system to furnish short and easy transport from one building to another, and an adequate provision for future extensions of the plant.

It is not the purpose here to discuss in detail the best method of grouping, and sub-grouping railway shop plants, because the conditions will require different forms in nearly every case. What it is wished to emphasize is the desirability of careful attention to this feature. The Illinois Central Ry. shops furnish a good example of this attention to the division of labor and grouping of buildings and are deserving of study for that reason. The points to be noted particularly are: (1) The separate grouping of the car shops and locomotive shops, with the buildings common to both between them and equally available to either; (2) in each group the location of the buildings between which communication is most frequent nearest to each other, and the provision of special facilities for transport; (3) the adoption of systematic provisions for transportation, sewerage, water supply, fire protection, lighting, etc., so as to concentrate the power machinery and collateral apparatus and to economize in the labor force required for their operation.

Turning to the individual buildings for railway shop plants, there are several requirements to be considered in their construction. Such construction must be chosen as to develop and utilize the best abilities of the workmen as well as of the machinery. The requirements to this end are ample floor area, the avoidance of unproductive travel and of floor spaces not open to immediate observation, abundant and uniform lighting, efficient heating and good ventilation and sanitation. As railway shops must of necessity be single story buildings, ample floor area is to be secured only by buildings of great lateral dimensions. This gives the best possible conditions for abundant and uniform lighting and good drainange and ventilation, but not so good conditions for easy heating nor for overlooking the workmen and avoiding unproductive travel.

By the liberal use of skylights a single story shop can be made almost as light as outdoors and there is little limitation to the use of such lights up to half the area of the roofs with the use of wire glass and the proper construction of the skylight frames. By making a portion of these lights movable, ample ventilation is secured. The questions of drainage and sanitation are also simplified. With the proper gratings, catch basins and crowning, the floors can be flushed clean with a hose and all drippings of grease and water adequately disposed of.

The difficulty of easy heating makes it a feature to be looked after only the more carefully. It is too often the case that the difficulty is met in railway shops by burning more coal rather than by installing an efficient heating system. Not many months ago in a discussion before a prominent railway club a well known superintendent of motive power made the statement that he did not think there was a shop on his system which was economically heated. Crude appliances installed and added to in a haphazard manner were the cause. Many other roads are suffering in the same manner. In the thoroughness of their heating system the Burnside shops of the Illinois Central R. R. stand as a monument of good sense and good engineering among railway shop plants in this country, as well as in their lighting, their drainage, and their other appliances for providing for the sanitary needs of the working force.

These points are mentioned here not alone because of their humanitarian desirability but because experience has shown that they mean a gain in dollars and cents by furnishing the best conditions for effective and rapid work. Take an illustration: it may seem of little moment whether the floors of the pits in a round house are crowned or dished as far as efficient drainage alone is concerned, but a man works dry shod in one and slops around and wastes time in keeping out of the water in the other. So it is often with other details of construction, but further than this, the effect of a clean, well lighted, well ventilated, well sewered and generally comfortable shop on the health, habits and disposition of the workmen can but be wholesome. This is a thing which has been learned by our most progressive manufacturers, many of whom go to almost excessive lengths in this direction, but a too small number of railway managers give it their attention, if we may judge from their shops.

Another important feature of shop construction is the interior arrangement. The best modern practice inclines toward single floor shops with as few dividing walls and partitions as possible. The reason for this is threefold, the lighting is better, unproductive travel is reduced, and the workmen are directly under the eye of the foreman from every part of the building. Probably the maximum division allowable is the separation of distinctly different departments, and when on the same floor and unless for good reason privacy is necessary it is an open question whether separating partitions are advisable even to this extent. The machine shop of the Burnside plant is open from one end of the building to the other. Even the office of the superintendent and foreman is a polygonal cabin with windows on all sides so that it affords a conning tower from which all points of the shop are visible. In railway shops the convenient obscurities of cars and locomotives are frequent enough temptations to loitering workmen without taking trouble to provide them in the shape of partitions, even if such construction was not objectionable for other reasons. It may seem to some that disproportionate stress is laid upon the interior arrangement of the shop in its relation to securing the best abilities of the men, but we believe that the experience of the best shop construction and practice will testify to the importance of this feature. The output of a shop is directly dependent upon the alertness, vigor and attention to duty of the workmen, and anything that acts to keep these faculties at the highest point acts to increase production.

Little has been said thus far about the purely structural features of the building construction in railway shop plants. Generally these are simple. The large area of roof and the provision for shafting, traveling crane tracks, and supports for hoists and suspended machinery are about the only things which introduce complexity. In the ordinary railway shop building the roof trussing is simplified and lightened by the frequent use of interior columns, which are also necessary for the support of the crane tracks and overhead machinery. Heavy hoisting and conveying machinery in the shape of bridge cranes, air and steam hoists, etc.,is almost a necessary requisite of the locomotive shops and adequate provision should be made for them in constructing the framework, even though their use may be a thing of the future. At no other time will the task be so easy and inexpensive as during the first construction.

Architectural embellishment is a feature for minor consideration, although effort should always be directed to secure a neat and substantial appearance of the buildings. Uniformity in the spacing and construction of doors and windows and the lines of the brick walls does a great deal in this direction, and is moreover a measure of economy in construction.

It is recognized that little has been said in the foregoing which is not already known, but young engineers are constantly coming up who are not familiar with all these considerations and sometimes older men appear by their work to have forgotten them. It does not seem time and space idly spent, therefore, to emphasize the principles of railway shop construction in connection with the practical example of such work to which we have given so much space.

LETTERS TO THE EDITOR.

Proposed Standard Specification for Portland Cement.—Correction.

Sir: Referring to my article published in your issue of July 16, I would like to correct one error on the last column of p. 35, where it says: "Quick setting, final set to be not less than 30 minutes." It should read, "Quick setting, final set to be not over 30 minutes." This was a typographical error in the pamphlet which I got up, and which I did not notice until my attention was called to it a few days ago. There are no other errors in the article.

Yours very truly,
Wm. J. Donaldson.

Betz Building, Philadelphia, Pa., July 21, 1896.

A Confusion in Titles.

Sir: The following incident is brought to mind by the recent meeting of the Christian Endeavor Society at Washington: A member of the engineering corps of a prominent steel manufacturing concern, desiring to purchase a certain book on the subject of his profession, had his office boy go the rounds of all the leading book stores of the city for the purpose of procuring a copy, but without success, until finally the youth brought up at the United Presbyterian Book Store. Upon afterwards being asked what reason he had for inquiring at a store in which technical books are not ordinarily kept in stock, he replied that he thought they must have it for he saw a sign in the window which read, "C. E. Supplies."

J. C.

Pittsburg, Pa., July 17, 1896.

Dangerous Reference Points.—A Warning.

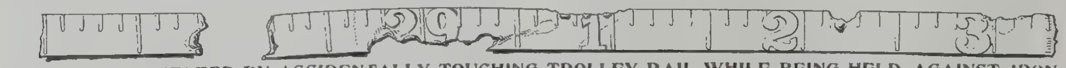
Sir: The enclosed pieces of steel tape were melted to-day by an electric current. In referencing a street monument from an iron trolley pole, the tape touched the rail and was melted at the point of contact. The end against the pole was also melted and the assistant's thumb and forefinger were severely burned.

The superintendent of the electric railway was notified and sent men at once to investigate the cause of the grounding of the current. Yours truly,

A. J. Gavett.

Plainfield, N. J., June 22, 1896.

(The accompanying sketch was drawn from the pieces of tape sent by Mr. Gavett. The pieces are blued over part of their length and show marked evidences of the extreme heat to which they were subjected.—Ed.)



STEEL TAPE MELTED BY ACCIDENTALLY TOUCHING TROLLEY RAIL WHILE BEING HELD AGAINST IRON TROLLEY POLE.

A Neglected Formula in Trigonometry.

Sir:—The following formula, applicable to the three sides and one angle of a plane triangle:

$$c^2 = a^2 + b^2 - 2ab \cos C \qquad (1)$$

or,

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab} \qquad (2)$$

(in which a, b, and c are the lengths of the sides and C the angle opposite side c) is familiar to the student of applied mechanics on account of its use with the parallelogram of forces, or of velocities. In case a, b, and c are given and C is the quantity sought, it would seem to be the most convenient formula to use, instead of the indirect relation necessitating the preliminary determination of the sum of the three sides and the difference between that sum and each of the sides, with the result that only the half angle is found, instead of the whole angle.

It is a matter of some surprise, therefore, that this formula, (1), is not to be found in engineers' pocket-books published in the United States, although given in foreign publications (for example in Weisbach's "Ingenieurs Taschenbuch" and in "Huette").

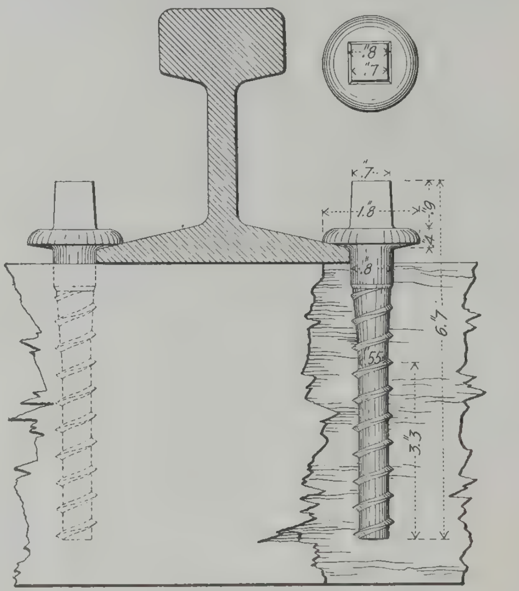
Only a few months ago a gentleman on the Pacific coast, in a letter to the writer, stated a modified form of formula (1) as original with himself, and inquired if it was not new, since he had been unable to find it in Haswell's Pocket-Book, and thought it simpler than those given in that work. It seems worth while, then, to call attention to the formula in your columns.

Sincerely yours, I. P. Church.

Ithaca, N. Y., July 4, 1896.

The Need of Improvement in Rail Fastenings.

Sir: The information on the present standards of American railroad tracks, contained in the articles and tables given in your issue of June 25, is not only interesting but of great value, and you deserve the thanks of all concerned with railroad construction and maintenance.



A Screw Spike Rail Fastening.

I strongly sympathize with your opinion as to the very unsatisfactory character of the ordinary spike as a rail fastening. To one who has observed with any care the condition of the track on even our best lines and noted the fact that hardly more than one-third of the spikes are effective to hold the rails down to the tie, or to do more than to keep them from moving sideways, nothing is more surprising than the continued use of such spikes. In this respect our railways are far behind those of Europe. Either the English bolt and treenail, used with their chairs and double-headed rails, or the Continental screw spike, used with the flat-footed rails like ours, is far better. The latter, the screw spike, is worthy of our special attention. For while it would cost somewhat more at first, it is more durable, as it can be drawn and replaced or used over again without injury to either the spike or the tie, and has the further capital advantage of having a holding power at least double that of the common spike. Its use would save many rail braces, and many ties which are now spoiled by old spike holes. Being unpatented and unpatentable it cannot command the services of enterprising agents to urge its introduction, but even without this, its great merits ought to secure its adoption on all first-class railways.

To make more clear the special features of the screw spike I enclose a blue print of a design, made several years ago, which follows very closely that of the spikes in common use on the Continent—particularly in France.

Robert Moore.

Room 52, Laclede Building,
St. Louis, Mo., July 2, 1896.

A Novel Scheme for Power Transmission.

Sir: I have recently devised a very novel system for the transmission of large amounts of power over long distances, which seems to me to have much merit. The system I propose is hydraulic transmission under very high pressure, say 5,000 lbs. per sq. in. Under this pressure it will be readily understood that a very small amount of water will transmit a large amount of power. The difficulty has been, however, that if such water is carried in metal pipes, they must be very thick and costly to withstand the enormous pressures, and as the system only becomes economical compared with electrical transmission when large conduits are used, the use of metal pipes is not feasible. Now, what I propose is to build a tunnel in solid rock for conveying water under high pressure, make it water tight by putting in a continuous lining of metal of moderate thickness, and rely for strength entirely on the solid rock in which the tunnel is built.

To show an application of this system I have taken the transmission of power from Niagara Falls to New York as an example. Call the distance 320 miles. A 30-ft. cylindrical tunnel with water moving through it at 4 ft. per second would give a flow of 2,800 cu. ft. per second. At a pressure of 300 atmospheres this would furnish in round numbers 2,500,000 HP. The loss of pressure in the 320 miles at the low velocity above given would be only 3.3% Estimating the cost of such a tunnel at $60 per lineal foot, its total cost would be about $100,000,000, and with 10% of this sum for interest and depreciation, the annual cost per 24-hour horse power would be only $4. One dollar per horse power per annum would pay for the hydraulic machinery required.

I have filed a caveat on the above system of power transmission.

Very respectfully,
Charles Steiner.

403 Bushwick Av., Brooklyn, N. Y.,
July 14, 7896.

(Our correspondent evidently does not hesitate at large figures.—Ed.)

The Spread of Dry-Rot.

Sir: I would like to hear your opinion, or that of some readers of Engineering News, about the character of dry-rot as a defect in lumber. The Encyclopedia Brittanica, treating of this subject, says it is a disease "apparently of an infectious character." If this is true, it would appear that timber having a defect of this nature, in the least degree, is unsuited for use in any permanent structure; as it is only a matter of time before the entire body of such sticks, thus affected, will be reduced to the same condition.

The question which, at present, concerns me, is this: Will heavy beams or girders of Southern hard pine, when used for inside work and occupying a well-ventilated situation, deteriorate from a small patch of "dote" or dry-rot such as is frequently found in such timber, at the butt end, and which otherwise, or for present purposes, is thoroughly acceptable for its intended use?

I am satisfied similar lumber is constantly used in buildings, and if any of your readers have positive knowledge that lumber of this kind deteriorates more rapidly, under favorable conditions, than sticks not affected; or if such, after years of use, show no apparent spread of the decay, I should for one be glad to hear their testimony.

A. F. W.

Centreville, R. I., July 8, 1896.

(We referred the above letter to the Division of Forestry, at Washington and have received the following reply:—Ed.)

Sir: In reply to your favor of the 11th instant, addressed to Mr. Fernow, who is absent on an extended tour through the West, permit me to say that the probability of dry rot spreading in beams of Southern hard pine when used for inside work in a well ventilated situation is very slight. As your correspondent is doubtless aware, dry rot is a form of fungus, being one of many different genera which grow in the inter-cellular spaces of timber, forming masses of extremely minute threads which penetrate in all directions, practically filling up the cell cavities and eating up, as it were, the cell walls, leaving a mass of dead and dried up threads of the wood material behind, after they are killed or have finished their work. At particular places thousands of these threads come to the surface and aggregate in a crack of the wood forming the whitish or colored bodies which we see as toadstool, bracket funges, etc. These are fruiting bodies which give rise to spores corresponding to the seed of higher plants. These fungi require quite an amount of moisture for their growth, especially at the start, and therefore well seasoned wood is not attacked, and they can even be killed, and usually are, and the "dotage" stopped by drying the timber thoroughly, preferably submitting it to a dry kiln treatment, where the heat will not only kill the fungi and spores but the seasoning will prevent further attacks.

There is little doubt that doty spots are easier of attack and, therefore, endanger the timber to some extent, but if well dried and placed in a dry, well ventilated position, the progress will stop.

Trusting that these notes will be of interest to you, I am, Yours respectfully

Charles A. Keffer,
Acting Chief, Division of Forestry.

Washington, D. C., July 13, 1896.

The Advantages and Disadvantages of a Steam Pile-Driving Hammer.

Sir: I have had occasion recently to use one of the Vulcan Iron Works steam pile driving hammers on the work under progress at the foot of Perry St., North River, N. Y., for the Department of Docks, and my observation of its use and progress in the cheapening of the cost of labor in driving through hard material, as compared with the drop hammer, is such that I feel confident it is only a question of time when, for specific cases, with a few improvements which can readily be made, a steam hammer will become universal, if the prejudices and fear of handling one can be overcome by those who are willing to try it and be benefited thereby.

The driving in the above locality is very hard, the bottom consisting of a 10-ft. layer of cobble stones, the largest being 6 ins. diameter, from 20 to 30 ft. below mean low water, and below that layers of very fine sand, coarse gravel and sand gravel alternate until rock or boulder is reached at a depth of about 90 ft. below mean low water, as shown by test borings.

With the drop hammer 12 piles, 9 in a row, from 2 ft. 3 ins. to 3 ft. c. to c., was considered a very good day's work (of 10 hours) with a crew of ten men. The pile dimensions averaged as follows: point 8 ins., butt 16 ins., length 55 ft. to 60 ft., and took an average of about 175 blows of a 3,300-lb. hammer falling 10 ft. Fifteen blows to the minute was a good average when working, the piles penetrating to from 43 to 50 ft. below mean low water.

With a Vulcan hammer of 8,400 lbs., the piston weighing 4,000 lbs. and having a 42-in. stroke, we were enabled to drive at the rate of 18 piles a day, two rows, and regulate and stay lathe them, the hammer striking 60 blows to the minute and some of the piles taking over 1,200 blows, without a sign of the head being broomed.

The steam hammer can be worked with from two to three less men in a crew than the drop hammer. The principal faults noticeable are that it is almost impossible and certainly not practical with economy to drive crooked piles, and that there is a great tendency to lose overboard the "saucepan" or hood which fits over the head of the pile when it has been trimmed to fit the hammer, which also wears out very quickly. A delay of from 2 to 5 minutes was caused by the steam condensing in the hose pipe leading to the hammer when it was hoisted aloft, a "U" being formed, but this is only a mechanical defect which can easily be remedied. After a pile is once placed, headlines can be dispensed with and the pile is more rapidly and truly driven to place than with the drop hammer. The use of this hammer by the Department of Docks was experimental and had to be stopped after about 75 piles had been driven owing to the fact that the "saucepans," of which there were only two, had worn out. Yours truly,

Eugene Lentilhon,
Assoc. M. Am. Soc. C. E.

New York, July 20, 1896.

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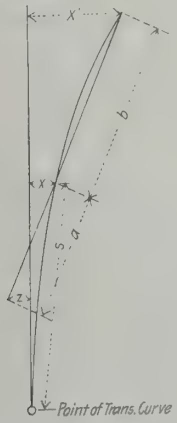
The Cubic Parabola as a Transition Curve for Street Railways.

Sir:—While engaged in business in Pittsburg, Pa., last year I had occasion to establish the alinement of an electric railway, and found in the cubic parabola an easy solution to a seemingly difficult problem. An explanation will be of interest and possibly of benefit to some of your readers.

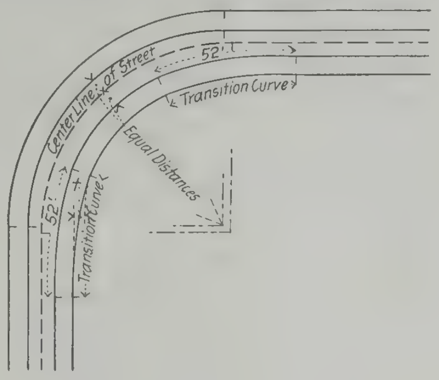


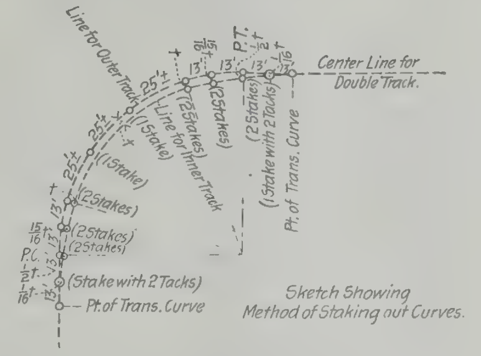
The city of Allegheny straightened, widened, graded and paved Perryville Ave., necessitating the complete rebuilding of the Pleasant Valley Ry. Co.'s line on that street. The avenue is a long and important thoroughfare; as it runs in many places along steep hillsides, requiring heavy retaining walls on both sides, its width was restricted to 60 ft., and at the southern end to 50 ft.; 32% of the alinement is curved; the total curvature amounting to about 1,600°. The radii of curves vary from 50 to 573 ft. In view of the narrowness of the street and the large amount of travel over it, the City Engineer fixed the distance between centers of tracks on tangents at 8 ft. 6½ ins., leaving a clearance of only 6¼ ins. between cars, but allowing the tracks to be spread sufficiently on curves to give the same clearance, but no more; requiring, however, that the tracks should follow approximately the line of the street and that a nearly equal distance should be maintained between track and curb on both sides.

The largest cars in use on this line are 30 ft. long over all; length of car body 22 ft.; maximum width 8 ft. 0¼ in. The cars are mounted on single trucks, with a wheelbase of 8 ft.

It is evident that no arrangement of simple curves would allow the cars to pass at the P. C.'s and P. T.'s and that any arrangement of compound curves would either make too much difference between the alinement of street and track, or would greatly complicate calculation and field work and add to the perplexities of the track foremen. I used the following comparatively simple method to fulfil the complex conditions:

The tracks were made concentric, being spread sufficiently to allow for the "overhang" of the cars; the outer track was made a simple curve, but a cubic parabola was introduced at each end of the inner track; the P. C. and P. T. of the outer track were moved toward the P. I. from the P. C. and P. T. of the street alinement, enough to make the two tracks equidistant from the center of the street at the middle of the curve.





Sketch Showing Method of Staking out Curves.

Approximately $t = \frac{l^2}{8R}$, t being the distance the tracks are spread, or the offset of the inner track, from the tangent to the regular curve produced; l the length of the car, and R the radius of curvature. I took l = 30 in order to "steal" a factor of safety, although l = 22 would have been theoretically correct, as the platforms of the cars are much narrower than the car bodies.

For the length of the cubic parabola (L)

$$\frac{3t}{\frac{1}{2}L} = \frac{\frac{1}{4}L}{R} \text{ or } L = \sqrt{24\,t\,R} \text{ (approximately)}$$

$$\text{or } L = l\sqrt{3}, \text{ a constant for all radii.}$$

Substituting l = 30, L becomes 51.96. Using l = 22, L would become 38.10.

I staked out the outer curve, using two chords of 13 ft. at each end, and dividing the rest of the curve in equal chords of as nearly 25 ft. as possible, for the convenience of the trackmen. Two stakes at 13 ft. and 26 ft. from tangent point, were also put in on tangent. Additional stakes were set by offsets from both tangent and curve for the parabolic portion of the inner curve, but no stakes were necessary for the circular portion.

The trackmen found no difficulty, after the first trial, in bending the rails to a parabolic curve; they began with the sharper end of the curve, with the bender set the same as for the regular curve, and loosened the screw each time the position of the bender was shifted.

To determine the minimum clearance between cars on any curve, and the extent to which this solution is applicable, let

a = distance from end of car body to axle,
b = distance between axles,
s = distance from pt. of trans. curve to nearest axle,
z = offset of end of car body from position on tangent,
x = offset of first axle from tangent,
x¹ = offset of second axle from tangent,
k = a constant, depending on nature of cubic parabola.

Then $x = ks^3$

and $x^1 = k(s+b)^3$

and $z = \frac{a}{b}(x^1 - x) - x$

or $z = \frac{a}{b}x^1 - \frac{a+b}{b}x$; substituting values for x and x^1,

$$z = k\left[\frac{a}{b}(s+b)^3 - \frac{a+b}{b}s^3\right]$$

or $z = k(3as^2 + 3abs + ab^2 - s^3)$.

To find a maximum value of z

$$\frac{dz}{ds}\quad k$$

or $s = a + \sqrt{a(a+b)}$

and $z = k\left[(a^2+ab)(2a+b+2\sqrt{a^2+ab})\right] =$

$$ka(a+b)(\sqrt{a}+\sqrt{a+b})^2$$

but $k = \frac{x}{s^3} = \frac{4t}{L^3}$

hence $z = \frac{4t}{L^3}a(a+b)(\sqrt{a}+\sqrt{a+b})^2$

and for L = 51.96, a = 7, b = 8, z = 0.127t or $\frac{7.6835}{R}$

the clearance of tangent being 6¼ ins. = 0.52 ft.

the minimum clearance is 0.52 — 0.127 t, or $0.52 - \frac{7.6835}{R}$

Substituting 0.52 for z, we get R = 14.77, the smallest radius to which this solution could be applied. As the minimum radius on this line was 50 ft., the solution was therefore applicable in every case. Yours truly,

Jenks B. Jenkins, C. E.

New York city, June 11, 1896.

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Notes and Queries.

R. S. M. asks which is the better practice in lettering maps, to say "Scale: 500 ft. = 1 in.," or "Scale: 1 in. = 500 ft.?" So far as we are aware the former expression is more commonly used on maps and the latter on drawings of structures, machines, etc., especially detail drawings to a large scale. Still another way to designate a scale, and one which has much to commend it, is to say "Scale = $\frac{1}{500}$."

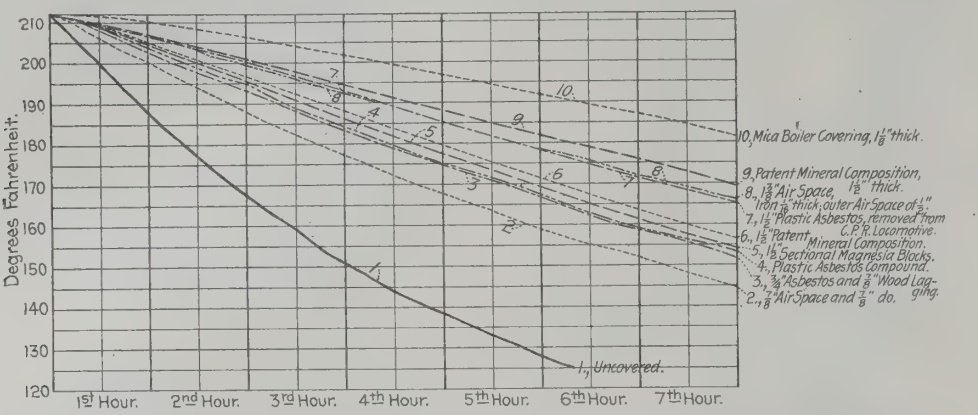
R. W. W., Shreveport, La., asks which side up an oak tie should be laid, which has one side flat for its full width and the other side has its corners rounded off. The roadbed is dirt. We refer the query to our readers.

WEATHER TABLE FOR JUNE, 1896. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.)				Wind.			Precipitation—rain or melted snow—inches.		
		Average.	Max.	Min.	Range.	Velocity in miles per hour.		Direction at time of max. velocity.	Total.	Heaviest in 24 hours.	No. of rainy days.
						Average.	Max.				
Northern Cities	Northfield, Vt.	59.9	86	36	50	8.8	36	NW	1.62	.81	8
	Portland, Me.	62.6	90	47	43	7.5	27	S	2.23	.60	10
	New York City	66.5	87	51	36	10.9	40	NW	6.38	2.59	11
	Pittsburg, Pa.	70.4	89	47	42	4.9	24	SW	4.79	1.22	15
	Chicago, Ill.	66.8	89	50	39	14.2	50	SW	2.82	.92	12
	Omaha, Neb.	72.0	94	49	45	7.3	35	NW	1.90	.69	10
	St. Paul, Minn.	68.2	89	47	42	6.5	32	NW	3.30	1.59	9
	Duluth, Minn.	61.0	90	39	51	9.1	42	NE	2.00	.63	11
	Bismarck, N. Dak.	65.6	96	42	54	10.3	47	SW	2.64	1.30	11
	Average	63.7	90	45	45	8.8	37		3.08	1.15	11
Southern Cities.	Washington, D. C.	71.3	92	52	40	5.2	26	NW	2.39	.72	13
	Louisville, Ky.	74.2	92	56	36	6.7	32	W	4.79	2.87	10
	St. Louis, Mo.	74.0	91	56	35	8.2	52	NW	4.57	.72	15
	Savannah, Ga.	79.6	99	64	35	6.5	27	NE	5.31	1.25	15
	Kansas City, Mo.	72.2	92	50	42	6.5	32	NW	2.04	.59	11
	Jacksonville, Fla	80.0	97	66	31	7.1	32	S	9.41	3.07	14
	Chattanooga, Tenn.	75.0	94	56	38	6.0	33	NW	2.64	0.85	6
	New Orleans, La.	80.0	95	69	26	7.1	30	SE	8.23	2.02	17
	Memphis, Tenn.	77.0	92	58	34	7.9	39	W	2.07	0.49	9
	Palestine, Tex.	81.6	100	58	42	5.9	20	N	0.71	0.60	5
	Average	76.5	94	58	36	6.7	32		4.22	1.32	12
Western Cities.	Helena, Mont	63.2	88	39	49	8.0	36	SW	0.71	.25	8
	Port Angeles, Wash.	53.8	83	40	43	7.3	27	SW	0.31	.08	6
	San Francisco, Cal	57.2	79	47	32	14.3	42	W	.00	0	0
	Salt Lake City, Utah.	70.0	93	44	49	6.2	30	S	0.25	.23	2
	Santa Fe, N. Mex	69.0	89	48	41	7.4	31	SW	0.69	.49	4
	Denver, Colo.	68.2	92	44	48	7.3	36	NE	0.89	.25	9
	Yuma, Ariz	88.8	117	63	54	6.7	32	SW	.00	0	0
	Average	67.2	92	46	45	8.2	33		0.41	0.19	4

TESTS OF NON-CONDUCTING MATERIALS FOR BOILER COVERINGS.

The Canadian Pacific Ry. Co., in April last, undertook a series of experiments to determine the comparative merits of various different coverings for steam boilers, to determine which was the best to adopt as a lagging for the boilers of its locomotives. Among the materials tested was a new composition made by the Mica Boiler Covering Co., of Toronto, Ont., which showed in the test remarkable insulating qualities, materially exceeding those of any other non-conductor tested, as will be seen by the lines on the accompanying diagram.



EXPERIMENTS TO DETERMINE RELATIVE HEAT INSULATING POWER OF VARIOUS BOILER COVERINGS.
Made at the Canadian Pacific Ry. Shops, April, 1896, R. Atkinson, Mechanical Superintendent.

Note: In all the tests but Nos. 9 and 10, to the covering noted above an outer coat of Russia iron was added.

The method of testing was as follows: An iron tank was entirely covered with the non-conductor to be tested, and was then filled with water which was heated to a temperature of 212°. The tank was then allowed to cool and the temperature of the water in its interior was taken at intervals, and the diagram was constructed in accordance with these results. Simultaneous observations were taken of a thermometer in the room where the tank was located, and these results were also plotted, but as they showed the atmospheric variations to be too small to have any appreciable effect on the results we do not reproduce this diagram, merely remarking that these external temperatures varied between extremes of 70½° and 87°, but in most of the tests the range was much smaller than this.

The tank used in tests 1 and 2 was 14 ins. high and 13⅜ ins. in diameter. That used in tests 3, 4 and 5 was of the same diameter and 15¼ ins. high. That used in tests 6, 7, 8, 9 and 10 was 13⅜ ins. diameter and 13⅝ ins. high. While the tests should properly have all been made with the same tank, the difference in size does not appear to have been great enough to materially affect the results.

The fact above stated and the diagram from which ours is redrawn are published in the "Canadian Electrical News," which presents also the following table, showing the loss of heat in degrees in the fifth hour per degree of difference of temperature between the tank and the surrounding atmosphere:

Covering.	Mean temp. during 5th hr.	Diff. bet. tank and air, deg.	Loss, 5th hr. Actual, deg.	Loss, 5th hr. Diff. of temp., deg.
None	133½	55½	11	0.198
Asbestos composition	163½	85½	9	.105
Sectional magnesia	181¾	103¾	7	.0674
Wood lagging and air space	.81¾	103¾	7	.0674
Asbestos and wood	185	107	6	.056
Mica	194½	116½	5	.0428

It will be seen from the above that the heat escaping from the bare tank was 1.88 times that escaping through the asbestos compounds, 2.92 times that lost through the sectional magnesia blocks, or the wood lagging and air space, 3.53 times the loss through the asbestos and wood covering, and 4.62 times the loss through the mica covering.

The mica covering has been placed upon the market quite recently, and, we are informed, consists of leaves or films of mica separated by minute corrugations so as to make a great number of air cells. Any of our readers interested can doubtless obtain samples by addressing the manufacturers, the Mica Boiler Covering Co., 9 Jordan St., Toronto.

THE EFFECT OF RETARDERS IN FIRE TUBES OF STEAM BOILERS.*

By Jay M. Whitham,** M. Am. Soc. M. E.

The trials were conducted on a 100-HP. horizontal tubular boiler at the Sutherland Ave. Station of the Philadelphia Traction Co., Philadelphia. The purpose of the trials was to ascertain under what condition, if any, retarders in the fire tubes would add to the efficiency of the boiler.

Dimensions and Proportions of Boilers and Setting.

Boiler shell	60 ins. × 20 ft.
Tubes (44)	4 ins. × 20 ft.
Grate surface	26.7 sq. ft.
Water-heating surface	1,137 sq. ft.
Ratio of heating surface to grate area	42.6 to 1
Steam-drying surface in top of shell	150 sq. ft.

Boiler set with a return pass over the top.

Ten such boilers are connected to a brick stack 10 ft. diameter by 175 ft. high. During the tests from four to seven of these boilers were run in connection with the boiler tested. On certain tests retarders were used in the tubes. These were made of loosely fitting strips of No. 10 sheet-iron, running the whole length of the tubes, and twisted to a pitch of 10 feet., or making two entire convolutions in the length of the tube.

The tests were conducted according to the methods advised by this Society, and all instruments used were standardized. L. Kennedy, a careful and skilful fireman, fired on all the tests. The boiler tubes were clean at the beginning of each test, while the boiler was fairly clean on the water side. Several of the tests were duplicated in order to make sure that no error existed.

Results of the Trial.

Coal.—The coal was practically uniform in quality on all the tests. The percentage of ash and refuse varied from 8.72 to 4.25%.

Drafts.—The draft was measured in the furnace, in the front connection, and in front of the damper at the rear end of the return pass over the top of the boiler. The damper was manipulated so that the draft would be just sufficient to burn coal for the power desired to be developed on each test.

Table I. compiled from the results obtained in the tests should be valuable in predicting the drafts needed for any rate of combustion from 5 to 40 lbs., an hour per sq. ft. of grate with bituminous coal, natural draft and horizontal tubular boilers, while it should be of use also with water-tube boilers.

TABLE I.—Draft Required for Boiler with Various Rates of Combustion.

	Resistance due to				Total draft			
Pounds of dry coal burned an hour per sq. ft. of grate.	Furnace draft.	Pass under boilers and thro' tubes; no retarders.	Retarders in tubes.	Pass over top of boilers.	No. retarders; no return pass.	With retarders; no return pass.	Top pass; no retarders.	With top pass and retarders.
	inch.	inch.	inch.	inch.	inch.	inch.	inch.	inch.
5	0.04	0.04	....	0.04	0.08	0.08	0.12	0.12
8	0.11	0.05	0.02	0.04	0.16	0.18	0.20	0.22
10	0.13	0.07	0.03	0.05	0.20	0.23	0.25	0.28
12	0.17	0.07	0.04	0.05	0.24	0.28	0.29	0.33
14	0.19	0.10	0.03	0.05	0.29	0.32	0.34	0.37
15	0.20	0.11	0.03	0.05	0.31	0.34	0.36	0.39
16	0.21	0.12	0.03	0.05	0.33	0.36	0.38	0.41
18	0.23	0.13	0.06	0.05	0.36	0.42	0.42	0.48
20	0.24	0.16	0.08	0.06	0.40	0.48	0.46	0.54
22	0.26	0.18	0.12	0.06	0.44	0.56	0.50	0.62
25	0.27	0.22	0.19	0.06	0.49	0.68	0.55	0.74
28	0.29	0.24	0.27	0.07	0.53	0.80	0.60	0.87
30	0.30	0.27	0.31	0.07	0.53	0.88	0.64	0.95
34	0.32	0.31	0.38	0.08	0.63	1.01	0.71	1.09
36	0.33	0.34	0.40	0.08	0.67	1.07	0.75	1.15
40	0.36	0.38	0.46	0.08	0.74	1.20	0.82	1.28

Quality of Steam.—The steam was practically dry for every condition of the tests, however much, the boiler was pushed in capacity. This is due to the large liberating surface in boiler and the use of dry pipes.

Economic Evaporation.—Table II. shows tests with and without the use of retarders.

The advantage due to retarders is as high as 18% when the boiler is greatly forced. The temperature of the waste gases is always less when retarders were used. Herein lies the advantage of retarders. Their use renders more efficient the heating surface of the tubes, enabling the gases to be reduced in temperature, and the same capacity of boiler to be developed with a less expenditure of fuel.

The accompanying cut shows at a glance the usefulness of retarders. A reduction in temperature of the waste gases shows at once a decrease in the coal consumption, as follows:

52	HP., gases reduced	20° F., fuel saving	0.0%
75	" " "	53° " " "	0.0%
100	" " "	32° " " "	3.2%
125	" " "	46° " " "	4.0%
150	" " "	19° " " "	3.3%
170	" " "	59° " " "	3.6%
200	" " "	36° " " "	4.1%
225	" " "	26° " " "	8.6%
239	" " "	123° " " "	18.4%

Variation of Economy with Capacity.—By Table II. we see that the 100 HP. boiler, rated on 11.37 sq. ft. of water-heating surface to the horse-power, could easily develop over 200 HP. At its rated power 3.03 lbs. of water, from and at 212° F., were evaported per hour, yet there was no difficulty in evaporating 7.26 lbs. to 1 sq. ft., or in getting a horse-power on 4.76 sq. ft. of heating surface.

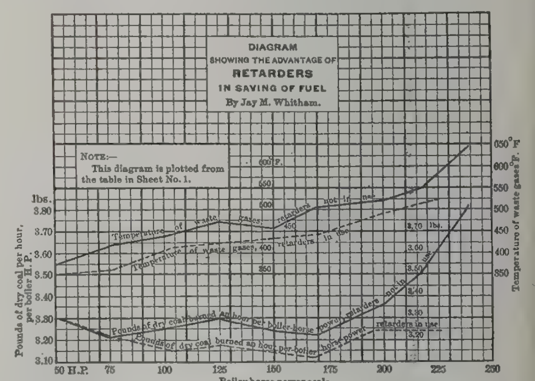


Diagram Showing Fuel Saving due to the Use of Retarders in Steam Boiler Tubes.

TABLE II.—Results of a Series of Trials on a 100-HP. Horizontal Tubular Boiler, to Determine the Value of Retarders in the Tubes.

Duration of trial, hours	9	9	9	9	9	9	9	9	9.1	9	9	9	9	9	9	.9	9
With or without retarders in tubes	W'out	With.	W'out	With.	W'out	With.	W'out	With.	W'out.	With.	W'out	With.	W'out	With.	W'out	With.	W'out.
Absolute steam pressure in boiler, lbs.	135.20	133.16	135.45	133.35	137.17	134.90	138.30	133.90	136.70	132.80	136.23	133.52	136.90	133.56	136.59	133.53	135.66
Draft in pass over boiler at damper, ins.	0.16	0.15	0.21	0.28	0.33	0.31	0.36	0.38	0.42	0.49	0.51	0.53	0.65	0.71	0.62	0.86	0.67
Draft in furnace over top of fire, ins.	0.07	0.07	0.13	0.13	0.17	0.17	0.19.	0.20	0.24	0.23	0.25	0.24	0.36	0.24	0.30	0.34	0.32
Temperature of fire room, degrees F.	103	70	94	67	104	70	112	75	110	76	87	76	102	78	99	80	89
Temperature of escaping gases, degrees F.	371	351	414	361	444	412	470	424	455	436	506	447	526	490	551	523	646
Percentage of ash and refuse in dry coal, %	8.33	8.72	6.04	7.42	6.15	5.55	4.93	5.81	4.93	5.06	4.96	5.76	4.63	5.49	4.43	4.53	4.25
Quality of steam, dry steam taken as unity	0.99	0.99	0.99	0.99	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	1.00	0.99
Water evap.,* per lb. of dry coal, lbs.	10.43	10.44	10.70	10.72	10.58	10.92	10.44	10.86	10.65	11.00	10.70	11.09	10.26	10.68	9.84	10.69	9.03
Water evap.,* per lb. of combustible, lbs.	11.38	11.43	11.38	11.57	11.29	11.56	10.99	11.53	11.20	11.60	11.27	11.53	10.76	11.30	10.29	11.19	9.43
Saving in dry coal by use of retarders, %					3.22		4.02		3.29		3.55		4.09		8.64, 18.39		
Water,* per hour per sq. ft. of heating surface, lbs.	1.59	1.59	2.25	2.34	3.03	3.16	3.80	3.87	4.55	4.51	5.25	5.13	6.06	5.99	6.59	6.86	7.26
Dry coal burned per hr per sq.ft. grate surface, lbs.	6.49	6.49	8.89	9.33	12.13	12.30	16.35	15.18	19.20	17.45	20.87	19.73	26.55	23.86	30.10	27.32	34.30
Boiler HP., basis 34½ lbs. water, 212° F., pr hr., HP.	52.4	52.4	74.6	77.3	99.7	104.2	125.3	127.5	150.0	148.6	169.6	169.1	199.7	197.3	217.4	226.1	239.0
Heating surface per HP. developed, sq. ft.	21.7	21.7	15.24	14.71	11.37	10.91	9.09	8.92	7.58	7.65	6.70	6.72	5.68	5.76	5.23	5.03	4.76

*From and at 212° F.

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* Condensed from a paper presented at the St. Louis meeting of the American Society of Mechanical Engineers.

** 131 South 3d St., Philadelphia, Pa.

The cost in fuel of a horse-power was as follows for the tests made without the use of retarders:

Boiler, HP.:	52.4	74.6	99.7	125.3	150.0	169.6	199.7	217.4	239.0
Dry coal per HP., lbs.:	3.30	3.21	3.25	3.30	3.24	3.22	3.36	3.51	3.82

These results show that there is practically no change in the economic workings of the boiler when run at from 50% below to 70% above its rating, i. e., when making a horse-power an hour on anywhere from 21.7 to 6.7 sq. ft. of heating surface.

The cost of fuel per horse-power was as follows for the tests made with retarders in the tubes:

Boiler, HP.:	52.4	77.3	104.2	127.5	148.6	169.1	197.3	226.1
Dry coal per HP., lbs.:	3.30	3.21	3.15	3.18	3.14	3.11	3.23	3.23

It is therefore evident that retarders enable a boiler to be run as economically on 5 sq. ft. of heating surface to the horse-power as on 21.7 sq. ft., or, practically, as on any number of square feet between these limits.

Conclusions.

1. Retarders in fire tubes of a boiler interpose a resistance varying with the rate of combustion.
2. Retarders result in reducing the temperature of the waste gases, and in increasing the effectiveness of the heating surface of the tubes.
3. Retarders show an economic advantage when the boiler is pushed, varying in the tests from 3 to 18%.
4. Retarders should not be used when boilers are run very gently, and when the stack draft is small.
5. It is probable that retarders can be used with advantage in plants using a fan or steam blast under the fire, or a strong natural or induced chimney draft, when burning either anthracite or bituminous coals.
6. Retarders may often prove to be as economical as are economizers, and will not, in general, interpose as much resistance to the draft.
7. Retarders can be used only with fire tubular boilers.
8. The economic results obtained on the boiler tested are ideal, showing that it was clean, the coal good in quality, and the firing skillful. With retarders the tubes are more effectively cleaned than without their use.
9. The tests prove that the marine practice of using retarders is good, and that the claim, often advanced, that they show from 5 to 10% advantage, holds, whenever the boiler plant is pushed and the draft is strong.

Discussion.

Charles Whiting Baker.—It is a rather curious fact that while "retarders," as they are called, have been used more or less for several years, and, in some instances with very notable advantage, Mr. Whitham's paper, so far as I am aware, is the first extended account of their use and their advantages which has appeared in technical literature, although of course allusions to their use in connection with various steam plants have been made in various papers.

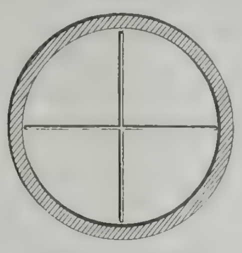
Another curious fact is that the action of "retarders" in the flue has been generally misunderstood, as is indicated by their name. The "retarder" does of course obstruct and "retard" the flow of gas through the flue; but this is by no means the purpose for which it is placed there. If it were desired simply to make the hot gases flow more slowly through the tubes, the simplest and best way is to check the draft by dampers in the chimney or at the ash pit.

What the so-called retarder does that is beneficial is to increase the amount of heat transmitted to the tube surface from the hot gases; and it does it in two ways. First, by a mixing action upon the gas in the tube. The friction upon the surface of the retarder aids in stirring up the gas in its passage through the tube and mixing the hot gas at the center with the cold film next the surface of the tube. Also in every horizontal tube there is a tendency for the gases to be cooler in the upper part of the tube and hotter in the lower, for the upper half of the tube extracts heat far more readily from the tube than the lower half. The twist of the retarder has the effect of repeatedly "turning over" the gas in the tube as it flows along.

In the second place the retarder acts by direct radiation of heat to the tube surface. While this action may not be apparent at first sight it is of such importance that it should be clearly understood. To this end the fact should first be realized that the temperature of the tube surface exposed to the fire in any steam boiler is practically the same as that of the water in contact with it, no matter what the temperature of the gases on the other side. (We, of course, suppose the tube surface to be clean.) The reason is that water absorbs heat many times as rapidly as gas. As experimental proof I may add that in a small boiler filled with cold water I have often seen dew collect and stand in beads upon the fire side of the tube when a current of gas at a temperature of over 1,000° F. was passing through the tube.

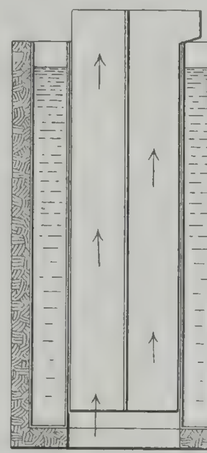
The rate of absorption of heat by boiler heating surface then, depends almost entirely on how much heat we can impart to this surface on the fire side. In the ordinary boiler tube, heat is imparted to the surface of the tube only by the contact of the hot gases. Now suppose we place in the tube any solid body, of any shape whatever. Manifestly, as it is surrounded and bathed on all sides by gases at a temperature of say 1,000°, it will, if it loses no heat, soon become of the same temperature as the hot gases. Suppose the surface of the tube is at a temperature of 300° F. Then we shall have these two surfaces only an inch or two apart and a difference of temperature between them seven times as great as exists between a very cold winter day and the maximum heat of summer. Under these circumstances, of course, the hot body at the center of the tube will energetically radiate heat to the walls of the tube and will materially increase the rate of heat transmission.

The amount of radiation in any given tube depends on the area of radiating surface and on the difference in temperature between the radiating surface and the surface of the tube. A radiator of cross shape, like that shown in the accompanying cross section of a tube, has a radiating surface nearly 1½ times as great as the inner surface of the tube, and experiment shows it to radiate nearly twice as much heat in a given time as a flat strip of a width equal to the tube diameter.

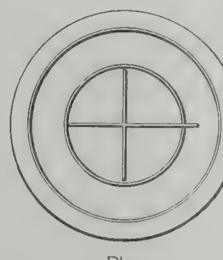


Cross Section of Boiler Tube With Radiator Inserted.

I have made numerous experiments to test the efficiency of radiators, with the apparatus shown in the accompanying sketch. It represents a section of a single tube of a vertical boiler. The water space surrounding it is well protected by a non-conductor, so that the loss of heat is very small. Through the tube a current of hot gas is caused to flow from a lamp, gas jet, or other suitable source and the amount of heat transmitted to the water in a given time is measured. The test is then repeated under identical conditions, except that a radiator of the form shown above is placed in the tube. The increased amount of heat transmitted to the water is taken as the amount due to the radiation from the internal piece.



Section.



Plan.

Apparatus for Measuring Increase in Transmission of Heat to the Tube Surface due to Radiation.

Experiments with this apparatus show the following general results:

(1) That the percentage of increase in heat transmitted due to radiation increases with increase in temperature of the gases passing through the tube.

(2) That the percentage of increase in heat transmitted due to radiation is larger in vertical tubes than in horizontal, on account of the fact that a given area of heating surface in a horizontal tube absorbs heat faster by direct contact with the gases than the same area in a vertical tube.

In general, the experiments showed that with vertical tube heating surface and gas passing through the tubes at a temperature sufficient for the tube to transmit 1,000 to 3,000 B. T. U. per sq. ft. per hour, the insertion of a radiator would cause an increased heat transmission of 200 B. T. U. to 1,200 B. T. U. per sq. ft. of radiating surface per hour; or, in other words, the insertion of a radiator in that part of a tube in which the gas is of high temperature appears to increase the amount of heat absorbed from 20 to 40%.

These experimental figures for the amount of heat transmitted by a radiator in a tube are corroborated by the figures for relative radiation and convection given by D. K. Clark in his treatise on the steam engine, p. 68, et seq.

The radiators possess the advantage over the spiral retarders described by Prof. Whitham, that they do not obstruct the draft to so great an extent, and they interfere less with the cleaning of tubes with the steam jet blower.

Experiments on actual boilers indicate that either device is most useful on boilers with short tubes, of not too small diameter and with an abundance of draft. With either device the tube surface must be kept clean, otherwise the increased efficiency will soon disappear, as is the case with the Serve ribbed tubes when care is not taken in this respect. It appears likely that either of these devices may be used with especial advantage, therefore, where a clean fuel like gas or oil is used. Another application of these devices which appears to have promise is to the tubes of vertical boilers of the Corliss or Manning type. An objection to these otherwise excellent types of boilers is the very high head room that is required to get in tubes long enough to extract the heat from the gases with reasonable completeness. By the use of some device to increase the tube-heating surface efficiency, a shorter tube should be permissible, with a consequent reduction in the height of the boiler.

The economic gain by the use of either radiators or retarders depends entirely on the temperature at which the boiler is discharging its hot gases. In general it may be assumed that every 100° reduction in the temperature of the waste gases represents from 5 to 10% saving in fuel.

In general it will not usually be found worth while to introduce either retarders or radiators in the tubes of any boiler unless the thermometer shows its hot gases to be discharging at a temperature of over 550° F.

I notice among Mr. Whitham's conclusions the statement that: "Retarders can be used only with fire tube boilers." This doubtless refers to the proposition to place retarders inside the water tubes, which is absurd on its face to any one correctly understanding the action of the retarders. The use of radiating bodies of extended surface, however, in the gas passages between the tubes of a water-tube boiler, should in theory at least give the same advantage as in the case of fire tubes. Two methods for effecting this radiating action devised by the writer may be found by reference to U. S. patents Nos. 529,997 and 559,021.

◆

A 1,000 HP. VERTICAL TUBULAR BOILER has just been placed in the Cortlandt St. Station of the New York Steam Co. It weighed 119,000 lbs., and was 23 ft. long and 10 ft. in diameter. Its 220 steel flues are each 5 ins. diameter and a 7-in. circulating tube surrounds each flue and extends from near the bottom of the boiler to near the water line. The boiler was built by the Edgar Boiler Co., of Warren, Pa.

◆

AMERICAN AGRICULTURAL MACHINERY is finding a market in Ireland. U. S. Consul Newton B. Ashby, of Dublin, in commenting on the exhibits at the recent show of the Royal Dublin Agricultural Society, says that the English and Irish agricultural tools are as a rule much heavier in make and more clumsy in appearance than the corresponding American tools. He believes that it would be well to study the prejudices of the farmers and build heavier machines for sale in this market.

◆

NEARLY $400,000,000 is the total of British capital which was invested in various enterprises floated on the London stock market during the first six months of 1896, according to the London "Economist," the actual figures being £79,494,000. Of this sum about £11,000,000 was invested in loans of foreign governments, and about an equal sum, it is amusing to note, in companies formed to manufacture cycles and cycling appliances.

◆

THE EFFECT OF ELECTRICITY ON PROJECTILES while in flight has been illustrated by some recent trials of the Swiss army rifle. The "Journal de Geneve" states that during this trial strange deflections of the bullets were noticed that could not be accounted for until it was discovered that an electric line paralleled the range. Experiments were made by building a line of four steel cables the full length of the range, 780 ft., and about 120 ft. from it. When these cables carried a heavy current of electricity the lateral deflection for this distance was about 70 ft. For a longer range the deflection was much increased; with artillery and a range of 9,000 ft. the deflection from the true line is claimed to reach the enormous amount of 14°. It is not stated whether the deviation is toward or away from the electrical current.

ELECTRICAL SUBWAYS are to be built by the city of Minneapolis in all streets which are to be paved with asphalt. Space will be provided sufficient for the use of the city and for all companies having electric wires of any sort in the streets. The work will be in charge of Mr. F. W. Cappelen, city engineer, and is expected to cost about $90,000.

ELECTRIC MOTORS have been installed to operate the swing span of the new highway bridge across the Connecticut River, from Middletown to Portland, Conn. Four General Electric 800 motors are used, one of which swings the span, two others operate each the lifting mechanism at one end of the span, and the fourth is held in reserve. The span is 450 ft. in length, and we are informed that previous to the installation of the electric motors 15 men were required to start the bridge and 8 to swing it.

A PNEUMATIC TUBE POSTAL SYSTEM is reported to be contemplated in Philadelphia to connect the main post office with the sub-stations. A half-mile tube, 6½ ins. diameter, from the Philadelphia Stock Exchange to the post office has been in successful operation for some years.

THE EXPOSITION BUILDINGS, AT ATLANTA, GA., have been badly injured by prolonged and heavy rains. The manufactures and liberal arts building is almost totally destroyed. It had a flat gravel roof on which the water collected, owing to stoppages in the water pipes, and the weight of water caused its collapse.

THE ARCHITECTURAL APPEARANCE OF THE NEW East River Bridge is engaging the attention of the Commission in charge of the work. Mr. Selim H. Peabody, a member of the Commission, proposes the appointment of an architect to co-operate with the Chief Engineer, Mr. L. L. Buck, in designing details of the structure, such as balustrades, lamp-posts, etc., so as to produce the most pleasing effect. The suggestion is an eminently sound one, and it is to be hoped that it may be carried out.

AN ENGINEER CORPS is a novel feature of the staff of Brigadier-General Wheeler of the Illinois Militia. The staff has been organized by Capt. J. I. Kelly, and among its members are Albert F. Reichmann, assistant bridge engineer of the Chicago, Milwaukee and St. Paul Ry.; W. H. Finley, bridge engineer of the Chicago & Northwestern Ry.; C. L. Crabbs, assistant engineer of the Metropolitan Elevated R. R.; Jules Roemheld, Superintendent of Bridges of Chicago; J. W. Crissey, assistant engineer of the Metropolitan Elevated R. R.; and Fred E. Mather, architect. The corps is expected to become proficient in the construction of fortifications, military bridges, etc.

A CODE OF ETHICS was adopted by the Denver chapter of the American Institute of Architects at its meeting on July 6. The following extracts from it are published in a Denver daily paper:

> No member should enter into partnership, in any form or degree with any builder, contractor or manufacturer.
>
> No member should guarantee an estimate or contract by personal bond.
>
> It is unprofessional to offer drawings or other services "on approval" and without adequate pecuniary compensation.
>
> It is unprofessional to make alterations or to complete a building in the course of construction designed by another architect, until satisfactory settlement has been made with the first architect, unless dishonest practice on the part of the first architect has been proven.
>
> It is unprofessional to attempt to supplant an architect after definite steps have been taken toward his employment.
>
> No member shall compete in the amount of compensation, or offer to work for less than another, in order to secure the work.
>
> It is unprofessional to work for less compensation than that indicated by the schedule of charges adopted by the American Institute of Architects, which is as follows: For full professional services, including supervision, 5% of the cost of the work. For drawings, specifications and details without supervision, 3½%. For alterations and additions an additional charge to be made, in proportion to the extra labor involved. Necessary traveling expenses to be paid by the client.

TRIPLE SCREWS are to be adopted on two battleships and five cruisers to be built by the German government.

THE LATEST AIRSHIP INVENTOR is one John F. Cooley, of Philadelphia. According to the newspapers he is about to construct "a mammoth 200-ft. air ship, at Charlotte, N. Y." The apparatus is to be of the inclined plane type, propelled by gasoline motors.

THE GALVESTON JETTIES are rapidly approaching completion to the point fixed by the project of 1886, which was the 30-ft. contour. On July 9, according to the Houston "Post," the trestle of the south jetty was within 400 ft. of the proposed terminus and the trestle of the north jetty was 800 ft. from its terminus. The same authority states that whereas the engineer's estimate of the cost of the work in 1886 was $7,000,000, it now appears that the entire work will be completed for nearly a half-million dollars less.

BOOK REVIEWS.

STEEL IN CONSTRUCTION.—Convenient Rules, Formulas and Tables for the Strength of Steel Shapes Used as Beams, Struts, Shafts, Etc., Made by the Pencoyd Iron Works. A. & P. Roberts & Co., Philadelphia, Pa. 12mo; cloth; pp. 232; illustrated.

This is the ninth edition of the familiar little handbook published by the A. & P. Roberts & Co., and like former editions it contains besides tables of weights and dimensions a large number of formulas, rules and instructions for the use of the different shapes in construction. There are numerous cuts in the text and 30 full page plates, and also a very adequate index.

CHEMISTRY AT A GLANCE.—A Study in Molecular Architecture. Issued in Series. No. 1, Oxides. By Herbert B. Tuttle, 131 Lexington Ave., New York. Pamph. 8vo.; pp. 59; 60 cts.

In this pamphlet are given diagrams showing for over 200 chemical substances the structure of the molecules, according to the generally accepted theory of such structure. Those unfamiliar with chemistry may not be aware of the fact that the position of atoms in a molecule may be as important in determining the nature of a substance as the nature of the atoms. Thus alcohol, a liquid, and methyl ether, a gas, have each the same composition and the same chemical symbol ($C_2 H_6 O$).

The knowledge of molecular structure is therefore often very important to a working chemist, and this handy volume will be found convenient by many, we presume, as a work of reference. We do not see why the author does not give together with his "architectural formulas" the ordinary formulas also. They might be a convenience to some who are not familiar with current chemical nomenclature. For example, the formula given for silicon triethyl oxide, alias silico-heptyl oxide, takes up three-quarters of a page, being an architectural structure, 18 stories high. We find that it contains 30 H's 12 C's, 2 Si's and an O. Might not its formula $H_{30} C_{12} Si_2 O$ also be given?

WATER SOFTENING AND PURIFICATION.—The Softening and Clarification of Hard and Dirty Waters. By Harold Collet (Stanhope Water Engineering Co., Limited, London). London: E. & F. N. Spon & Co., New York: Spon & Chamberlain. 12mo.; cloth; pp. 168; 12 illustrations. $2.

This book is almost wholly devoted to water softening, with a little matter relating to the removal of iron and to the clarification of water. The information on clarification is not only meager, but fails to convey an adequate idea of clarification processes, practically ignoring mechanical filtration as practiced in this country.

The author sets forth the chemical and other characteristics of hard water, noting especially the objections to its use for household and industrial purposes. The various chemicals used for softening are discussed and their chemical action stated.

No descriptions of softening plants in actual use are given, but some apparatus for this purpose is described and illustrated. The fact that practically all the devices presented are made by the company with which the author is connected raises the question whether the book is not intended as much as anything else for an advertisement. The name of the author's company follows directly after his own on the title page; the devices described are frankly credited to the company; and the reading matter is followed by advertisements of the company, the only ones in the book.

Much of the information given is of such a character that it would not be affected by the fact that the writer is personally interested in certain processes, but most, if not all, books written under such circumstances need to be read with caution.

DIRECTORY TO THE IRON AND STEEL WORKS OF THE UNITED STATES.—Embracing a full list of the Blast Furnaces, Rolling Mills, Steel Works, Tinplate Works, Forges and Bloomaries; also of all the Wire Rod Mills, Wire Mills, Cut-Nail Works, Wire-Nail and Horse-Nail Works, Car Axle Works, Car Wheel Works, Car Building Works, Locomotive Works, Cast and Wrought Iron Pipe Works, Malleable Iron Works, Shipbuilding Works and Bridge Building Works. To which is added a complete list of the Iron and Steel Works of Canada and Mexico.—Compiled and published by the American Iron and Steel Association, Philadelphia, Pa. Cloth; 8vo.; pp. 334. $6.

This is the thirteenth edition of this well-known directory, which is published every two years, and its scope is pretty clearly shown by the sub-title quoted in full above. Since the edition of 1894 was issued a large number of new enterprises have been undertaken, including a surprisingly large number of sheet mills and tinplate works. The list of malleable iron works is a new feature of the directory. The directory includes 469 blast furnaces, with a capacity of 17,373,637 tons per annum; 505 rolling mills and steel works, of which 463 contain trains of rolls; 4,408 puddling furnaces; 44 standard Bessemer steel works, with 95 converters; 3 Clapp-Griffiths and 4 Robert-Bessemer steel plants, the annual converting capacity of all the Bessemer steel works being 9,472,350 gross tons of ingots and direct castings; 88 completed open-hearth steel plants, and 4 in course of erection; the annual capacity being 2,430,450 gross tons; 35 open-hearth plants prepared to manufacture castings; 45 crucible steel plants; 53 cut nail mills with 4,598 machines; 53 wire nail works; 23 works for rolling wire rods; 73 wire-drawing works; 156 completed plate mills; 69 tinplate works; 23 forges and bloomaries; 74 bridge works; 108 pipe and tube works, 112 car wheel works, etc.

The equipment and capacity of each plant, the date of construction, the names of officers and other interesting information is given. All this matter has been entirely rewritten. The establishments are classified by their products and arranged alphabetically in this classification, while there is an index to the names of works and companies, and to the principal brands of pig iron. The book is well printed and neatly bound, and is an invaluable work of reference for all persons interested in the iron and steel industries.

THE SAN FRANCISCO CONVENTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

By F. S. Odell, M. Am. Soc. C. E.

The 28th Annual Convention of the American Society of Civil Engineers was held in San Francisco, June 29 to July 2. A nucleus formed by the Eastern members with their families and friends to the number of 28 left Grand Central Depot, New York, on June 22, at 6 p. m. Other members joined the party at various points en route until a very creditable representation gathered at San Francisco.

The details of the itinerary were arranged and the party conducted by Raymond & Whitcomb.

The first stage of the journey ending at Chicago was swiftly accomplished over the New York Central and Lake Shore & Michigan Southern railways. At Chicago a stop of an hour and a transfer to the Chicago, Rock Island & Pacific R. R. was made. The following day, June 24, was passed amid the wheat and corn fields of Iowa and Nebraska, where the luxurious growth of leaf and stalk gives promise of abundant harvests. Another night is passed and the party awakens on the morning of the 25th on the Colorado plains. Either there has been an unusual amount of rainfall in this region this year or man has made great conquests on these arid plains within the ten years since the American Society of Civil Engineers held its convention in Denver. Certainly a very great change is evident since then. Man has taken possession; the whole country is fenced in, cattle and sheep are seen on every side, the slopes appear somewhat verdent and even the little prairie dogs and jack rabbits have mostly disappeared.

The party take a late breakfast at Colorado Springs and go on to Manitou.

If the plains of Colorado have changed, what may be said of the towns? Colorado Springs has become a thriving city, and the Manitou of ten years ago could not be recognized were it not for the unchangeable mountains. A trolley line now makes frequent trips between Colorado Springs and Manitou, running as far up as the Iron Ute Spring. Houses and shops line the street all the way, and, climbing out of the narrow valley, perch in picturesque locations on the mountain sides and cap the summits of the foothills. A good wagon road leads up William's Canon to the Cave of the Winds, and a railway ascends the old Pikes Peak trail to the summit of the mountain.

The party availed itself to the fullest extent of the opportunity to enjoy the wonderful scenery; the canons were diligently explored, the Garden of the Gods was visited, Pike's Peak ascended, a great volume of rarefied air inhaled and quantities of the pungent, sparkling waters imbibed.

Unfortunately for those ascending the 14,200 feet of Pike's Peak, the day was somewhat overcast and the summit enveloped in clouds, but the magnificent views obtained during the ascent and descent, and the exhilaration of the lofty altitude, were considered sufficient compensation. The hours fled all too quickly, and every one regretted that the stay was so brief, as it would take a week at least to thoroughly "do" Manitou.

A good night's rest and the journey is renewed on the 26th by special train on the Denver & Rio Grande R. R. This special train added very greatly to the pleasure of the journey—stops being prolonged at points and places of special interest to the party, while others of less attraction were omitted altogether. At 11 a. m., Pueblo, "the Pittsburg of the West," is reached. Here are abundant signs of progress, hither is brought the product of the mines, iron ores, coal, gold and silver, here the ores are smelted and rolled into commercial forms. Some fine public buildings are noted, among them the State Normal College; also many handsome residences, as well as the remains of some old adobe houses still peopled by Mexicans, a strange blending of ancient and modern life.

From Pueblo westward, the railway follows the Arkansas River, which flows through a broad valley at Pueblo, along which frequent irrigation flumes and ditches are seen leading water from the river upon the arid and parched bottom lands, which at once respond with luxuriant growths of alfalfa, corn and other cereals.

As the train speeds onward the valley contracts, the mountains seem to bar the way and forbid further progress, but the roadway glides around the base of a lofty mountain and makes its sinuous passage along the verge of the river, which has here become a narrow, foaming torrent, occupying the full width of the gorge from which the rocky walls of the cliffs rise almost perpendicular to the height of a thousand feet or more, the climax is reached at the Royal Gorge, where the cliffs on either side approach each other so closely that there is no room for the railway, so the engineers in the original construction bridged the river lengthwise, or, in other words, hung up the railway above the river on long girders suspended from rafters like trusses thrown across the canon and buttressed against the solid walls of the cliffs on either side of the river.

The railway as originally constructed through the canon was narrow gage, but has since been widened to standard, and in the reconstruction it was found practicable to build a heavy retaining wall under the suspended bridges, so now it is more ornamental than useful, but it affords an excellent object lesson of the readiness with which the engineers surmounted a difficult obstacle in a novel and unusual manner, and it is to their credit that if they erred it was on the side of greater security in construction. The scenery at the Royal Gorge and for miles through the canon is wonderful beyond description, the mountains rising almost vertical for thousands of feet, and as the train moves onward, taking various forms, rent by side canons of marvelous wildness and beauty, the traveler is entertained with a kaleidoscopic series of views that can never be forgotten.

At Salida we stop for dinner and then proceed through Leadville, the most westerly town visited by the convention party in 1886. Only a brief stop was made and the ascent was begun to Tennessee Pass at the Continental Divide, which attains an altitude of 10,418 ft., the highest elevation passed over in the train during the trip. The railway passes under the summit through a tunnel, the Arkansas River and the Atlantic slope are left behind, and the descent toward the Pacific is begun. The Eagle River is followed until it empties into the Grand. In the Eagle canon the train is stopped to view some mining operations at the Belden mines. These are very rich gold producing mines, the entrances to the shafts are hundreds of feet up the mountains, where buildings containing the hoisting machinery can be seen. Communication with the valley and railway is had by means of cableways. To the uninitiated it looks like a very improbable place to find precious metals. Further down the valley of the Eagle, large lava beds are seen on the easterly side of the river. Apparently the lava has been forced from fissures in the mountain, as no crater appears. At the Grand another canon is entered, which if not so sublime as that of the Arkansas, is equally wonderful, and by some is considered more beautiful, the cliffs taking the forms of Egyptian architecture and rising into suggestions of temples and theatres, but we are surfeited with mountains and canons, and while the day has been crowded with marvelous scenes and interesting features, all are so wearied that a few hours' rest with a bath in the warm sulphur water and a good supper at Glenwood Springs is most welcome. We find this place a gem set in the mountains, with a commodious and well appointed hotel, ample lawn, verdant with grass and shaded with trees and vines, large bath houses with all the appliances for bathing in luxury. A large swimming pool, fed by a gushing sulphur spring that sends out sparkling crystal water at a temperature of about 120° F.; the water in the pool is kept at a pleasant temperature for bathing by the admixture of a sufficient quantity of cold water. Bathing in the open pool is indulged in at any time of year, even in the coldest of weather and amid snow storms.

Supper is taken at the hotel; a delightful siesta on the veranda, with coffee, cigars and the accompaniments of music and an electric fountain, a dream of delight. Again the cars are taken and the weary members of the party seek their berths. Later the cars are attached to the regular train and the journey is resumed.

The next morning, June 26, the aspect has changed wonderfully; we are in Utah; the mountains are lost to view and barrenness and desolation is all that meets the eye. On these alkali plains, with a scanty growth of sage bush, a solitary coyote, gaunt and ill-favored, gives the finishing touch to a landscape that for dreariness can hardly be surpassed. This continues for miles and miles until the Valley of the Jordan is approached, where, under the influence of irrigation and cultivation, the soil is very productive; grass and grain wave in the meadows, the trees are prolific in fruits, and flowers bloom in the gardens by the roadside.

Salt Lake City is passed with dissolving views of the Tabernacle and New Temple, the latter a notable work of architecture. Thus far the genius of these Mormon architects seem to have been expended on the ecclesiastical structures, and but little appears in the homes of the people. We follow the northeasterly shores of the Great Salt Lake for many miles, look out on its sparkling waters and inwardly long to plunge in and free ourselves from the soot and dust of the day's journey. Ogden is passed with a brief stop, and we enter the desert of Northwestern Utah and awaken on the 27th in a similar desert in Nevada. Nor do we find much that is not desert in crossing the whole state on the line of the Central Pacific Ry. We are told the entire state has a population of not more than 50,000, and that it is decreasing in the number of its inhabitants.

That the soil is not unproductive, however, is demonstrated at Humboldt, a station on the railway where water is had for irrigation and which is a veritable oasis in a dreadful desert. A story is related of an enthusiastic native who, in extolling the advantages of his state to an Eastern man, declared that all they needed was plenty of water and good society. His companion replied he had heard that is all that is lacking in hell!

At Humboldt the first Indians were seen—two Piute squaws—one in brilliant paint. The photographic fiends of the party went into ecstasies at once, though it was difficult to get even satisfactory snap-shots owing to the aversion of the Indians to being photographed. They have learned the tricks of the Kodak and other wiles of the amateur photographer. However, at stations further on, by strategy and a liberal use of coin of the realm, a number of quite satisfactory likenesses of some squaws and their papooses were obtained.

Breakfast and dinner were taken on the dining car. At noon we were met by Mr. W. G. Curtis, Assistant to the General Manager of the Pacific System of the Southern Pacific Co.; Geo. E. Gray and Col. Geo. H. Mendell, Corps of Engineers, U. S. A., and other members of the Local Reception Committee who had come out in a private car to meet and welcome us.

From the moment of their arrival the local committee were most assiduous in their attentions to their guests, and until we parted from them at Ashland, Ore., on July 5, they never ceased their ministry to our comfort and enjoyment. The first intimation of their hospitable attentions appeared immediately after their arrival when a number of crates of the most delicious strawberries, apricots and peaches were distributed through the cars with the "compliments of the local committee."

The state line is crossed, and we enter California about 2 p. m. The Truckee River, which we are following, soon leads into the mountains, and after pausing a few minutes at Truckee we are soon among the snow-capped Sierras, and are again enchanted with beautiful mountain scenery. As we slowly ascend toward the summit of the range magnificent views greet us at every turn until we are engulfed in snow sheds and ride mile after mile in a sort of nightmare vainly hoping in a few minutes to come out into the open and get full views of what we are sure, from the tantalizing glimpses we get through the cracks between the boards, must be grand and beautiful scenery. But we hope in vain, for not until we have reeled off some 42 miles of darkness do we emerge from the sheds into daylight again, and then we have passed far down from the summit. The necessity for these snow sheds was very evident, as we could still see snow banks outside as high as the car windows.

A series of small mishaps had occurred to the train. Between Denver and Sacramento three draw-bars were broken. Each occasioned delay for repairs, so Oakland was reached about four hours behind time; further delay occurred at the ferry, and the party did not finally reach the Palace Hotel in San Francisco until about 3 a. m., June 29.

The sessions of the convention began at 10 a. m., on the 29th.

The following are brief abstracts of the papers presented, all of which were published in full in the May number of society's proceedings:

Flow of Water in Wrought and Cast Iron Pipes from 28 to 42-ins. Diameter.

This paper by Mr. Isaac W. Smith, M. Am. Soc. C. E., dealt with investigations made on the flow of water in the pipe lines, which carry the water from Bull Run River to the city of Portland, Ore. The water supply is taken from the river by means of a canal terminating in a funnel mouth connecting with the 42-in. discharge pipe. The water is conducted to the city through 24 miles of riveted steel pipe and 6 miles of cast-iron pipe. The steel pipe is 42, 35 and 33 ins. diameter, and the cast-iron pipe 32 and 28 ins. diameter, the latter diameter being used for a distance of 2,000 ft. to carry the pipe line under the Willamette River. On March 28, 1895, there were 2,995,000 gallons, by reservoir measurement, turned into reservoir No. 1 in 3.7 hours and 617,000 gallons into other reservoirs, making 3,162,000 gallons in 3.7 hours, or 23,410,000 gallons in 24 hours. The flow by weir was 23,750,000 gallons, or 340,000 more than the reservoir and weir measurements combined. On Jan. 21, 1896, all the water was let out of the reservoir and the full flow from Bull Run River turned in, the time being noted as the water level reached each million gallon mark; time being 61 minutes in seven cases, and 62 minutes in three cases, or 10 hours, 13 mins. for 10,000,000 gallons, equivalent to 23,491,000 gallons in 24 hours. On Feb. 27, 1896, the discharge was 23,500,000 gallons through the riveted pipes and 20,750,000 through the cast-iron pipes.

A Water Power and Compressed Air Transmission Plant for the North Star Mining Co., Grass Valley, Cal.

This paper by Mr. A. D. Foote, M. Am. Soc. C. E., described a plant in which air compressors with cylinders 10 × 24 and 18 × 24 ins. are driven by a Pelton water wheel 18 ft. 6 ins. diameter, making 110 revolutions per minute, the water being taken from a canal and conveyed through 2½ miles of 22-in. riveted iron pipe and 7,070 ft. of 20-in. riveted steel pipe, the head being 775 ft. This plant was described and illustrated in our issue of Dec. 19, 1895.

The Condition of Steel in Bridge Pins.

Mr. A. C. Cunningham, M. Am. Soc. C. E., has made a number of investigations as to the strength and quality of steel pins for bridge work, and finds that when they are tested for quality and not for the purpose of getting them past a specification, it is found that forged pins are better than rolled pins, and that a medium hard steel of about 70,000 lbs. ultimate tensile strength will give better results than a soft steel. The tests (a number of which are given in tabular form) show that bridge pins, even when made from a special quality of steel, are not in a uniform condition; the interior portions show a lack of work, and may show excessive segregation, which in steel of common quality is liable to reach a dangerous amount. It is also shown that pins are improved by annealing. The following specification is submitted as being likely to procure as good bridge pins as can be had in common practice:

> Bridge pins shall be made of open-hearth steel. If made of acid steel, the cast analysis shall show not more than 0.06% of phosphorus, nor more than 0.03% of sulphur. If made of basic steel the cast analysis shall show not more than 0.03% of phosphorus, nor more than 0.03% of sulphur. The manganese for either steel shall be not less than 0.5% nor more than 0.8%.
>
> The smallest diameter of the final bloom or ingot to be made into pins shall be at least 50% greater than the diameter of the pin.
>
> All pins shall be stamped with the cast number of the steel from which they are made and shall be stamped with consecutive numbers from the bottom of the ingot to the top.
>
> After pins have been manufactured to diameter, they shall be slowly and uniformly heated to a dark red heat in a suitable furnace, and left to cool slowly for a period of not less than 24 hours. Test pieces cut from near the surface of annealed pins, and of a sectional area of not less than ½ sq. in. shall have an ultimate strength of not less than 60,000, nor more than 70,000 lbs., per sq. in., an elastic limit of not less than half the ultimate strength, an elongation in 8 ins. of not less than 20%, and a reduction of area at fracture of not less than 40%. Test pieces cut from near the center of pins shall comply with the above requirements, except that a fall of 5,000 lbs. in ultimate strength, and a fall of 5% in reduction of area will be allowed.
>
> The fracture of all pin tests shall be free from granulation.
>
> ....
>
> Analyses of drillings taken from near the surface of pins shall not exceed the limits of the cast analysis by more than 10%, and, when taken from near the center, shall not exceed said limits by more than 50%.
>
> Tests and analyses shall be made on such pins as the engineer shall designate.

The Construction of a Light Mountain Railway in the Republic of Colombia.

The railway in question was built for the Caribbean Manganese Co., of Baltimore, Md., and extends from the harbor of Nombre de Dios to the manganese mines, the main line now in operation being about nine miles long. The author of the paper, Mr. E. J. Chibas, Assoc. M. Am. Soc. C. E., was the engineer. The surveys and location were made with difficulty owing to the dense forest and undergrowth, and the absence of paths or roads. During about six months suspension of work, luxuriant vegetation, 5 to 7 ft. high, covered the right of way, which had been cleared and grubbed, and some of the centre stakes were growing into trees. The bridge work gave considerable trouble, the native carpenters being unable to work from plans, and being such poor workmen that they had to be watched to keep them from spoiling the timber when the whole work had been laid out for them. The embankments were only 7 to 8 ft. wide on top, the idea being to widen them with refuse from the mines during operation, but the author did not consider a less width than 10 ft. advisable for a line of 3 ft. gage. The cuts are 10 ft. wide, but 12 ft. would have been better. In pick and shovel work, and in nearly all manual labor, Jamaica negroes proved superior to the natives. The track is laid with 35 lb. rails on 2,200 ties per mile, the ties being usually 6 × 6 or 5 × 6 ins., 6 ft. long. The ballast is a decomposed rock obtained from the cuts. The curvature of the line aggregates about 30% of the total length. The cost of building and equipping 10½ miles of line averaged $13,400 per mile. The average for the Nombre de Dios branch (including wharf, buildings and port terminals) was $6,800 per mile.

Improving the Entrance to a Bar Harbor by a Single Jetty.

In this paper, Capt. T. W. Symons, M. Am. Soc. C. E., U. S. Engineer Corps, describes a plan prepared for the improvement of the entrance to Gray's Harbor, Wash., by means of a single jetty. this plan being applicable here on account of the relations of the currents, tides, volume of flowing water, and other conditions. In general two parallel or converging jetties are used, or one jetty with the other replaced by a headland or permanent shore, but the author believes, from his experience on the Pacific coast, that there are places where double jetties are unnecessary. Such a plan has been successfully carried out at Coos Bay, Ore., and the plan proposed for Gray's Harbor is based largely upon the results obtained and studies made at Coos Bay. The jetty, as proposed, is to be of rubble stone or a brush mattress foundation, the jetty reaching up to the level of high tide, and its total length (to the crest of the bar) being 25,500 ft. The cost of the wall is estimated at $1,000,000, as compared with $2,500,000 for a plan involving two jetties.

Interesting discussions followed the reading of these papers, especially that by Mr. Cunningham.

In the evening a reception was given at the hotel which was largely attended by distinguished citizens of the city and vicinity, and many pleasant acquaintances were made.

On Tuesday, the 30th, the local committee tendered the party an excursion in a steamer on the bay and to the

Union Iron Works. The harbor and Golden Gate were seen to advantage. Luncheon was served on board the steamer, after which appropriate speeches were made. An inspection of the new U. S. battleship "Oregon," now under construction, and of the Union Iron Works completed the day's sightseeing and pleasures. In the evening President Clarke's address (Eng. News, July 2) was read by the Secretary, Mr. Charles Warren Hunt, Mr. Clarke not being present. This closed the formal labors of the convention, and the visiting members and friends committed themselves unreservedly to the hands of the local committee, and for the remainder of the stay in California "joy was unconfined."

The following day the party visited Mayor Sutro's beautiful residence and park, dined at the Cliff House, where hospitality flowed so freely that guests who had never spoken before made speeches and afterwards saw sea serpents or rather seals on the rocks in the bay.

The freedom of the city was conferred upon the visitors. They were invited to the Board of Trade; the Bohemian Club opened wide its doors; everywhere hospitalities were lavished and people "fell over each other" in their efforts to do honor and afford pleasure to the American Society of Civil Engineers.

On July 2, by courtesy of the local committee, an excursion, to which a large number of resident citizens were invited, started by special train to visit the Spring Valley Water-works, Leland Stanford, Jr, University, and Monterey. At San Mateo a large number of conveyances met the train and the party drove several miles throughout a pleasant country to the famous dam of the Spring Valley Water Co., about which so much has been said and written that it has become very familiar to the engineering profession. A thorough examination of the structure was made, and full explanations of the details of construction, were given by Mr. Herman Schussler, Chief Engineer of the Spring Valley Water Co. Then the drive along the lake was resumed until a pleasant grove was reached, where on long tables under the trees a feast was spread with everything pleasant to eat and drink in great abundance. Liquids—not all of which originated in the lake—flowed redundantly and good cheer prevailed. After the feast a very rich program of after-dinner speeches was served, by men of all professions and occupations, from bishop to banker.

Again the carriages were taken and the party boarded the train at San Mateo, full of gratitude to the Spring Valley Water Co. for the delightful carriage ride and dinner. From San Mateo the train sped through one of the garden spots of California—a great grain and fruit-growing belt, through thousands of acres of wheat white for the harvest, where machines operated by 28 horses thresh the grain as it is cut and drop it off in bags, through beautiful parks of live oak, through miles of fruit orchards, apples, peaches, apricots, prunes and cherries, through hundreds of acres of seed onions and sweet peas—everything is on a most generous scale in this country.

We stopped a few minutes at Palo Alto, got a glimpse of the grounds and buildings of the Leland Stanford, Jr., University, and then hastened onward through San Jose where we could see upon Mt. Hamilton, 28 miles to the eastward, a white speck that indicates the location of Lick Observatory, with its world-renowned telescope. At last we approach Monterey and are soon at the Hotel Del Monte. In the evening, as we view the hotel and park, it seems a veritable fairy land, an impression which the light of the following day fully justifies, for the place is lovely almost beyond conception. Nature and man have co-operated in perfect union and harmony in the creation of the Del Monte. Nature laid the foundation, planted the great oaks and cypresses, and man erected the beautiful hotel and cultivated and adorned the park with consummate taste, harmony and skill. All the flowers that will thrive in the congenial soil of Central California here unfold in exuberant bloom; strange, fantastic, semi-tropical plants exhibit their foliage in the Arizona Garden; tempting vistas with paths leading in every direction invite to strolls in the park. Of all the places visited during the trip none approaches Del Monte for loveliness.

Time and space fail to give in detail a proper description of the delightful drive of 18 miles on the 3d of July through the quaint old town of Monterey, located irregularly on the Bay of Monterey—through Pacific Grove, the Chatauqua of the Pacific coast, on through an immense natural park to the ocean, along the ocean to Cypress Point, with its fantastic forest of hoary wind-swept cypress trees, reputed to be as ancient as the cedars of Lebanon—on back to Monterey, and the Hotel Del Monte, and dinner; after which the train is again taken, and the return journey made to San Francisco, via, Santa Cruz and over the Santa Cruz Mountains, passing a grove of "big trees," some of the smallest of their kind, but one of which ("Fremont's tree") still standing and growing, easily accommodated 34 of the party with room to spare in its hollow interior.

According to the program, the time had arrived to leave California, but our hospitable hosts importuned us to stay another day, as they would not be satisfied without showing us something further of the material development of their wonderful state.

Yielding to their solicitations, another night was spent in San Francisco, and on the morrow, July 4, under escort of the local committee the party was taken to Sacramento and thence to Folsom, to examine the electric power plant located on the American River at that place, and illustrated and described in Engineering News of April 11, 1895, and May 7, 1896.

The electric current is transmitted from Folsom to Sacramento, 22 miles, and furnishes the motive power for all the electric street car lines in the city. The shops of the Southern Pacific Ry. are also supplied with electric power and experiments are being made to determine whether it will be sufficiently economical to warrant extending the use of the electric power to all the shop uses.

It is to be noted that a difficult engineering problem seems to have been satisfactorily solved in this water-power plant. It has been found that in diverting the water from rapid silt-bearing rivers like the American, very great difficulty has been encountered in keeping the comparatively slow flowing canals from becoming filled by deposits of silt. This difficulty is overcome at the Folsom dam by what is virtually a large settling basin, in the bottom of which are outlets, passages and gates, through which the sediment is washed into the river below the dam at intervals and only the water freed from its burden of silt is allowed to pass through the headgates into the canal. The gates are controlled and operated by hydraulic jacks and are very easily handled.

Near the dam is located the state prison, to which a brief visit was made, and the remainder of the afternoon was spent in Sacramento, where points of interest were visited the state capital with its very beautiful park, the historical Sutter's Fort and other places. The "glorious Fourth" was celebrated by the natives with characteristic Western energy and vim. To the ladies of the party who had not satisfied themselves with curios in Chinatown at San Francisco, another opportunity was presented in the Japanese bazaars of Sacramento, which were the only shops open on the Fourth.

About 9 in the evening a start was made toward the North, and on awakening the following morning the train was keeping company with the Sacramento River, which as it comes from the mountains is a clear, sparkling stream easily forded. We stopped at Craig, a resort in the mountains, with an outlook on Mt. Shasta, a wonderful peak, rising 14,442 ft., covered with a beautiful mantle of perpetual snow. We pass Castle Gate and are apparently lost in the mountains. Moss Brae Falls are seen, a series of dainty cascades, springing out from a drapery of verdant moss and foliage, and leaping and bounding down the steep mountain side to the valley below. Not far beyond we come to the famous Shasta mineral springs. After slaking our thirst with the cool, pungent water, the journey was renewed, penetrating further into the mountains and rising by loops and turns to the summit of the divide between the waters of the Sacramento and the Umpqua rivers, and as we rise we gain ever new views of beautiful Mt. Shasta, traveling nearly all day in sight of it.

About 4 p. m., our friends of the local committee, Mr. Curtis and Colonel Gray, who had accompanied us beyond the state line of California, parted from us at Ashland, Ore.

Too much praise cannot be given to our fellow members of the American Society of Civil Engineers on the Pacific coast and their friends for the magnificent hospitality which they extended to their visiting guests. From San Francisco to Tacoma attentions were showered upon the visitors and nothing was left undone that could add to their comfort or pleasure. The local committee of San Francisco, headed by their chairman, Mr. Curtis, were particularly assiduous and successful in their efforts to render the convention memorable by the heartiness of their welcome, and the wealth of good things prepared for their guests.

The remainder of the journey to Portland was pleasantly passed. The railway runs through some treacherous country, where slides occur, at one point the portal of a tunnel was once closed by a slide, and at another three miles of the road were buried under an avalanche of earth and debris which dropped from the mountain side, creating a temporary dam which formed a lake some miles in extent. This was speedily emptied when the dam gave way soon after the water began to pass its crest.

Portland was reached early on July 6. After breakfast at "The Portland" the party was conducted about the city and to Portland Heights, from which magnificent views of the surrounding country were had. the three great mountain peaks, St. Helens, Adams and Hood, like stars of the first magnitude, claim special attention, standing separate and apart, each mantled with perpetual snow.

Our Portland friends had arranged a trip by train to the Cascades and Locks, about 50 miles up the Columbia River. Here more beautiful scenery was enjoyed, the Locks were inspected, lunch was taken, and a salmon wheel was visited. The wheel is propelled by the current, and carries large buckets or scoops, which gather all the fish within their reach and deposit them on a platform.

But few of the party from the East had any conception of the abundance of fish or the size to which they attain in these Western rivers; and the sight of 50-lb. fish as they came flopping from the wheel was a revelation. It seems, however, a barbarous way of fishing and is prohibited by law by our Canadian neighbors.

Returning to Portland, the journey north was resumed, and Tacoma was reached late in the evening.

Here, as elsewhere, we were royally received, and were escorted about the town to view its sights.

In the afternoon the party were taken on an excursion to Point Defiance, and by steamer on the bay. In the evening an informal reception was held at the Tacoma. after which the party began disintegrating, a number leaving for the Yellowstone Park. Those remaining started northward again in the morning, July 8, by steamer, touching at Seattle and Port Townsend, and stopping at Victoria for a few hours for supper and a trip through the town.

Morning found us at Vancouver, which is a thriving city and an important port.

From here the journey east over the Canadian Pacific Ry. was begun. The water in the rivers was very high,. thousands of acres were flooded on either side the railway. As the afternoon wore away, however, the submerged plains were left behind and we were again enjoying picturesque scenery in the Fraser Canon which was followed until daylight faded into darkness.

The morning of the 10th found the party in the Lake region, circling the shores of the great Lake Shuswap, which the railway follows for 50 miles. The Lake is hemmed in by mountains rising high on every side and covered with virgin forest.

The country is said to bear a strong resemblance to the lake country of Scotland. It is a paradise for sportsmen, the forests abounding in large game and the lakes in fish and water fowl.

Leaving the Lake country the descent is made to the westerly crossing of the Columbia River at Revelstoke, the railway runs in an easterly direction up the Canon of the Illecilliwaet, leaving the Columbia, which makes a long detour to the north sweeping around the Selkirk Mountains. South of Revelstoke it widens into the Anow Lakes.

The Illecilliwaet is a torrential mountain stream fed by the melting snows seen on all sides on the summits of the lofty mountains of the Selkirk range. Recent hot weather had swollen all the streams, making the waters turbulent and muddy; the valleys were flooded, the rails of the railway being at times covered to the depth of 6 to 12 ins. A trestle on the line was started from its foundation and the train was stalled at a small station in the mountains in company with another train which had already been waiting for 24 hours.

A weary wait with frantic efforts to get into communication with the railway officials, who were empowered to advance the train and transfer the party to Glacier, an interesting and comfortable station to spend the waiting hours, failed to meet with success. Dinner and supper were taken on the dining car, and one by one the party retired for the night.

At midnight the road was opened, and the party was joined by Chief Engineer P. Alex. Peterson, M. Am. Soc. C. E., who had been superintending the repairs at the trestle, and the train moved forward up the canon, rising from the bottom of the valley and climbing the sides of the mountains on narrow shelves. The scenery grew wilder and the sleeping members of the party were dragged from their berths and began to appear variously clad in all sorts of garments, from linen suits worn the previous day, during the heat in the valley, to overcoats and blankets. But they were amply repaid for the loss of slumber and a hasty toilet. Stupendous mountains, towering on every side, began to appear, at that early hour in this northern latitude—day began to dawn at 2 a. m. Higher and higher the train climbed up the mountain side, around a "loop" most skilfully located in terraces, almost vertically above each other, until the altitude attained brought us in friendly proximity with the summits of the great peaks all around us, Ross, Cheops and Dix Donald being the most conspicuous. The little river was seen far down in the V-shaped canon, the trestle recently repaired was crossed, and when a turn of the road brought the great Glacier plainly into view, high up on the side of Ross' Peak, daylight had so far advanced that the billows of ice were plainly visible, extending upward toward the clouds in the stupendous masses—great plains of frozen crystal, hundreds of feet in depth.

Other glaciers were seen in the vicinity, but none of such extent or beauty. For many miles up to and through Roger's Pass, the scenery is sublime beyond the power of pen to describe.

Time and space fail to record the interesting features of the descent to the easterly crossing of the Columbia, at Donald, the ascent of the Kicking Horse Pass to the Continental Divide, in the heart of the Rocky Mountains, or the brief stop at Banff, in the Canadian National Park.

At Banff another division of the party took place, and the practical breaking up of "Tour No. 1." Those who were fortunate enough to go on "No. 4" are probably at this writing still enjoying the delights of the Yellowstone Park, but even those who came directly east from Banff have had sufficient grand scenery to last them at least another year.

The convention, as a pleasure excursion, at least, was an unqualified success, and I believe will have no small influence in strengthening the fraternal bonds between the members of the East and the Far West, as well as increase the interest of the engineers of the Pacific Slope in the American Society of Civil Engineers.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXVI., No. 5.

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- A Question of Professional Ethics—The Spread of Dry-Rot — Low Charges for Engineering Work Again—A Possible Solution of the Problem of Weights and Measures—The Benefits of Dry and Superheated Steam.

PLANS FOR RAILWAY TRACK DEPRESSION on Atlantic Ave., Brooklyn, were submitted to the commission in charge of that work by the counsel of the Long Island R. R. Co., on July 27. It is proposed to lower the tracks from the Flatbush Ave. terminus to the city limits, a distance of 31,040 ft., and carry the streets across the sunken tracks by 38 bridges 60 ft. wide at important streets and 46 foot bridges 14 ft. wide at other streets. The estimates for the work are as follows:

For excavating and wasting, 50 cts. per cu. yd.
For masonry in walls, $8 per cu. yd.
For concrete, $6 per cu. yd.
For first-class masonry, $13 per cu. yd.
For steel construction, 4 cts. per lb.

The consulting engineer estimates that to carry out the entire work, as shown on plans submitted and sketched out in this report will cost $3,912,932.

The above estimates does not include engineering expenses, the cost of removing water mains, alterations to sewers and other work connected with the city works department, or the cost of maintaining the railroad traffic during construction.

◆

THE COMPETITIVE DESIGNS for the proposed drawbridge over Newtown Creek, Brooklyn, N. Y., were opened on July 23. According to the Brooklyn "Eagle," those submitting designs were the following:

Name.	Type of bridge.	Estimated cost bridge.	Price, design.
E. B. Jennings	Bascule.	....	$1,000
W. H. Breithaupt	Hinged arch.	$200,000	6,000
Chas. E. Bedell	Bascule.	....	1,600
John D. Wilkins	....	....	6,300
Chas. A. Steiner	....	....	500
Waddell Bridge Co.	Lift.	....	...
Thos. E. Brown, Jr.	Bascule.	100,000	5%*
Alfred Liebmann	Lift.	....	500
Structural Eng. Co.	Lift.	400,000	2%*
Scherzer Bridge Co.	Rolling lift.	....	...

*Of cost.

◆

THE EAST RIVER TUNNEL proposed by Benj. S. Hening and his associates is likely to become a reality at an early date, if a long article in the "Tribune" of July 26 may be believed. The tunnel is to extend from a New York terminus at Park Row and Ann St., to a point near Willoughby Ave., in Brooklyn, a distance of about 8,700 ft., of which 2,600 ft. would be under the river. The section proposed is a horseshoe 28 ft. in width and 24 ft. in height. A franchise was granted for the tunnel by the New York Board of Aldermen some weeks ago, and it is stated that the funds for the work have been raised by an auxiliary organization known as the Columbian Co.

◆

A NEW EAST RIVER BRIDGE, to parallel the present structure and to be built solely for the use of the elevated and surface railway lines, has been proposed by President Jas. Howell, as an offset to the petition to permit elevated railway trains to run across the present structure. It would seem highly unwise to build another bridge close beside the present one until the traffic capacity of the present is fully utilized and until it is ascertained what relief will be given by the completion of the new bridge at Grand St. As New York and Brooklyn are not likely to supply funds for such a bridge, and private capital is still less likely to take it up, the newspaper discussion spent upon it is probably wasted.

◆

WORK ON THE HUDSON RIVER TUNNEL may be resumed, if the plan for the reorganization of the company agreed upon at a meeting of the bondholders in London last month is successful. It is stated that Mr. Chas. M. Jacobs has presented an estimate setting $2,376,779 as the cost of completing the tunnel and its approaches, and purchasing land for its terminals. By the reorganization it is hoped to raise sufficient additional funds to complete the work. It will be remembered that one tunnel has already been driven nearly across the river.

◆

THE NEW YORK RAPID TRANSIT LAW was declared constitutional by a majority of the Appellate Division of the New York Supreme Court on July 28. Two of the five judges dissented from the opinion. While this decision does not remove the obstacle presented by the refusal of this same tribunal some months ago to approve the plan prepared by the Rapid Transit Commission, it appears to open the way for the preparation of some plan involving smaller first cost, which could again be presented to the authorities for approval.

◆

THE CONTROL OF STREET CAR FARES by the state railway commission is to be tested in California. The commission will investigate the cost, debt, expenses, and earnings of the roads, and in case information is refused by the companies will carry the matter to the courts.

◆

A FIVE-CENT FARE for all suburban distances under 20 miles has been adopted by the Chicago & Northern Pacific Ry., running out of Chicago. This is said to be the cheapest suburban transportation ever offered by a railway company in this country.

◆

ELEVATOR CHARGES are complained of in a communication sent by a committee of canal carriers to the New York Produce Exchange. It is shown that for transferring a boat load of 8,000 bushels of wheat from Buffalo to New York the boatman has to pay $104 at Buffalo for the transfer, trimming, storage, etc., and $143 at New York. He receives a gross freight of 3¾ cts. per bushel, and after deducting the transfer charges as above, the insurance and the towing, has $113.50 left to feed his teams and crew, pay his men and bear other expenses of his journey of 1,000 miles, for west-bound freight is not often obtainable, and when it can be secured barely pays for the time of detention necessary to secure it. The protest continues as follows:

> It is adding insult to injury for the grain elevator combines, as aforesaid, to tax the state canal traffic upwards of $100 more on a boat load of oats than we, the canal carriers, receive gross for carrying it such a long distance from Lake Erie to New York Harbor, when it is taken into consideration that the entire time consumed for the simple transfer of grain at Buffalo and New York does not exceed 1½ hours at each port. It is no uncommon occurrence for the modern elevators at Buffalo and New York to transfer a boat load of grain from lake vessel to canal boat and from canal boat to ocean ship complete in the short space of 50 minutes.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred near Murphysborough, Ill., July 21, on the Chicago & Texas R. R. A trestle failed, precipitating the rear car of a passenger train to the ground. Fifteen passengers were injured. Cable dispatches from Bombay, India, state that on July 27 a passenger train was derailed on the railway between Bombay and Delhi and 50 passengers were killed.

◆

A BOILER EXPLOSION occurred at English, Ind., July 20. The regular engineer was absent. The substitute in charge was killed.

◆

A PISTON ROD BROKE on the steamer "Connecticut," July 23, of the Providence Line, on Long Island Sound. The broken rod connected with a low pressure cylinder and had been inspected by the chief engineer only three minutes before. The accident occurred at midnight and on a quiet sea, and steam was shut off before any damage was done to the vessel.

◆

A WATER-WORKS RESERVOIR is reported as having failed at Stanford, Ky., July 17, flooding a part of the city and doing some slight damage.

◆

AN ARTESIAN-WELL FRAUD is reported from Washington, D. C., the U. S. government being the victim. In 1893 a contract was let for a well to supply Fort Meyer, near Washington, the well to have a capacity of at least 50,000 gallons a day. Rock being struck in this well by a sub-contractor at some depth, a second well was started in 1894. Water was developed at a point surprisingly near the surface, but after the first test the contractor claimed that the well had been tampered with. The authorities not being satisfied with the well, anyway, a third one was put down in 1895. Water was again found near the surface. It was of a satisfactory chemical character, but the objection was raised that the well was not deep enough to insure a permanent supply, and on a test it yielded only 48,000 gallons a day. The contractor said he would sink the well deeepr, and shortly afterwards made a test which showed a yield of 60,000 gallons. The well was accepted and the contract price, $8,000, was paid in November. The well was not put in use until this year, when it was found to give little or no water. The Cook Well Co., of St. Louis, was called on to investigate the matter. It was found that both the second and third wells had been connected by means of a pipe with a near-by brook. A second pipe was laid to the third well to increase the apparent yield from 48,000 to 60,000 gallons. It is claimed that a dam was thrown across the stream and that the water pumped from the wells during the test was carefully conveyed back to the stream, the latter having only a small flow. We cannot vouch for the accuracy of the details of the above story, as they are taken from a press dispatch, but there is no doubt regarding the attempted fraud and its general method.

◆

THREE PUMPING ENGINES OF 12,000,000 GALlons capacity each are to be purchased for the Chicago, Ill., water-works. Plans and specifications for these pumps are now being prepared and it is stated that bids will be called for within a few weeks. One pump will be placed at the Lake View Station, one at the Fourteenth St. Station and one at the Chicago Ave. Station. The work will include all the necessary boilers and appurtenances.

◆

A WATER-POWER FRANCHISE is under consideration at Sault Ste. Marie, Mich. The proposed ordinance grants a franchise to Messrs. Edw. V. Douglass, of Philadelphia, and Francis H. Clergue, of New York, for building and operating a canal 15 ft. deep and not less than 150 nor more than 600 ft. wide through the city, from a point on the shore of St. Mary's River above the St. Mary's Falls Ship Canal. The city is given the right to discharge surface water and sewage into the canal, but must pay $4,000 a year for 20 years and construct such bridges over the canal as may be necessary. The proposed franchise also provides that the city shall pay $6,000 a year for 20 years for 400-HP., including a site to make use of it. No provisions regarding charges for power supplied to manufacturers are included in the franchise.

◆

FASTER TRAIN SCHEDULES are to be put into effect on the Manhattan Elevated Ry. on Aug. 3. A reduction of three minutes will be made in the schedule time between terminals on the Second, Third and Sixth Ave. lines. The following table summarizes the facts of interest:

Line.	Length miles.	No. stops.	Present schedule time* mins.
Second Ave	8.76	25	43½
Third Ave	8.48	25	43
Sixth Ave	10.76	27	52

*By Official Guide.

Newspaper reports give the present schedule time something less than the above.

◆

AMERICAN FILES are being sold in England in competition with those of Sheffield manufacture. "The Engineer" (London) in its issue of July 17 says:

> Mr. J. W. Schofield, a Sheffield manufacturer, has directed the attention of Sir Howard Vincent, M. P., to the severe American competition to which Sheffield file manufacturers are now subjected by their American rivals in the English markets. "My agent," he says, "writes me this morning that a large order, for which we quoted an outside discount, has gone to America at 67½% and 5%, and this, with freight and charges, represents approximately 70% off Sheffield list, which will mean a heavy loss if supplied by Sheffield manufacturers." Mr. Schofield adds that surely the time has come when something should be done in the way of practically testing protection by the imposition of a duty on goods, which can be seriously affected by combination on this side. He suggests in that connection agricultural machinery and files—each of them small matters in themselves, but of vast importance to those in this country engaged in their production. Sir Howard Vincent, in his reply, says that he is painfully aware of the existence of this state of affairs, and has for years past done his best to remedy it, but expresses his sorrow at having been almost single-handed in the matter, and at receiving so little support from any quarter.

◆

A STEAMSHIP LINE from Japan to Seattle, Wash., in connection with the Great Northern Ry., is announced as arranged for. At the beginning there will be one steamer a month each way. The Royal Japanese Mail Steamship Co. is said to be the company which will undertake the venture.

◆

A NEW METHOD OF MARINE PROPULSION is to be tested by a naval board this fall. The system consists, according to newspaper reports, of an apparatus for exploding a mixture of gas and air, as in an ordinary gas engine, and directing the explosive force directly against the water at the stern of the boat without the intervention of any pistons, screw propellers or other machinery. The system is the invention of John A. Secor, who is building a 75-ft. launch to be fitted with this system at the foot of 44th St., New York city.

THE WEST SIDE IRRIGATION AND MINING CANAL IN WYOMING AND COLORADO.

By Elwood Mead, M. Am. Soc. C. E.

(With inset.)

About 70 miles south of Rawlins, Wyo., in Routt county, Colo., is an area of gold-bearing sand which promises to attract much attention in the near future. Beginning at the southern boundary of Wyoming, it extends south to the divide between Bear and Snake rivers, and from Range 89 to Range 97 west, embracing in all a district about 30 miles wide and 50 miles long. This deposit of placer gold has apparently no relation to existing water courses nor to any definite source of supply, but wherever bars or areas of sandy soil occur, there gold in paying quantities is usually found. In a series of tests which embraced over 20,000 acres, the average value of the ground tested was over 30 cts. per cu. yd. and the returns from the hydraulic operations in this district last season, as far as received, have shown results equally large.

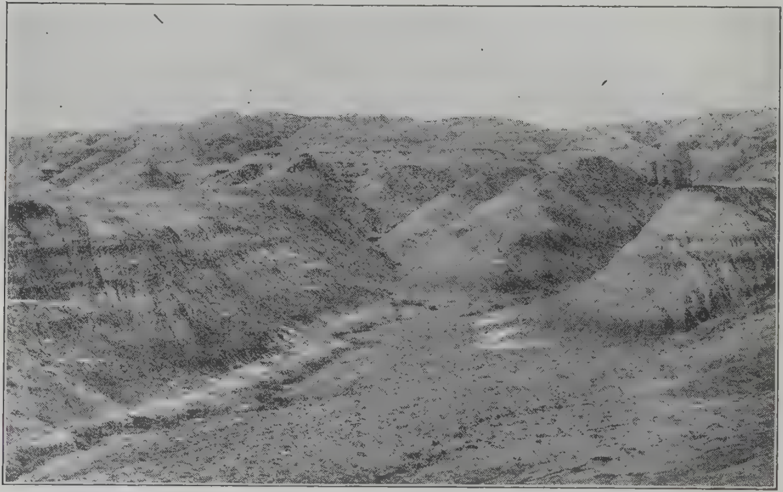

Fig. 4.—Character of Country Through Which Canal must Have Passed Had Not Pipe Line Been Adopted.

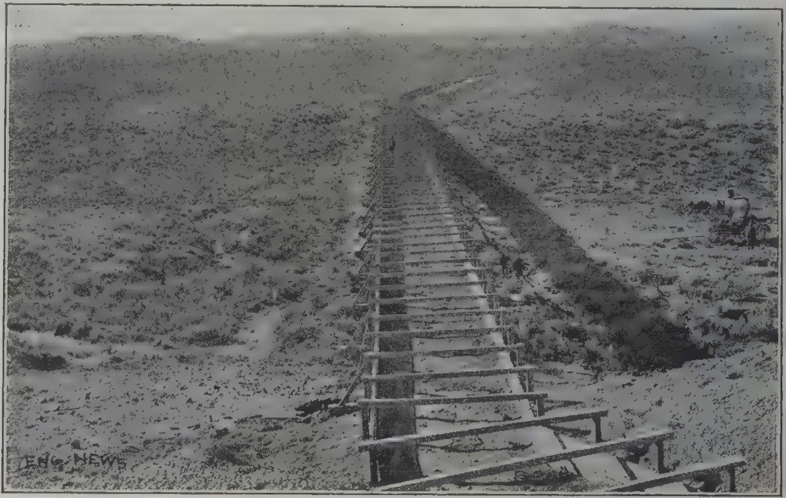

Fig. 8.—View of Flume With Mountains in the Distance.

VIEWS ON THE WEST SIDE CANAL IN WYOMING AND COLORADO.

The largest work yet constructed for washing and securing this gold is the West Side Canal, owned by the West Side Mining Association, composed principally of citizens of Providence, R. I. This association has secured, by location and purchase, several thousand acres of placer ground lying south and east of Snake River in the northwest corner of the district. To secure the required elevation for their water supply it was necessary to build a canal about 29 miles long, starting at Dixon, Wyo., and terminating on the south side of Dry Gulch on one of the largest and richest bars owned by the association. The location of the canal is shown by Fig. 1 and the head gate by Fig. 2. This work was begun in July and completed in November, 1895. Mr. Edw. A. Greene, M. Am. Soc. C. E., was the contractor, and the writer was chief engineer. Messrs. F. J. Cramer and Fred Bond were engineers in charge of the first and second divisions, respectively, of the canal. Messrs. W. B. Haskins, Geo. E. Perkins and Wm. Howard were trustees of the association. The canal is intended to supply water for the irrigation of about 5,000 acres of farming land and to deliver 1,500 miners' inches of water on the bar at the lower end. At the head it is 10 ft. wide on the bottom and 16 ft. wide on the water line. The lower bank is 4 ft. high, and the canal is intended to carry 3 ft. of water with a grade of 4½ ft. per mile. Ten miles from the head the width on the bottom is reduced to 8 ft. and the grade is 2½ ft. per mile. Two cross sections of the canal are shown by Fig. 3.

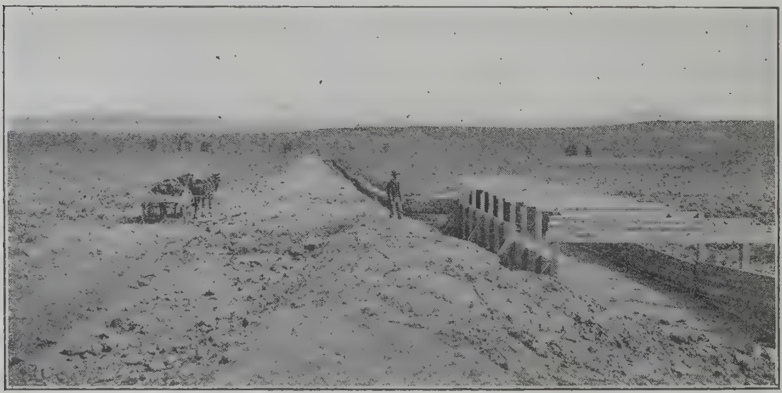

Fig. 5.—Change From Pipe Line to Canal.

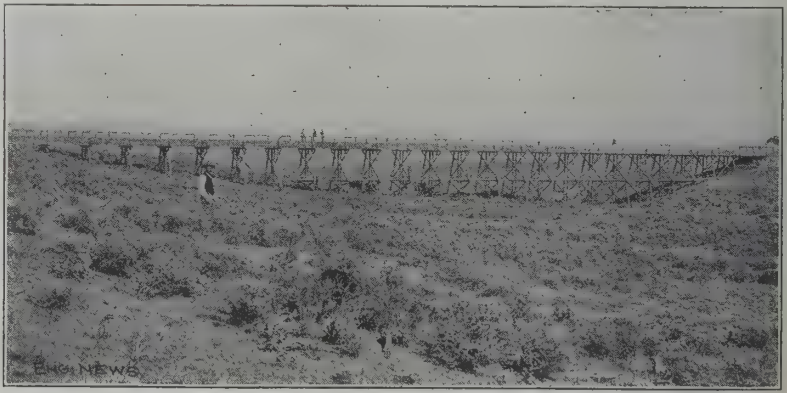

Fig. 9 —View of Flume Across Small Gulch.

STRUCTURES ON THE WEST SIDE CANAL.

The most interesting feature on this canal is the extent to which wooden pipe has been utilized. As the ditch runs almost parallel to the stream and through a broken country, to have crossed the various drainage channels with a grade canal would have greatly increased its length, besides requiring the erection of several long and high flumes. This was given up and instead pipe lines following the irregularities of the surface were substituted in the most difficult locations. The first of these is at the crossing of Four Mile Creek. To follow a grade line up this creek to a point where it could be flumed would have required nearly ten miles of ditch and two flumes about 1,200 ft. long, while an inverted syphon crossing directly from the east to the west side of the valley would be only 6,500 ft. long, and this was substituted. This pipe has an internal diameter of 3 ft., a total fall of 24½ ft., and a maximum static head at the creek crossing of 90 ft.

Five miles below the outlet of this pipe the canal grade passed along the slope of a series of bad land hills which border the river. The slope of these hills is so precipitous and their outline so broken that the construction of a grade canal was out of the question, even if the soil had been of a satisfactory nature, but in addition to the other obstacles the large percentage of gypsum and sodium salts which it contains caused it to dissolve almost as readily as sugar when exposed to water. It was decided, therefore, to carry the water around these hills by means of a pipe line laid in the river valley, at their base. This pipe is about 9,000 ft. long, and from where it drops into the valley at the upper end to where it rises at the lower is from 50 to 80 ft. below grade. Aside from its being the only satisfactory means of passing this obstacle, it is believed to be cheaper than an earth canal owing to the saving in distance. To have followed the contour of the hills would have required a canal about seven miles long, or about four times the length of the pipe. The accompanying view, Fig. 4, shows the character of the country avoided.

A third pipe line crosses Dry Gulch, the static head at the lowest point being 85 ft.

The pipe used is what is known as Allen's patent stave pipe. The staves are made of Texas pine and Oregon fir, shaped from 2 × 6-in strips, varying in length from 12 to 18 ft. and banded with ½-in. iron rods spaced to give a factor of safety of five for the varying static heads.

To secure the maximum discharge, the bottom of the inlet of each pipe is placed 6 ft. below the grade of the ditch. The inlet is expanded, being 4 ft. in diameter at the end and decreasing to that of the pipe in 12 ft. A 4-in. blow-off is placed in the lowest point of each pipe, to drain them when necessary and to permit of the removal of sediment should any accumulate.

The inlet and outlet boxes of all pipes are of timber, as are the head gates, flumes, etc. No masonry was employed. Lumber could be had from the mountains near by and was cheap, while there was no satisfactory stone, lime or cement on the ground, and the distance to the nearest railway, 70 miles, made the cost of outside material prohibitory. The view, Fig. 5, shows one of the changes from pipe line to canal, and details of several of these penstocks are shown by Fig. 6. A view of the mouth of one of the penstocks is shown by Fig. 7. Two flumes are shown by the views, Figs. 8 and 9.

The uncertain factors in the use of wood pipe

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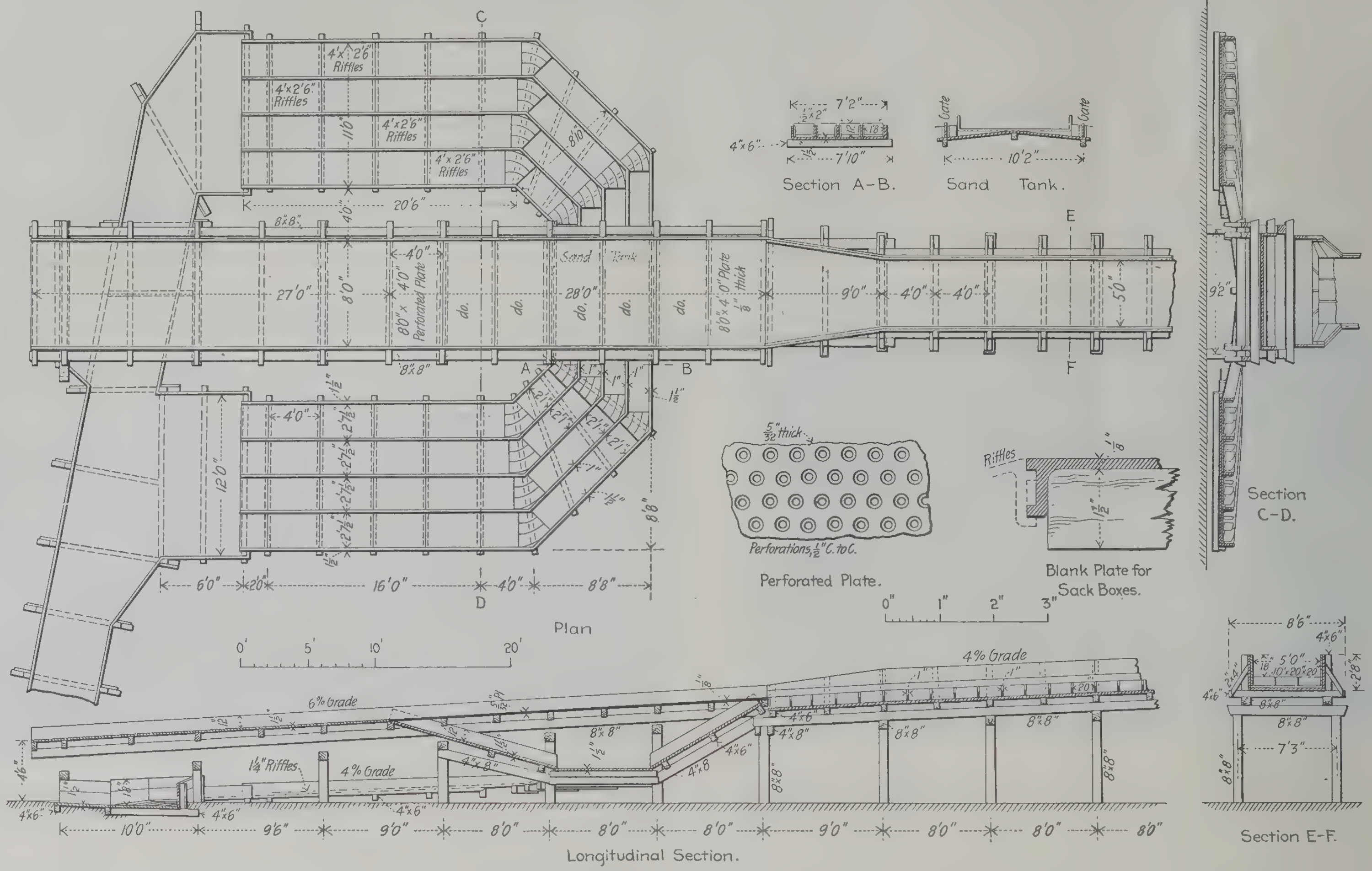


FIG. 10.—DETAILS OF GOLD WASHER FOR PLACER MINING.

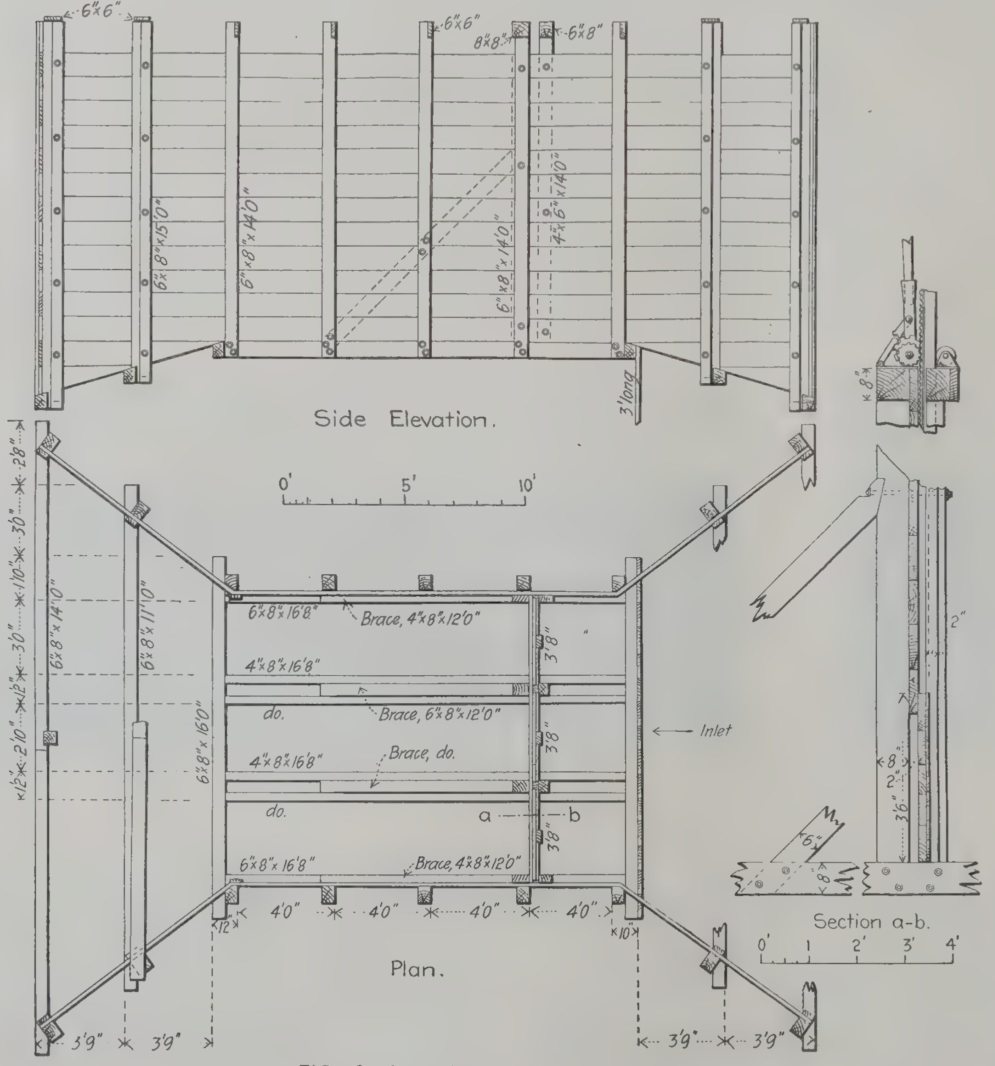


FIG. 2.—DETAILS OF HEAD GATE.

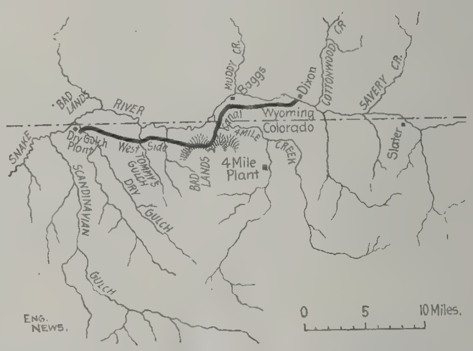
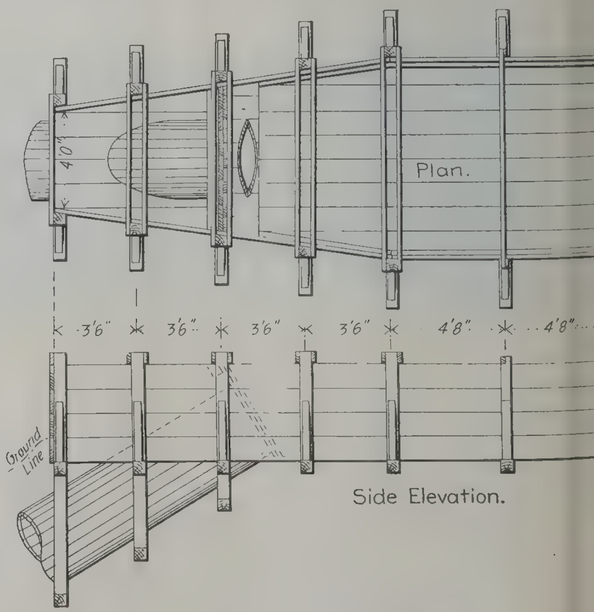
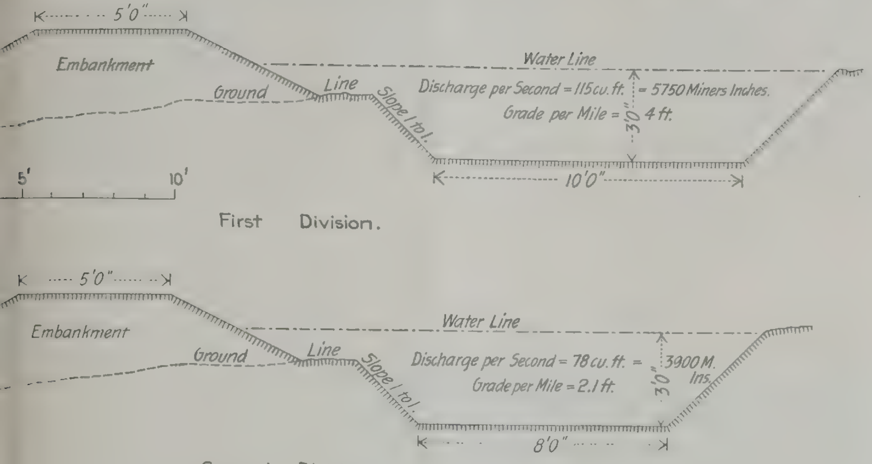


FIG. 1.—MAP OF WEST SIDE CANAL, WYOMING AND COLORADO.



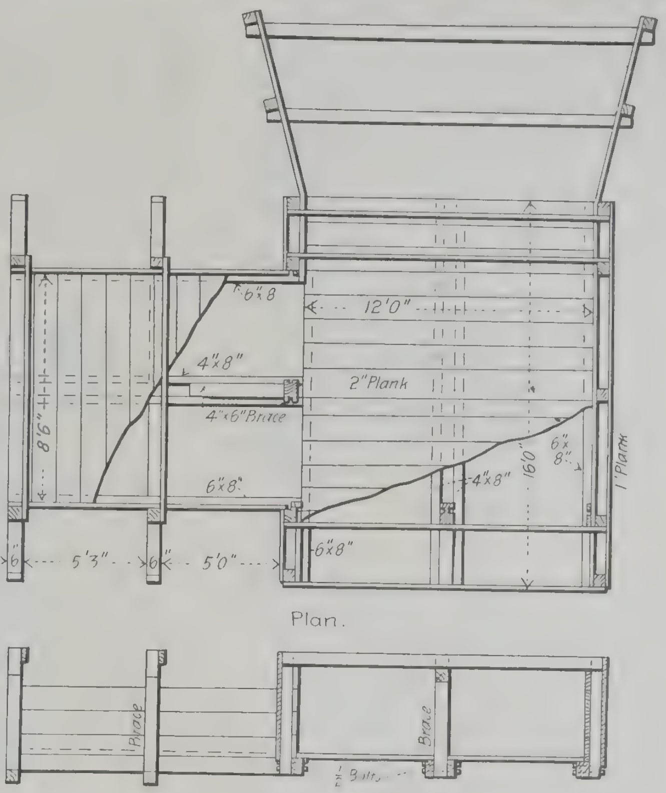
Outlet Penstock.



First Division.

Second Division.

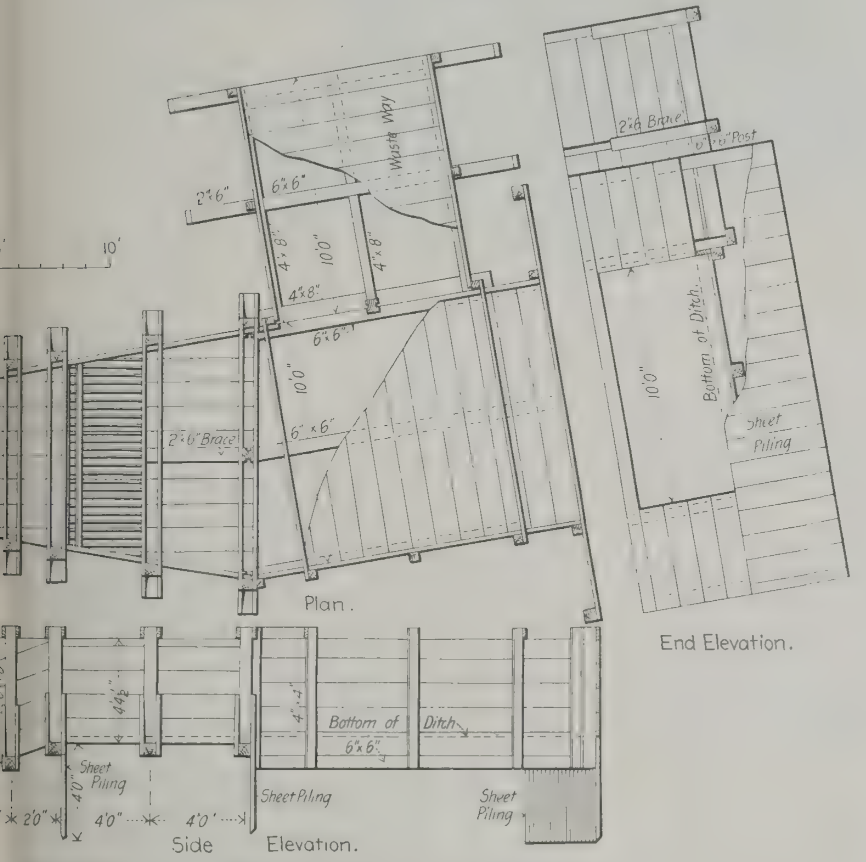
FIG. 3.—CROSS SECTIONS OF CANAL.



Plan.

Side Elevation.

FIG. 12.—DETAILS OF WASTEWAY.

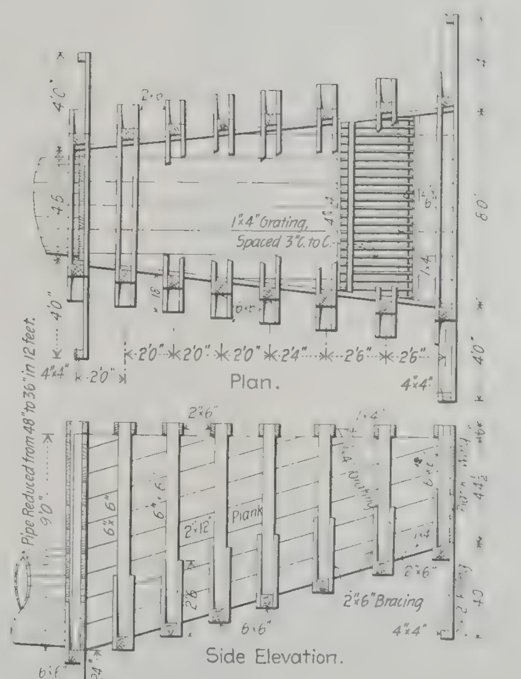


Plan.

End Elevation.

Side Elevation.

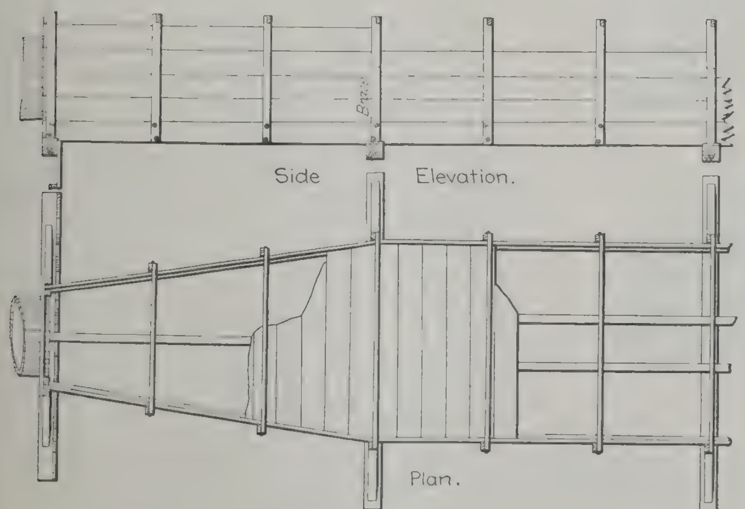
Penstock at Head of 36-in. Pipe Across Four-Mile Gulch



Plan.

Side Elevation.

Inlet Penstock.



Side Elevation.

Plan.

Outlet Penstock.

FIG. 6.—DETAILS OF PENSTOCKS, OR INLET AND OUTLET BOXES, AT CHANGES FROM CANAL TO PIPE LINE.

WATER SUPPLY WORKS OF THE WEST SIDE MINING ASSOCIATION, WYOMING.

Elwood Mead, M. Am. Soc. C. E.,
Chief Engineer.

Edward A. Greene, M. Am. Soc. C. E.,
Contractor.

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are its durability and the danger from leaks resulting from shrinkage when not in use. Wood-pipe kept constantly filled under the pressures which these must sustain would probably last as long as wrought iron in the alkaline soils of this region. Some have been in use 30 years with no evidence of decay; but this pipe will be emptied in winter, as the climate of this region will not permit operating the canal for from four to five months. If left exposed during this time the life and usefulness of the pipe would probably be brief. To preserve it from decay and to lessen the danger from accidents or malicious injury these pipes have been buried, the trenches in which they were laid being 4 ft. deep. The pressure will, it is believed, force enough water through the pores of the wood to moisten the surrounding earth, and this, taken with the fact that the ground will be frozen during the greater part of the time the pipe is empty, will largely if not entirely prevent both shrinkage and decay during this period.

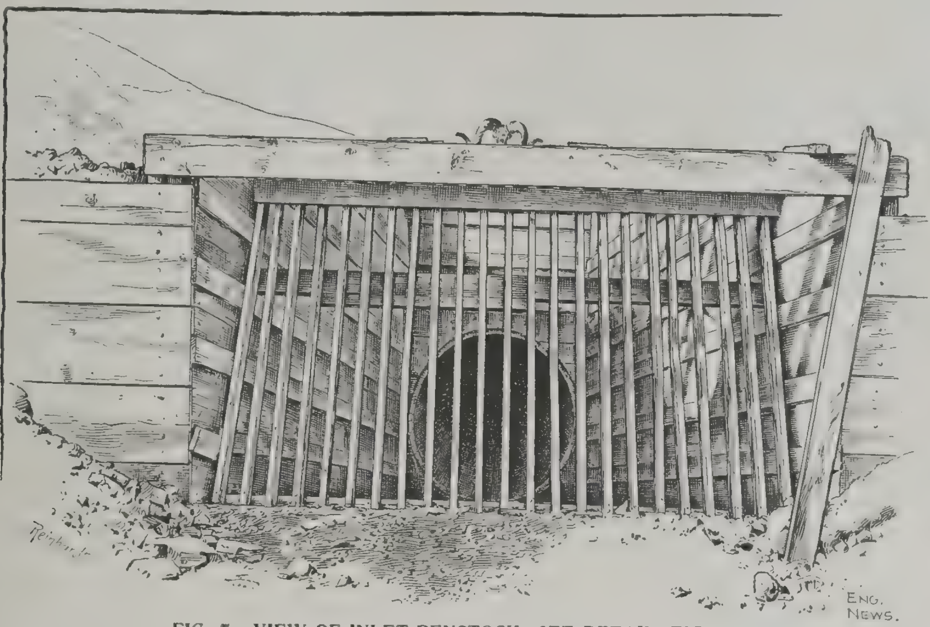

FIG. 7.—VIEW OF INLET PENSTOCK (SEE DETAIL, FIG. 6).

The distribution of gold in this district is somewhat unusual. It is almost as abundant in the roots of the sage brush as on bed rock. There are no nuggets; every particle is of exceeding fineness, from 1,200 to 1,500 being required to make a cent in value. This fact proved for several years an insurmountable obstacle to saving it, as it was carried off with the sand. The first successful washing plant was built two years ago on Four Mile Creek by the Rock Springs Mining Co. The illustration of their device shows its character. Fig. 10 shows it in detail and Fig. 11 is a view of it. It consists of the ordinary sluice box, in the bottom of which is a perforated iron plate, 32 ft. long, the perforations being ⅛ in. in diameter. The mixture of water, gold and fine sand passes through these openings, falling into a tank from which it is distributed in a thin uniform layer over an incline having a fall of 6 ins. in 12 ft. The bottom of this incline is covered with burlap, and as the depth of water and gold bearing sand which flows over it does not exceed ½ in. the gold is caught and held in the meshes of the cloth. No quicksilver is used in either the sluice boxes or the incline. Success in saving the gold depends upon having the soil thoroughly dissolved before it reaches the perforated plate and in having enough water to prevent sand lodging on the burlap.

The West Side Association will use a modificaton of this device, designed by Mr. M. J. Miller, a mining engineer of Chicago. The same method of separating the gold and fine sand from the coarser material will be used, and practically the same plan for distributing the water and gold bearing sand in a thin layer on the incline, but the bottom of this incline instead of being of burlap will consist of a series of indented iron plates which will have the bottoms of the depressions filled with quicksilver.

The canal was completed too late in the season to permit of washing gold last fall, but it was expected that it would be begun about April 1, 1896. Two washing plants will be used, each utilizing 750 ins. of water. This will be distributed by means of wrought iron pipes, connected with a stand-pipe placed at the south end of the Dry Gulch pipe line.

About 300,000 ft. of lumber were used in flumes and in the washing plants. This cost $12 per thousand at the mill and about $27 per thousand when placed in the flumes and other structures. The wood pipe cost $2.25 per ft., laid, with a guarantee of maintenance for eight months. Earth excavation was 8 cts.; loose rock, 27 cts.; solid rock, 60 cts. The canal, independent of the washing plant, cost, complete, $150,000.

The work included 89 acres of plowing, 187,845 cu. yds. of earth excavation, 30,043 cu. yds. loose and 6,442 cu. yds. of solid rock excavation, 114,114 ft. B. M. of fluming and 17,536 of lin. ft. of wood pipe.

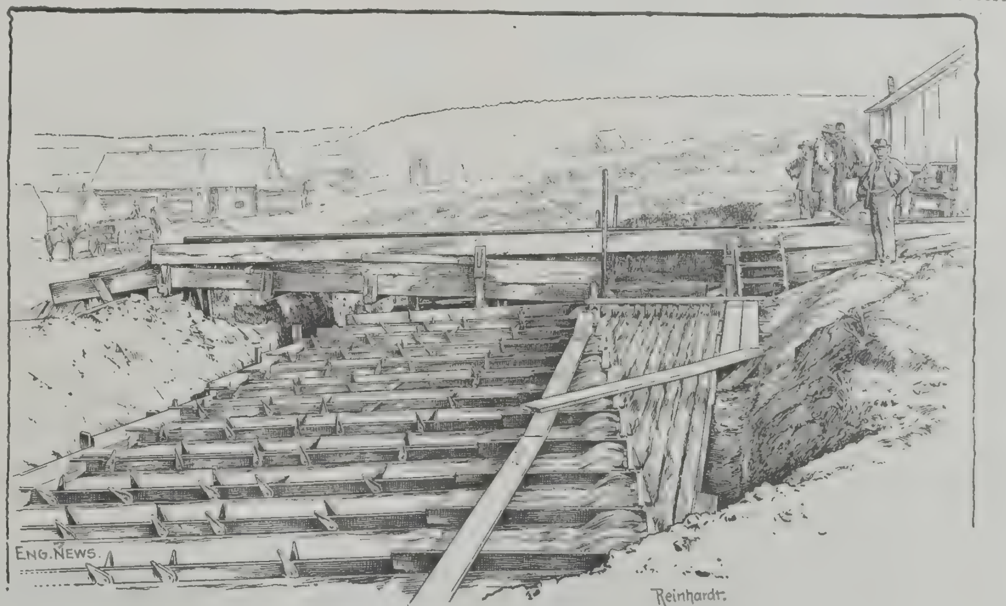

FIG. 11.—VIEW OF GOLD WASHER.

◆

STATISTICS OF RAILWAYS OF THE UNITED STATES FOR THE YEAR ENDING JUNE 30, 1895.

The Statistican of the Interstate Commerce Commission, Prof. Henry C. Adams, has furnished to the press an advance abstract of the forthcoming eighth annual statistical report of the Commission. From it we take the following figures of principal interest to our readers:

> In the introduction of the report reference is made to the effect of the continued business depression, and the large number of receiverships. On June 30, 1895, 169 roads were reported in the hands of receivers, showing a net decrease of 23 during the year. The roads under receivers operated 37,855 miles of line, which shows a decrease of 2,963 as compared with 1894. The railway capital represented by these roads was nearly $2,500,000,000, or about 22% of the total railway capital in the United States.
>
> Mileage.—The total railway mileage in the United States on June 30, 1895, was 180,657 miles, an increase of 1,949 miles, or 1.09% being shown. The increase in 1894 was 2,247 miles, or 1.27%, which was less than for any preceding year during the period for which reports have been made to the Commission. The territory and states in which the increase in mileage exceeds 100 miles are, Arizona, 247 miles; Illinois, 188 miles; Pennsylvania, 157 miles; Maine, 133 miles; Texas, 110 miles, and Montana, 106 miles. The aggregate length of all tracks in the United States on June 30, 1895, was 236,894 miles. Included in this total track mileage were 10,640 miles of second track, 975 miles of third track, 733 miles of fourth track, and 43,888 miles of yard track and sidings.
>
> Classification of Railways.—The number of railway corporations on June 30, 1895, was 1,965, of which 1,013 maintained operating accounts, and 800 financial accounts. During the year 14 roads were abandoned, 9 merged, 32 reorganized, and 28 consolidated. Forty-two companies, each operating more than 1,000 miles, operate 100,715 miles of line, or 55.67% of the total railway mileage; 24 roads, with an operated mileage ranging from 600 to 1,000 miles, operate 18,896 miles, or 10.45%. One hundred and thirty-three roads, or 12.05% of the operating companies operate 145,155 miles, or 80.24% of total mileage in operation.
>
> Equipment.—The increase in number of locomotives in service was 207, the total number on June 30, 1895, being 35,699. Of this number, 9,999 were passenger locomotives, 20,012 were freight locomotives, 5,100 were switching locomotives, and 588 were unclassified. The number of cars of all classes reported, being those owned by railways, was 1,270,561, which indicates a decrease of 7,517 as compared with the previous year. Of the total cars reported, 33,112 were in passenger service, 1,196,119 were in freight service, and the remainder, 41,330, were cars used by the reporting companies in their own service. There was an increase of 94 in the number of passenger cars, and an increase of 1,439 in cars assigned to company's service, but cars in freight service decreased 9,050. The explanation of this decrease is not wholly to be found in an effort on the part of the railway companies to economize in equipment, but rather in the increased use made of private cars.
>
> From the summaries given it appears that there was a decreased efficiency in passenger service, and an increased efficiency in freight service during the year covered by the report. The number of passengers carried per passenger locomotive was 50,747, or 3,907 less than in 1894. The number of passenger miles per passenger locomotive was 1,218,967, or 225,433 less than in 1894, while the number of passenger cars per 1,000,000 passengers carried was 65, or 12 greater than the preceding year. This is probably largely due to decreased travel on account of business depression, but it also suggests that passenger traffic has returned to its normal condition previous to the World's Columbian Exposition. The number of tons of freight carried per freight locomotive in 1895 was 34,817, showing an increase of 2,908 when compared with the corresponding figures for 1894. The number of ton miles per freight locomotive was 4,258,821, the increase over the previous year being 242,066. These figures indicate increased economy in transportation of freight. The same result is shown by the fact that 1,888 freight cars were required to move 1,000,000 tons of freight in 1894, and 1,717 in 1895. These figures, however, are not satisfactory because the basis of the computations does not include cars not owned by railway companies, in which a large proportion of freight is transported.

Out of a total equipment of 1,306,260 locomotives and cars, only 362,498 were fitted with train brakes, and 408,856 with automatic couplers on June 30, 1895. The increase in equipment fitted with train brakes was 31,506, with automatic couplers, 51,235. The summaries presented show that almost all passenger locomotives are fitted with train brakes, and 16,712 out of 20,012 freight locomotives have them. The number of passenger locomotives fitted with automatic couplers on June 30, 1895, was 3,893, the increase during the year being 414. It appears that 6,106 passenger locomotives were without automatic couplers. The number of freight locomotives fitted with automatic couplers was 2,039, the increase during the year being 731. On June 30, 1895, the number of passenger cars in service was 33,112, of which 32,384 were fitted with train brakes, and 31,971 with automatic couplers. The number of freight cars in service was 1,196,119, of which 295,073 were fitted with train brakes, and 366,985 with automatic couplers.

Employees.—The number of men employed by railways shows an increase of 5,426, as compared with last year, the number of employees being 785,034 on June 30, 1895. The returns for the present year show that 128 men were assigned to Maintenance of Way and Structures per 100 miles of line, against 123 in 1894. The number of men correspondingly assigned to Maintenance of Equipment also shows a slight increase, being 88 for 1895, and 86 for 1894.

Capitalization and Valuation of Railway Property.—The amount of railway capital on June 30, 1895, is shown to be $10,985,203,125, or $63,330 per mile of line. The increase during the year was $188,729,312. The amount of capital stock was $4,961,258,656, of which $4,201,697,351 was common stock, and $759,561,305 preferred stock; the funded debt was $5,407,114,313; the current liabilities amounted to $616,830,156. Of the capital stock outstanding, $1,169,071,178, or 23.57% was owned by the railway corporations, as well as $437,508,841, or 9.39% of bonds outstanding. These figures show an increase in the corporate ownership of securities, probably rather due to railway consolidation than to the strengthening of reserve funds.

Stock to the amount of $3,475,640,203, or 70.05% of the total outstanding paid no dividend, and $904,436,200, or 16.90% of funded debt, exclusive of equipment trust obligations, paid no interest during the year covered by the report. In no other year since the organization of the Division of Statistics has so large a percentage of stock passed its dividends, or, except in 1894, has so large a percentage of funded debt defaulted its interest. Of the stock paying dividends, 6.89% of the total stock outstanding paid from 4 to 5%; 5.39% of this stock paid from 5 to 6%; 4.41% paid from 6 to 7%, and 3.99% paid from 7 to 8%. The total amount of dividends was $85,287,543, which would be produced by an average rate of 5.74% on the amount of stock on which some dividend was declared.

Public Service of Railways.—The number of passengers carried by the railways during the year ending June 30, 1895, was 507,421,362, which shows a decrease of 33,266,837. The number of passengers reported as carried one mile was 12,188,446,271, a decrease of 2,100,999,622 being shown when compared with figures for previous year. The number of tons of freight carried as reported by railways was 696,761,171, which gives an increase of 58,574,618 for the year. The number of tons caried one mile was returned as 85,227,515,891, indicating an increase of 4,892,411,189.

Earnings and Expenses.—The gross earnings of the railways of the United States for the year ending June 30, 1895, were $1,075,371,462, an increase of $2,009,665 for the year being thus shown. Passenger revenue was $252,246,180, showing a decrease of $33,103,378, or 11.60% for the year. Freight revenue increased $30,502,549, or 4.36%, being $729,993,462 for 1895.

The expenses of operation for the same period were $725,720,415, which were $5,693,907 less than for 1894. That important unit in railway statistics, the percentage of operating expenses to operating income, for 1895, was 67.48%; for 1890, 65.80%. The income from operation, $349,651,047, though $7,703,572 greater than it was in 1894, was yet less than for any other year since 1890. The amount of money at the disposal of railways for fixed charges and dividends is the aggregate of income from operation and income from other sources. This amount for 1895 was $482,083,180. Fixed charges for the year amounted to $425,966,921. The deduction of fixed charges leaves $56,116,259 as net income from which to pay dividends. The amount of dividends, including $673,957 other payments from net income, was $85,961,500, from which it appears that the railways of the United States closed the year with a deficit from the year's operations of $29,845,241, which was met by a decrease in accumulated surplus, or by the creation of current liabilities. The corresponding deficit for the year ending June 30, 1894, was $45,851,294.

Railway Accidents.—The number of railway employees killed during the year ending June 30, 1895, was 1,811, and the number of injured was 25,696. These figures, compared with those of the previous year, show a decrease of 12 in number killed, and an increase of 2,274 in the number injured. The number of passengers killed was 170, the number injured, 2,375. These figures give for the year a decrease of 154 in the number killed, and 659 in the number injured. The number of passengers killed is remarkably small. The smallest number killed in any of the preceding seven years was 286 in 1890. One employee was killed for each 433 employed, and one employee was injured for each 31 employed. Of the class of employees known as trainmen—that is, engineers, firemen, conductors, and other employees whose service is upon trains, it appears that one was killed for each 155 in service, and one injured for each 11 in service. The number of passengers carried for each passenger killed during the year was 2,984,832, and the number carried for each passenger injured was 213,651. The liability of passengers to accidents is better shown in the fact that 71,696,743 passenger miles were accomplished for every passenger killed, and 5,131,977 passenger miles for every passenger injured.

Conclusion.—The statistician renews his recommendations that reports be required from express companies engaged in interstate traffic, from all corporations, companies, or persons owning rolling stock which is used in interstate commerce, as also all corporations, companies, or persons owning depot property, stock yards, elevators, and the like, and from all carriers by water whose business influences interstate traffic. The further recommendation is made that Congress be requested to provide for a bureau of statistics and accounts, which shall have the right of inspection and control over the accounting departments of the common carriers.

MINERAL PRODUCTION OF THE UNITED STATES IN TEN YEARS.

The accompanying table, just issued by the U. S. Geological Survey, is so convenient a one for reference that we reproduce it herewith for the benefit of our readers. The statistics from which this table is compiled were collected by the Division of Mineral Resources of the Survey, of which Dr. David P. Day, M. Am. Inst. M. E., is the Chief.

MINERAL PRODUCTS OF THE UNITED STATES FOR THE CALENDAR YEARS, 1886 TO 1895.

(Compiled by the Division of Mineral Resources of the U. S. Geological Survey. Chas. D. Walcott, Director; David T. Day, Chief of Division.)

PRODUCTS.		1886.		1887.		1888.		1889. (a)		1890.		1891.		1892.		1893.		1894.		1895.	
		QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.	QUANTITY.	VALUE.
METALLIC.																					
Pig iron, value at Philadelphia	long tons (c)	5,683,329	$95,195,760	6,417,148	$121,925,800	6,489,738	$107,000,000	7,603,642	$120,000,000	9,202,703	$151,200,410	8,279,870	$128,337,985	(d) 9,157,000	$131,161,039	(d) 7,124,502	$84,810,426	(d) 6,657,388	$65,007,247	(d) 9,446,308	$105,198,550
Silver, coining value (e)	troy ounces	39,445,312	51,000,000	41,269,240	53,350,000	45,783,632	59,195,000	51,354,851	66,396,988	54,500,000	70,464,645	58,330,000	75,416,565	63,500,000	82,099,150	60,000,000	77,575,757	49,501,122	64,000,000	47,000,000	60,766,300
Gold, coining value (f)	do.	1,881,250	35,000,000	1,596,500	33,000,000	1,604,927	33,175,000	1,590,869	32,886,744	1,588,880	32,845,000	1,604,840	33,175,000	1,596,375	33,000,000	1,739,081	35,950,000	1,910,816	39,500,000	2,273,629	47,000,000
Copper (g), value at New York City	pounds	161,235,381	16,527,651	185,227,331	21,115,916	231,270,622	33,833,954	231,246,214	26,907,809	265,115,133	30,848,797	295,812,076	38,455,300	352,971,744	37,977,142	337,416,848	32,054,601	360,844,218	33,141,142	381,106,068	38,682,347
Lead, value at New York City	short tons (h)	135,629	12,200,749	145,700	13,113,000	151,919	13,399,256	156,397	13,794,235	143,630	12,668,166	178,554	15,534,198	173,654	13,892,320	(i) 163,982	11,839,590	(i) 159,331	9,942,254	161,440	10,655,040
Zinc, value at New York City	do.	42,641	3,752,408	50,340	4,782,300	55,903	5,500,855	58,860	5,791,824	63,683	6,266,407	80,873	8,033,700	87,260	8,027,920	78,832	6,306,560	75,328	5,288,026	89,686	6,278,020
Quicksilver, value at San Francisco	flasks (j)	29,981	1,060,000	33,825	1,429,000	33,250	1,413,125	26,484	1,190,500	22,926	1,203,615	22,904	1,036,386	27,993	1,245,689	30,164	1,108,527	30,416	934,000	36,104	1,337,131
Aluminum, value at Pittsburg	pounds	3,000	27,000	18,000	59,000	19,000	65,000	47,468	97,335	(l) 61,281	61,281	(k) 150,000	100,000	259,885	172,824	339,629	266,903	550,000	316,250	920,000	464,600
Antimony, value at San Francisco	short tons	35	7,000	75	15,000	100	20,000	115	28,000	129	40,756	278	47,007	....	56,466	250	45,000	200	36,000	(aa) 450	68,000
Nickel, value at Philadelphia	pounds	214,992	127,157	205,566	133,200	204,328	127,632	252,663	151,598	223,488	134,088	118,498	71,099	92,252	50,739	49,399	22,197	9,616	3,269	10,302	3,091
Tin	do.	....	....	....	....	....	....	....	....	....	....	125,289	25,058	162,000	32,400	8,938	1,788	....	....	....	....
Platinum, value (crude) at San Francisco	troy ounces	50	100	448	1,838	500	2,000	500	2,000	600	2,500	100	500	80	550	75	517	100	600	150	900
Total value of metallic products		....	$214,897,825	....	$248,925,054	....	$253,731,822	....	$267,247,033	....	$305,735,670	....	$300,232,798	....	$307,716,239	....	$249,981,866	....	$218,168,788	....	$270,453,979
NON-METALLIC (Spot Values b).																					
Bituminous coal	short tons	73,707,957	$78,481,056	87,887,360	$98,004,656	102,039,838	$101,860,529	95,685,543	$94,504,745	111,320,016	$110,420,801	117,901,237	$117,188,400	126,856,567	$125,124,381	128,385,231	$122,751,618	118,820,405	$107,653,501	135,118,193	115,749,771
Pennsylvania anthracite	long tons	34,853,077	76,119,120	37,578,747	84,552,181	41,624,611	89,020,483	40,714,721	65,879,514	41,489,858	66,383,772	45,236,992	73,944,735	46,850,450	82,442,000	48,185,306	85,687,078	46,358,144	78,488,063	51,785,122	82,019,272
Building stone			19,000,000		25,000,000		25,500,000		(n) 42,809,706		47,000,000		47,294,746		48,706,625		33,885,573		37,055,030		34,688,816
Petroleum	barrels (p)	28,064,841	19,996,313	28,278,866	18,877,094	27,612,025	17,947,620	35,163,513	26,963,340	45,822,672	35,365,105	54,291,980	30,526,553	50,509,136	26,034,196	48,412,666	28,932,326	49,344,516	35,522,095	52,983,526	57,691,279
Natural gas		....	10,012,000	....	15,817,500	....	22,629,875	....	21,097,099	....	18,792,725	....	15,500,084	....	14,800,714	....	14,346,250	....	13,954,400	....	13,006,650
Brick clay	(q)	....	6,200,000	....	7,000,000	....	7,500,000	....	8,000,000		8,500,000		9,000,000		9,000,000	....	9,000,000	....	8,000,000	....	9,000,000
Clay (all other than brick)	long tons	40,000	325,000	65,000	340,000	36,750	300,000	(r) 294,344	635,578	350,000	756,000	400,000	900,000	420,000	1,000,000	400,000	900,000	380,000	800,000	360,000	800,000
Cement	barrels (s)	6,500,000	3,990,000	6,692,744	5,674,377	6,503,295	5,021,139	7,000,000	5,000,000	8,000,000	6,000,000	8,222,792	6,680,951	8,758,621	7,152,750	8,002,467	6,262,841	8,362,245	5,030,081	8,731,401	5,482,254
Mineral waters	gallons sold	8,950,317	1,284,070	8,259,609	1,261,463	9,578,648	1,679,302	12,780,471	1,748,458	13,907,418	2,600,750	18,392,732	2,996,259	21,876,604	4,905,970	23,544,495	4,246,734	21,569,608	3,741,846	21,463,543	4,254,237
Phosphate rock	long tons	430,549	1,872,936	480,558	1,836,818	448,567	2,018,552	550,245	2,937,776	510,499	3,213,795	587,988	3,651,150	681,571	3,296,227	941,368	4,136,070	976,059	3,395,988	1,007,773	3,497,918
Salt	barrels (t)	7,707,081	4,736,585	7,831,962	4,093,846	8,055,881	4,374,203	8,005,565	4,195,412	8,776,991	4,752,286	9,987,945	4,716,121	11,698,890	5,654,915	11,816,772	4,054,668	12,967,417	4,739,285	13,669,649	4,423,084
Limestone for iron flux	long tons	4,717,163	2,830,297	5,377,000	3,226,200	5,438,000	2,719,000	6,318,000	3,159,000	5,521,622	2,760,811	5,000,000	2,300,000	5,172,114	2,620,480	3,958,055	2,374,833	3,698,550	1,849,275	5,247,949	2,623,974
Zinc white	short tons	18,000	1,440,000	18,000	1,440,000	20,000	1,600,000	16,970	1,357,600	....	1,600,000	23,700	1,600,000	27,500	2,200,000	24,059	1,804,420	21,443	1,500,975	25,000	2,000,000
Gypsum	short tons	95,250	428,625	95,000	425,000	110,000	550,000	267,769	764,118	182,995	574,523	208,126	628,051	246,274	671,540	253,615	696,615	239,312	761,719	265,503	807,447
Borax	pounds	9,778,290	488,915	11,000,000	550,000	7,589,000	455,340	8,000,000	500,000	9,500,000	617,500	13,380,000	869,700	13,500,000	900,000	8,699,000	652,425	14,680,130	974,445	11,918,000	595,900
Mineral paints	long tons (u)	18,800	315,000	22,000	330,000	24,500	405,000	26,307	483,766	47,732	681,992	49,652	670,479	51,704	767,766	37,724	530,384	41,926	498,093	51,373	618,352
Grindstones			250,000		224,400		281,800		439,587		450,000		476,113		272,244		338,787		223,214	....	205,768
Fibrous talc	short tons	12,000	125,000	15,000	160,000	20,000	210,000	23,746	244,170	41,354	389,196	53,054	493,068	41,925	472,485	35,861	403,436	39,906	435,060	39,240	370,895
Asphaltum	short tons	3,500	14,000	4,000	16,000	53,800	331,500	51,735	171,537	40,841	190,416	45,054	242,264	87,680	445,375	47,779	372,232	60,570	353,400	68,163	348,281
Soapstone	short tons	12,000	225,000	12,000	225,000	15,000	250,000	12,715	231,708	13,670	252,309	16,514	243,981	23,908	437,449	21,071	255,067	23,141	401,325	20,945	271,695
Precious stones			119,056		163,600		139,850		188,807		118,833		235,300		312,050		264,041		132,250	....	113,621
Pyrites	long tons	55,000	220,000	52,000	210,000	54,331	167,658	93,705	202,119	99,854	273,745	106,536	338,880	109,788	305,191	75,777	256,552	105,940	363,134	99,549	322,845
Corundum and emery	short tons	645	116,190	600	108,000	589	91,620	2,245	105,565	1,970	89,395	2,265	90,230	1,771	181,300	1,713	142,325	1,495	95,936	2,102	106,256
Oilstones, etc.	pounds	1,160,000	15,000	1,200,000	16,000	1,500,000	18,000	5,982,000	32,980		69,909	1,375,000	150,000		146,730	....	135,173	....	136,873	....	143,204
Mica	pounds	40,000	70,000	70,000	142,250	48,000	70,000	49,500	50,000	60,000	75,000	75,000	100,000	75,000	100,000	66,971	88,929	....	52,388	....	55,831
Barytes (crude)	long tons	10,000	50,000	15,000	75,000	20,000	110,000	18,161	106,313	21,911	86,505	31,069	118,363	32,108	130,025	28,970	88,506	23,335	86,983	21,529	68,321
Bromine	pounds	428,334	141,350	199,087	61,717	307,386	95,290	418,891	125,667	387,847	104,719	343,000	54,880	379,480	64,502	348,399	104,520	379,444	102,450	517,421	134,343
Fluorspar	short tons	5,000	22,000	5,000	20,000	6,000	30,000	9,500	45,835	8,250	55,328	10,044	78,330	12,250	89,000	12,400	84,000	7,500	47,500	4,000	24,000
Feldspar	long tons	14,900	74,500	10,200	56,100	8,700	50,000	6,970	39,370	8,000	65,200	10,000	50,000	15,000	75,000	18,391	68,037	17,200	167,700	12,900	119,775
Manganese ore	long tons	30,193	277,636	34,524	333,844	29,198	279,571	24,197	240,559	25,684	219,050	23,416	239,129	13,613	129,586	7,718	66,614	9,000	53,635	9,547	71,769
Flint	long tons	30,000	120,000	32,000	185,000	30,000	175,000	12,112	49,137	12,000	57,400	15,000	60,000	20,000	80,000	29,671	43,782	38,000	319,200	28,500	239,400
Monazite	pounds															130,000	7,600	546,855	36,193	1,573,000	137,150
Graphite	pounds	415,525	33,242	416,000	34,000	400,000	33,000	....	(v) 72,662	....	(v) 77,500	....	110,000	....	104,000	843,103	63,232	918,000	64,010		80,400
Bauxite	long tons							728	2,366	1,850	6,012	3,900	12,675	9,200	29,900	9,079	29,507	11,021	35,818	17,069	44,000
Sulphur	short tons	2,500	75,000	3,000	100,000	(w)	....	1,150	7,850	(w)	....	1,200	39,600	2,688	80,640	1,200	42,000	500	20,000	1,800	42,000
Fullers earth	short tons																			6,900	41,400
Marls	short tons	600,000	400,000	600,000	300,000	300,000	150,000	139,522	63,956	135,620	69,880	135,000	67,500	125,000	63,000	75,000	40,000	75,000	40,000	60,000	30,000
Infusorial earth	short tons	1,200	6,000	3,000	15,000	1,500	7,500	2,466	23,372	2,532	50,240	....	21,988	....	43,655	....	22,582	....	11,718	4,954	20,514
Millstones			140,000		100,000	....	81,000	....	35,155	....	23,720	....	16,587	....	23,417	....	16,645	....	13,887	....	22,542
Chrome iron ore	long tons	2,000	30,000	3,000	40,000	1,500	20,000	2,000	30,000	3,599	53,985	1,372	20,580	1,500	25,000	1,450	21,750	3,680	53,231	1,740	16,795
Cobalt oxide	pounds	35,000	36,878	18,340	18,774	8,491	15,782	13,955	31,092	6,788	16,291	7,200	10,000	7,869	15,738	8,422	10,346	6,763	10,148	14,638	20,675
Magnesite	short tons	(w)		(w)	....	(w)		(w)	....	(w)	....	439	4,390	1,004	10,040	704	7,040	1,440	10,360	2,200	17,000
Asbestos	do.	200	6,000	150	4,500	100	2,000	30	1,800	71	4,560	66	3,960	104	6,416	50	2,500	325	4,463	795	13,525
Rutile	pounds	600	2,000	1,000	3,000	1,000	3,000	2,000	3,000	400	1,000	300	600	100	300	....	....	150	450	100	350
Ozocerite, refined	do.	(w)		(w)		43,500	3,000	50,000	2,500	350,000	28,250	50,000	7,000	60,000	8,000	(x)	(x)	(x)	(x)	(aaa)	(aaa)
Total value of non-metallic mineral products		....	$230,088,769	....	$271,041,320	....	$286,197,614	....	$282,383,219	....	$312,776,503	....	$321,768,846	....	$339,930,615	....	$323,249,448	....	$308,199,806	....	$340,341,311
Total value of metallic products		....	214,897,825	....	248,925,054	....	253,731,822	....	267,247,033	....	305,735,670	....	300,232,798	....	307,716,239	....	249,981,866	....	218,168,788	....	270,453,979
Estimated value of mineral products unspecified (y)		....	800,000	....	800,000	....	900,000	....	1,000,000	....	1,000,000	....	1,000,000	....	1,000,000	....	1,000,000	....	1,000,000	....	1,000,000
Grand Total		....	$445,786,594	....	$520,766,374	....	$540,829,436	....	$550,630,252	....	$619,512,173	....	$623,001,644	....	$648,646,854	....	$574,231,314	....	$527,368,594	....	$611,795,290

THE EFFECT UPON THE DIAGRAMS, OF LONG PIPE CONNECTIONS FOR STEAM-ENGINE INDICATORS.*

By W. F. M. Goss, Lafayette, Ind.

Errors in indicator diagrams may arise from several causes, one of which is the pipe connecting the indicator with the engine cylinder. It is admitted that, under the conditions of ordinary practice, the presence of the pipe does not constitute the most prolific source of error, but it can be shown that it does cause serious distortion in the form of the diagram, and it is believed that this fact merits more careful consideration than has heretofore been accorded to it. The writer has already called attention to the fact that in road tests of locomotives, where the indicator is attached to a length of pipe sufficient to bring the instrument to the top of the valve box (a length of 3½ ft. or more), a true card can be obtained only at slow speeds; and has shown that, for a speed of 300 revolutions per minute, the diagram is likely to be in error as much as 17%. These early experiments have now been followed by a more extended series, the results of which are herewith presented.

The experiments were made in connection with a 7¾ × 15-in. Buckeye engine. The power of this engine was absorbed by an automatic friction brake, by means of which a very constant load was obtained. The head end of the cylinder was tapped with two holes (a and b, Fig. 1), both in the same cross section, and hence equally exposed to the action of the steam in this end of the cylinder. One of these holes (a) was made to serve for the indicator A, the cock of which was placed as close to the cylinder as possible. The hole b was made to receive one end of a U-shaped pipe, the other end of which entered a coupling fixed in the angle plate c. The cock of a second indicator, B, was screwed to this coupling. A single system of levers supplied the drum motion for both indicators. The closely-connected indicator, A, will hereafter be referred to as the "cylinder-indicator," and the cards obtained from it as "cylinder-cards." It is assumed that this indicator recorded the actual conditions of pressure existing in the cylinder. In like manner the indicator B will be referred to as the "pipe-indicator," and cards obtained from it as "pipe-cards." It is assumed that this indicator gave a record which, when compared with that given by the cylinder-indicator, demonstrated the effect of the pipe.

The pipe fittings were all half-inch. A right-and-left coupling at d allowed the U-shaped section d f b to be removed at will and replaced by a similar section of different length. Pipe lengths of 5, 10 and 15 ft. were used, length being measured from the outside of the cylinder wall to the end of the coupling under the cock of the pipe-indicator. The pipe and fittings were covered first with a wrapping of asbestos board, next with ⅝-in. of hair felt, and finally with an outside wrapping of cloth. It is to be noted that the bend in the pipe at f is easy, and that there is a continual rise in the pipe in its course from the cylinder to the indicator. Both indicators were always well warmed before cards were taken. The boiler pressure was kept constant as nearly as possible, and the throttle was generally "full open."

A pair of new Crosby indicators was set apart for this work, with 60-lb. springs. These instruments, when calibrated under steam, gave results which were nearly identical.

The results, which are presented in the form of diagrams (Figs. 2, 3, 4, etc.), were obtained in the following manner:

Diagrams with constant speed (200 revs. per min.), constant steam pressure (80 lbs.) and constant cut-off (¼ stroke, approximately). Dotted lines show cards obtained when indicator pipes were respectively 5, 10 and 15 ft. long.

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*Abstract of a paper presented at the St. Louis meeting of the American Society of Mechanical Engineers.

The engine having been run for a considerable period, and the desired conditions as to pressure, speed, and cut-off having been obtained, cards were taken simultaneously from the cylinder and the pipe-indicator. Two pairs of cards (i. e., two from cylinder and two from pipe) were thus taken as rapidly as convenient, after which the position of the indicators was reversed, and the work repeated. There were thus obtained four cylinder-cards and four pipe-cards, one-half of each set having been made by one of the indicators, and one-half by the other. Next, by the use of closely-drawn ordinates the eight cylinder-cards were averaged and combined in the form of a single card, and the eight pipe-cards were in the same way combined to form a single pipe-card. The two typical cards thus obtained, superimposed as in Fig. 2, constituted the record of the test. This process was repeated for each of the several conditions under which tests were made. The accuracy of the indicators used, and the constancy of the conditions maintained, were such as to make each card almost, if not quite, the exact duplicate of the representative of its set.

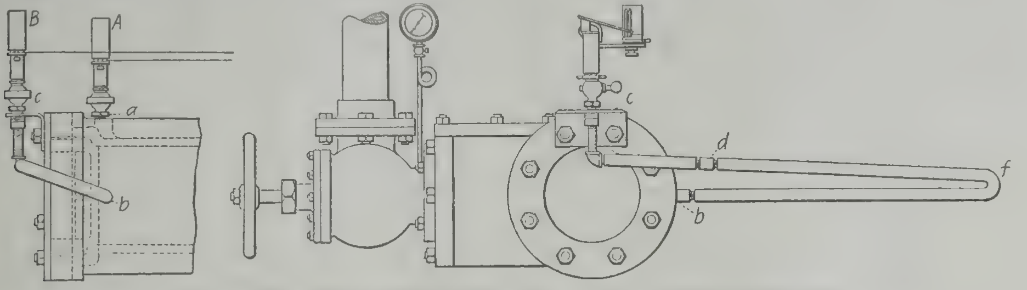


FIG. 1.--LONG PIPE CONNECTIONS FOR A STEAM ENGINE INDICATOR.

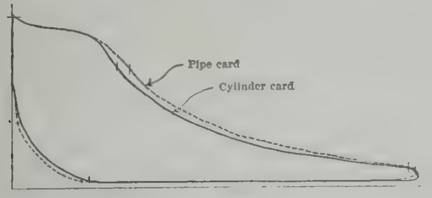


Fig.2. Five Ft. Pipe.

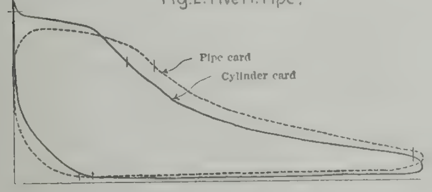


Fig.3. Ten Ft. Pipe.

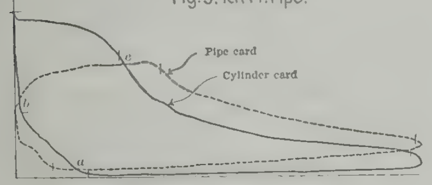


Fig.4. Fifteen Ft. Pipe

Figs. 2, 3 and 4.--Diagrams Taken With Constant Speed (200 Revs. Per Min.), Constant Steam pressure (80 lbs. and Constant Cut Off (1/4 Stroke, Approximately).

(The full lines show diagram taken with indicator closely connected. The dotted lines show diagram from an indicator with 5-ft., 10-ft. and 15-ft. pipe connections.)

By reference first to Fig. 2, it will be seen that the effect of a 5-ft. pipe is to make the indicator attached to it a little tardy in its action. Thus, during exhaust, when for a considerable interval of time the change of pressure to be recorded is slight, the lines from the two indicators agree: but during the compression which follows, the loss of sensitiveness in the pipe-indicator is made evident by its giving a line which falls below the corresponding line traced by the cylinder-indicator. Similarly, during admission there is an approximate agreement, while during the expansion which follows, the lagging of the pipe-indicator results in a line which is higher than the expansion line given by the cylinder-indicator. As a result of this lagging in the action of the pipe-indicator, its card is in error in the location and curvature of the expansion and compression curves; also in the location of the events of the stroke, and in the area which it presents. The speed at which these errors are shown to occur is moderate (200 revolutions), and the length of pipe attached to the indicator is not greater than is often used.

The general effect of a 10-ft. length of pipe (Fig. 3) is the same with that of the shorter length, but the lagging action due to the pipe is more pronounced, and all errors are proportionately greater. In this case, also, the admission and exhaust lines fail to agree, the total range of pressure recorded upon the cards being less than the range existing in the cylinder.

A still further addition to the length of the pipe brings changes (Fig. 4) into the form of the pipe-card diagram which, while entirely in harmony with those already discussed, are of such magnitude that the form of the card loses some of its characteristic features. The admission and expansion lines are lower, and the exhaust line is higher, than are the corresponding lines for the true card. While cards from pipes of 5 and 10 ft. in length present an area greater than that of the true card, the card in question (Fig. 4) from a 15-ft. length of pipe makes the area less.

It is true that the lengths of some of the pipes experimented with are excessive as compared with those commonly used for the connection of indicators, but this fact does not deprive the results of their significance. If pipes of 15, 10 and 5 ft. in length will produce the effects shown by Figs. 4, 3 and 2, respectively, it is but reasonable to suppose that pipes of less than 5 ft. in length will produce some effect. And, since the effect of a 5-ft. pipe is considerable, this length must be greatly reduced before the effect ceases to be measurable.

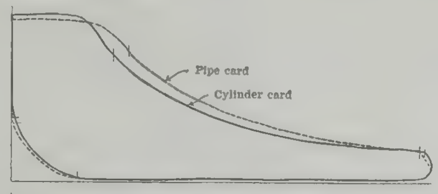


Fig. 5. 100 Revs. per Min.

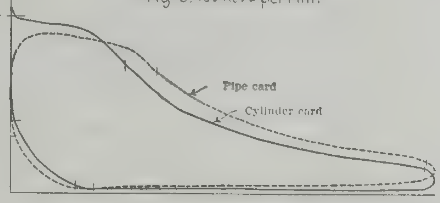


Fig. 6 200 Revs. per Min.

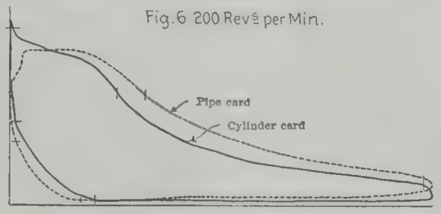


Fig. 7. 250 Revs. per Min.

Figs. 5, 6 and 7.--Diagrams Taken with Varying Speeds, but Uniform Steam Pressure (80 lbs.) Cut-Off (1/4 Stroke) and Length of Pipe Connection to Indicator (10 ft.).

Differences of speed have less effect than would be supposed in modifying the form of the pipe-card; even with a speed as low as 100 revolutions per minute, the effect of the pipe is strikingly apparent. The point of cut-off chosen for the whole series now under consideration (Figs. 2, 3 and 4), is not especially favorable for showing the modifying effect of the pipe. These considerations, together with the fact that indicator-pipes of 3 and 4 ft. in length are not uncommon, all serve to emphasize the practical value of the effects noted.

A study of the diagrams and data will make it evident that the differences are due wholly to a change in the length of the pipe. This single change, however, introduces an incidental change (1) in the clearance, (2) in the extent of surface exposed to the action of the steam, and (3) in the velocity of flow in and out of the pipe at the point of its connection with the cylinder.

The Effect of the Pipe at Different Speeds.—The effects thus far discussed are those recorded for a constant speed of 200 revolutions per minute. In considering to what extent changes of speed will modify these results, reference should be made to Figs. 5, 6 and 7, which give a series of results for which all conditions were constant except that of speed. It will be seen that increase of speed produces modifications in the form of the pipe-diagrams, which, in kind, are similar to those produced at constant speed by increasing the length of the pipe, but these changes are not great. For example, increasing the speed from 100 to 200 revolutions per minute (Figs. 5 and 6) produces less change than increasing the length of the pipe from 5 to 10 ft. (Figs 2 and 3). The fact that an engine runs slowly, therefore, does not seem to justify the use of an indicator at the end of a considerable length of pipe. Slow running reduces the error; it cannot be depended upon to eliminate it entirely.

The Effect of the Pipe at Different Cut-offs.—The relative effect of the pipe at different cut-offs, other conditions being constant, is shown by Figs. 8, 9 and 10. It will be seen that the differences of pressure recorded during expansion by the two indicators (pipe and cylinder) are approximately the same for all cut-offs; but the relative effect of these differences upon the area of the diagram is most pronounced upon the smallest, or shortest, cut-off card. The fact that in Fig. 10 the steam line on the pipe-card rises while that of the cylinder-card declines, constitutes a good illustration of the slowness with which the pressure in the pipe responds to that in the cylinder.

Table I. gives a comparison of the mean effective pressures and of the steam consumption per horse power per hour calculated from the pipe and the cylinder diagrams.

TABLE I.—Errors in Indicator Diagrams Due to Long Pipe Connections.

No. of figure representing diagram.	Excess (+) or Deficiency (—) as Shown by Pipe Diagram.			
	Mean effective pressure.		Steam consumption per HP. per hour.	
	Lbs.	Per cent.	Lbs.	Per cent.
2	+1.2	+3.7	—0.1	—0.5
3	+2.7	+8.5	—0.4	—1.7
4	—1.5	—5.0	+11.7	+45.9
5	+3.0	+8.8	—2.0	—7.2
6	+2.2	+6.6	—0.4	—1.7
7	+5.3	+18.7	—1.0	—4.2
8	+6.5	+35.3	+11.5	+47.9
9	+4.2	+12.8	—0.4	—1.7
10	+1.4	+3.4	—6.8	—23.6

All percentage values are based on results from cylinder diagrams.

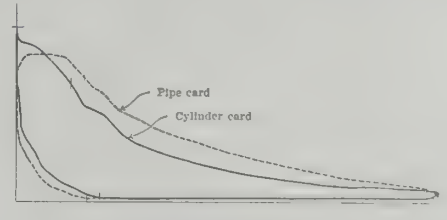


Fig. 8 Cut-off 1/8 Stroke

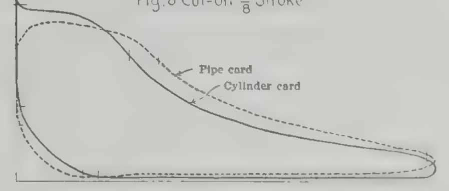


Fig. 9. Cut-off 1/4 Stroke

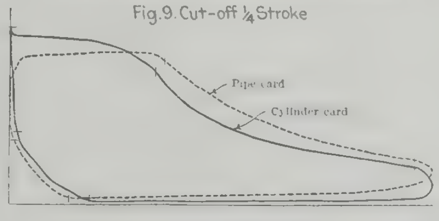


Fig. 10. Cut-off 1/3 Stroke.

Figs. 8, 9 and 10.--Diagrams Taken with Varying Points of Cut-off, But Steam Pressure, Speed and Length of Indicator Pipe Connections the Same as in Figs. 5, 6 and 7.

The principal conclusions drawn from the data presented is that if an indicator is to be relied upon to give a true record of the varying pressures and volumes within an engine cylinder, its connection therewith must be direct and very short.

◆

JAPANESE COMPETITION WITH AMERICAN MANUfactures has been a bugbear for some time, and all sorts of silly items have gone the rounds of the press. One which had especially wide currency was that Japanese bicycles were imported and sold for $12 in San Francisco. An interesting comment on this is found in a recent newspaper interview with W. Araki, of Osaka, Japan, in which he is quoted as saying:

> Our people have in the past dealt largely with English firms, but are coming to see the superiority of American manufactures in many lines. For instance, we have been buying our bicycles from Birmingham manufacturers heretofore, paying from $50 to $80 for them, but I now find that better ones can be bought in this country for less money. It would be a first rate idea for American bicycle firms to send samples to Osaka, as our bicycle demand is growing rapidly.

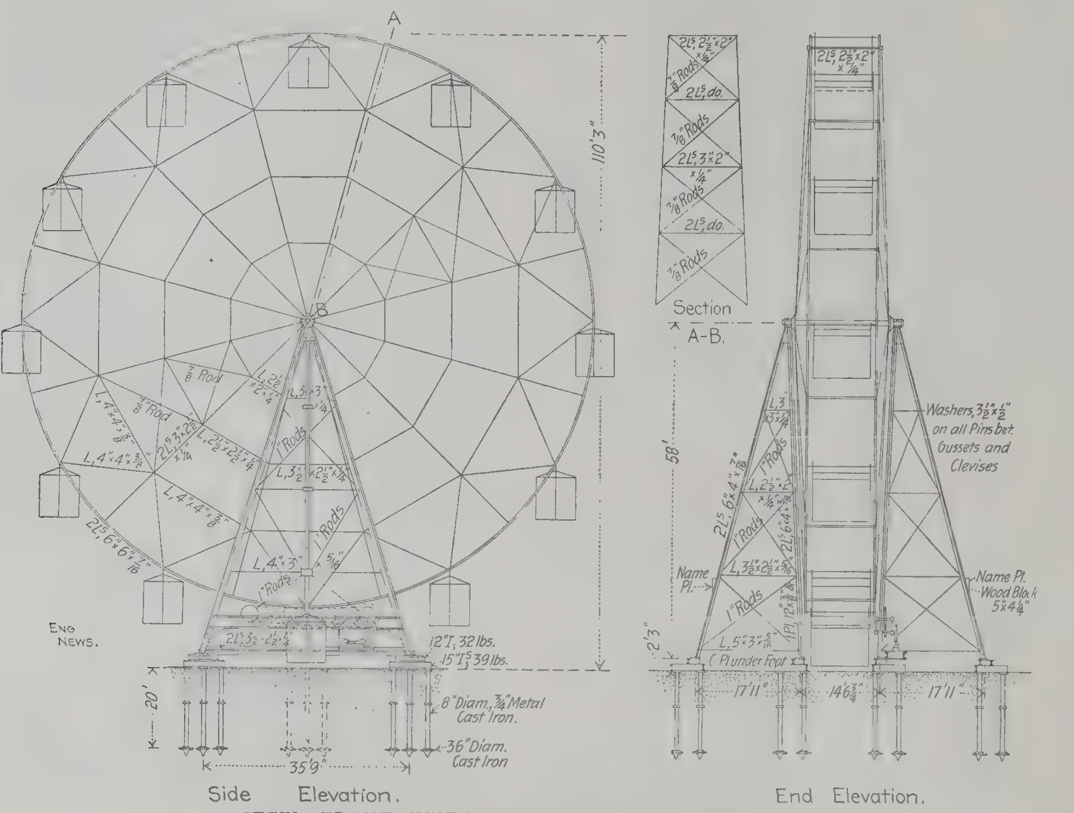
Mr. Araki comes to this country, according to the "Chicago Inter-Ocean," to obtain samples of American goods for the Osaka commercial museum, and invites all American manufacturers to send samples of their products, and their catalogues to the Osaka Commercial Museum, Osaka, Japan. The Japanese government will pay the charges for transportation and space for exhibits is free.

Respecting the idea that Japanese cheap labor is likely to compete successfully with American, it is stated that the fatalities of the late war have greatly increased the rates of wages. Ordinary workmen now receive 50 cts. per day and skilled workmen as high as $2 per day.

A STEEL FRAMED WHEEL 100 FEET IN DIAMETER.

A steel frame wheel, 100 ft. in diameter, on the general plan of the great Ferris wheel at the Columbian Exposition, was recently built by the Phoenix Iron Works, of Phoenixville, Pa., at Bergen Beach, N. Y., the wheel being similar to the one built by the same firm for the Atlanta Exposition last year.

The foundations are 18 cast-iron piles, 8 ins. diameter, with disks 3 ft. diameter, sunk by water jet to 20 ft. below the surface of the ground. The lower 8 ft. of this depth is seashore sand, which is overlaid with about 8 ft. of meadow mud, and that again overlaid with sand filling. The tower legs are made of angles and flats, and are braced with rods and angle struts, The axle of the wheel is of 8¼-in. square steel, turned to 8-in. journals at the ends; the hubs are of cast steel, the spokes, struts and rims are of angles, and the transverse bracing is of adjustable rods.



STEEL FRAME WHEEL AT BERGEN BEACH, N. Y.
The Phoenix Bridge Co., Phoenixville, Pa., Builders.

The motive power is a double cylinder steam engine of 15 HP., which was calculated to drive the wheel fully loaded at a rim speed of 2 ft. per second, making one revolution in about 2½ minutes. The driving gear consists of an endless flat link chain on sprocket wheels, which engages the teeth of a cast-iron sprocket wheel bolted in segments to the rim of one disk. There are 12 cars, 7 × 10 ft., with a capacity of 14 passengers each. The cars consist of angle iron frame work, clamped to and suspended from shafts which turn in journal boxes secured to the rim angles. They are covered with awnings and enclosed with heavy wire netting. A wind pressure of 50 lbs. per sq. ft. was assumed in making the computations.

The same firm has also built, at Coney Island, for Mr. Geo. C. Tilyou, a wheel of the same size and general design, but with cars constructed of angle and frame work enclosed with wood and glass for service in stormy weather. To resist the greatly increased effect of wind on the enclosed cars, the wheel and towers were made heavier throughout, and in addition the rim is stiffened laterally with straight I-beams, secured to the spokes, as shown by dotted lines, on the outline of the wheel. This wheel is founded on piles, similar to those at Bergen Beach, but as there is no deposit of mud at this point the disks are sunk only 10 ft. below the water level in the sand. The firm has also built a third wheel of the same dimensions at Washington Park, on the Delaware River, below Philadelphia. It is exactly like the wheel at Bergen Beach, except that the foundations are of masonry. We are indebted to Mr. H. H. Quimby, Principal Assistant Engineer, for the blue prints and information.

* * *

THE PRODUCTION OF METAL BARS BY EXTRUSION AT HIGH TEMPERATURES.*

By Perry F. Nursey.

The ingenious metallurgical process which I now have the privilege of bringing before the Institute is the invention of Mr. Alexander Dick, and deals with the production of all kinds of metallic sections, from a simple round wire to complex designs which it would be impossible to roll, by forcing metal heated to plasticity though a die under hydraulic pressure. The principle is simple enough, being nothing more than that employed in the manufacture of bricks, drain-pipes, and similar articles. It is, however, the application of that principle to the purpose under notice that constitutes the ingenuity and originality of the invention, and which marks it as a substantial advance in metallurgical practice.

I do not forget that the principle of extrusion has been applied in the production of continuous lengths of leaden pipes and wire, and also of leaden rod for the manufacture of projectiles for small arms, and for other purposes. In those cases, however, the lead is pressed at a comparatively low temperature, whilst in the present instance the metal is operated upon at a very high temperature, namely, that of plasticity, or about 1000° F., and which varies considerably with different metals and alloys.

The process of manufacture consists in placing the heated metal in a cylindrical chamber, at one end of which is a die. Upon pressure being applied at the opposite end the plastic metal is forced through the die, issuing therefrom as rods or bars of the required section and of a length governed by the quantity of metal placed in the receiver. This pressure-chamber has not only to withstand the high temperature of the contained metal, but has likewise, whilst under the influence of that temperature, to meet the severe strain brought upon the interior by the resistance of the metal to the pressure of the hydraulic ram in forcing it out through the contracted area of the die. Hence the first and most important point to be settled was the design of the cylinder and the material of which it should be constructed.

At starting several cylinders were made, some of cast and some of wrought steel, in order to ascertain which material was best suited for the purpose. The chamber was 24 ins. long and 6 ins. diameter internally, the walls varying in thickness from 3 ins. to 6 ins. Surrounding the cylinder was an annular chamber heated by a coke fire, the object of which was to maintain the plasticity of the metal during the operation of pressing. In practice, however, it was found that the strains set up by the unequal expansion and contraction of the walls of the cylinder, added to the internal working pressure, soon developed cracks, thereby rendering the cylinder useless.

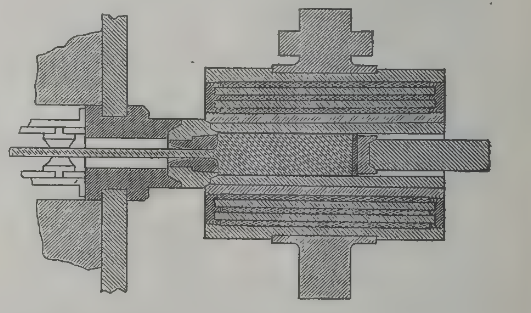
Nothing daunted by failure, Mr. Dick set to work to devise other means whereby he hoped to accomplish his end. The difficulty respecting the pressure-chamber, or container, was eventually overcome by dividing up the container into sections composed of concentric steel tubes alternating with annular spaces packed with a dense non-conducting material. This arrangement is based upon the principle, that whilst steel, when heated to a high temperature, loses its integral strength, as proved by Mr. Dick's experiments, yet at low temperatures it will retain its full power to resist pressure; so that a cylindrical chamber formed of several comparatively thin walls, and protected from extreme heat, will resist pressure better than a chamber having a thick solid wall heated to a high temperature. A chamber surrounded by comparatively thin walls heated to a comparatively high temperature is not so injuriously affected by variations of temperature as a similarly heated chamber having a solid wall of greater substance.

By this compound system of construction, the liner, which is exposed to the extreme heat of the metal, may be made with a comparatively thin wall, and will not be liable to be fractured by unequal heating and cooling, and consequent expansion and contraction. Further, in order that it may be capable of successfully resisting pressure, it is reinforced by means of the surrounding steel tubes, which, although of themselves thin, are insulated and supported by a dense packing of non-conducting material, and are therefore kept at a comparatively low temperature and in a condition to offer the greatest resistance, which condition is further mechanically influenced by a stout steel outer casing.

Another problem which took some time to solve was the selection of an efficient non-conducting material. The main conditions here were that the particles of the material employed should be capable of being densely consolidated, should not seriously affect either the liner or the outer cylinders, nor melt nor become decomposed at a high temperature. After experimenting with a variety of substances, Mr. Dick found that the best results were obtained from crushed granite mixed with a small proportion of borax. This compound satisfactorily fulfilled all the necessary conditions, and was therefore adopted as a non-conductor.

The apparatus as now constructed and in daily operation is 16 ft. in length, 6 ft. wide and 5 ft. high over all. It consists mainly of the compressing cylinder or container and the hydraulic ram. A longitudinal section of the container is shown herewith. The container, which is 2 ft. long and 2 ft. diameter externally, has an inner liner of cast steel. The internal diameter of the liner varies in different containers from 5 ins. to 8 ins., according as to whether it is wanted for pressing a small or a large charge, the container being changed as required. The liner is enclosed with a series of cylinders of ordinary mild steel spaced about ¾-in. apart, the annular spaces being filled in with the non-conducting material. The container is mounted on trunnions and fitted with worm-gearing for bringing it to a vertical position for being charged with metal and restoring it to the horizontal for the operation of pressing.

Great care has to be exercised in making the die-plates, the material of which is tungsten steel. They are formed with either one or several openings, each opening being of the section required to be given to the article to be produced. The edges of the openings in the dies are beveled, so as to give free access to the metal under pressure, and to more perfectly condense it. The die-plate is mounted in a holder, in which it is easily fixed, or from which it is readily removed, as different sections are required to be pressed. As it is necessary to heat the die and its holder previously to each pressing operation, the die is fitted into a shouldered recess in the holder, which is coned to seat into a hollow metal block. This block is firmly held in position during the operation of pressing by a pair of gripping jaws actuated by hydraulic power.



Longitudinal Section of Pressing Cylinder for Producing Metallic Bars by Extrusion; Alexander Dick, Inventor.

The metal is forced out of the container and through the die by a hydraulic ram 18 ins. in diameter, and working under a pressure of 2 tons per sq. in. The ram has a prolongation or extension, of reduced diameter, which forms the plunger of the container, entering it at the opposite end to the die. A different plunger is used with each container, the diameter varying to suit the internal diameter of the container. On starting to work each day the container is first heated up by gas with a Bunsen burner, which quickly brings the liner to the temperature necessary to prevent the first charge of metal getting a chill. The container does not require reheating, as the liner remains red-hot after each run.

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*From a paper read at the meeting of the Iron and Steel Institute, May, 1896.

The working of this ingenious system of production will be best described from my own observations during a recent visit to the Delta Metal Works, Pomeroy St., New Cross, London, where it has been in regular commercial operation for some time. Upon that occasion the machine was running on an order for Delta metal rods 12 ft. long by 1 in. diameter. Of course, much greater lengths and much heavier sections are turned out as required. The sections produced ranging from light sections, such as wire weighing about 1-100 lb. per ft., to heavy rounds, hexagons and squares weighing 40 lbs. and over per ft. The die in use on the occasion of my inspection had four openings, thus producing four lengths, or an aggregate of 48 ft. of rod at the same time.

A charge having just been put through, the opening at the front end of the container (that next the die) was closed by a removable plate or stopper, and the container was turned into a vertical position. A charge of 1½ cwt. of molten metal was then poured from a ladle into the container, and was allowed to stand for about six minutes, so as to acquire a plastic condition. The diameter of the plunger and that of a loose block which is placed between it and the charge (for a purpose which I will shortly explain) being less than the diameter of the steel liner, the plastic metal when under pressure would be forced backwards between the block and the liner were it not restrained. In order to prevent this back-flow taking place, a dished steel check-disk, which is less plastic and more rigid than the heated metal at the working temperature, is first placed on the top of the charge, and when the pressure is brought on, the disk is expanded and completely fills the bore of the liner, thus effectually preventing the backflow of the metal.

Upon this check-disk was then placed the loose steel block just referred to, which, having been previously heated, prevents the cold end of the plunger chilling the charge of metal. The plunger being of smaller diameter than the liner, there is no fear of the latter becoming chilled by the former. To preclude the possibility of such an occurrence, the back of the loose block is recessed to receive a corresponding projection on the front end of the plunger, which is thus kept horizontal in its forward travel and prevented from coming in contact with the liner.

The loose block having been inserted, the container was brought into a horizontal position, the stop plate removed, and the container run up to the die-block, which, with the die, had been previously heated. The hydraulic pumps were then started, and in four minutes the charge was expelled and had become converted into four 1-in. rods, each measuring over 12 ft. in length. The clips were then released and the ram continued its forward travel, pushing out the remaining metal, or stump, together with the die and its holder, as well as the check-disk and the loose block, leaving the container perfectly clear for a fresh charge. The rods were at once cut off from the stump or fag end of the charge to the exact length required and removed. The die and holder were then replaced by others, the container turned over into a vertical position, the stopper fixed in place, a fresh charge of metal teemed in, and as soon as it had become plastic the operation of pressing was again proceeded with. I may mention that the rate of travel of the ram can be varied to suit the size of the charge or the special nature of the output.

With regard to the physical characteristics of the bars thus produced, it is obvious that, owing to the great pressure put upon the metal, its quality must necessarily be greatly improved, in the same way that Whitworth steel is improved by compression. In the first place, it is found to be perfectly homogenous. The actual increase of strength in extruded bars over that of hot rolled bars of the same metal varies with the nature and composition of the metal or alloy. Taking ordinary yellow metal, the increase in tensile strength is 24%, with a proportionate increase in elongation. Some tests made at Woolwich Arsenal with Delta metal bars produced by extrusion show a tensile strength of 48 tons per sq. in., with 32.5% elongation on 2 ins., against 38 tons per sq. in. tensile strength and 20% elongation of rolled bars of the same metal.

I have stated that at the time of my visit the mode of procedure was to charge the container with molten metal. The objection to this method of working is the delay occasioned at the press in waiting for the molten charge to set or become plastic, besides which there is the time occupied in various detail operations attending the charging of the container with molten metal. The result is that the average rate of working is only 25 charges per day of 10 hours. This method of working has since been improved upon by Mr. Dick, and the container is now charged with billets after they have been heated to the point of plasticity in a furnace. With this method of working the output is doubled, easily reaching 50 charges and more per day. The labor cost per ton on the finished work is very small, being only the wages of two men and a boy per machine.

A larger press also is in course of construction which will have a 20-in. ram, and will be capable of turning out heavier work than any yet produced. Besides being in operation at the works already mentioned, the system is being worked under license in the Midlands, and it has also been adopted in the Delta Metal Works at Dusseldorf.

Mr. Dick is at the pesent time engaged upon experiments with the view of producing sections in iron and steel by this process.

* * *

SOME FACTS ABOUT SLOW SAND FILTRATION OF WATER.

By Mrs. Percy Frankland.

Every one who has carried out systematic bacteriological examinations of any given water supply is struck with the fluctuations which occur in the bacterial contents of filtered water.

In the case of the London water supply, for example, Prof. Percy Frankland, in his monthly reports to the Local Government Board, showed that one and the same company delivered water after filtration in which the bacteria present varied from 2,270 per cu. cm. in January to 49 in September. Until we can satisfactorily account for such variations in the bacterial quality of the filtrate we cannot hope to eliminate the present element of uncertainty which surrounds the production of a good filtrate. The question has given rise to much discussion, and it is, therefore, with special interest that we note some recent contributions to our knowledge of this subject.

In a previous issue of this journal (March 14, 1895,) attention was directed to some of the other factors which must be held responsible for an efficient filtrate and amongst these the formation of surface slime on the filter beds was mentioned.* We know that when the process of cleaning a filter has been carried out the latter does not immediately yield satisfactory results; the coating of slime has to be encouraged, and the time which elapses before a filter gets into condition will vary with different waters and probably at different seasons of the year. For example, in the case of the Zurich water supply, where pure water as derived from the Lake of Zurich is used, it is found that on renewing the sand in a filter, it is only after from 3½ to 36½ days that the water gets into proper working order and yields a satisfactory filtrate. The time required for such conditioning of a filter is, of course, exceptionally great in a case like this, in which a comparatively clear and bacterially pure water is being filtered; on the other hand, this delay is more than compensated for by the greatly extended length of time that filters dealing with such description of water can be kept working, from three to four years being the period allotted to them, and during which they are found capable of yielding an exceedingly pure filtrate.

Now, although the bacterial condition of the raw water may have a great deal to do in determining the microbial character of the filtrate, yet it would appear from recent researches that if the filters are working at their best, the filtrate does not reflect the fluctuations of the raw water; if, however, bacterially bad water chances to coincide with a period when the filters are not efficient then the result is immediately visible in greatly increased numbers of bacteria in the filtrate.

This point is brought out by the Zurich water supply. The average number of bacteria present in the lake water was, one year, 123 per cu. cm., and in the filtered water, 24 per cu. cm.; the following year, however, in consequence of the lake freezing, the average for the raw water was raised to 583 per cu. cm., but the filtered water exhibited no corresponding increase, the average for the year being only 23 per cu. cm. This satisfactory result was entirely ascribed to the excellent working of the filters.

A confirmation of these facts in greater detail has been lately furnished by Dr. Kurth in the course of his bacteriological examinations of the Bremen water supply delivered from the river Weser and submitted to sand filtration before delivery.

In the winter months, when rivers are often in flood, the number of bacteria present may often rise enormously in excess of what are found at other times; thus Dr. Percy Frankland has found as many as 56,000 to 121,000 per cu. cm. in the rivers Thames and Lea in the winter, whilst in the summer months the numbers present in these waters are represented by much smaller figures, such as 1,070 to 3,000. This condition of the raw water in the winter was frequently strikingly reflected in the filtrate.

Dr. Kurth fully confirms these observations, but having access to the individual filters he has been able to ascertain in detail how it is that the filtrate becomes affected when flood water is supplied to the filter beds. These investigations bring out very clearly not only the manner in which the bacterial condition of the raw water affects the filtrate, but also how efficient filtration may be successful in evading the deterioration of the filtrate in times of flood. The following investigations illustrate these points very clearly: The number of bacteria in the raw river water rose suddenly between Jan. 20 and 24, from 5,000 to 30,000 per cu. cm. After the breaking up of the frost between Jan. 15 and 22, the opportunity was taken of cleaning as many filter beds as possible, and only two beds, Nos. 1 and 7, which were left to the last, had not been touched when the investigations were made. So that here we have a coincidence of bacterially bad water and freshly cleaned, or, in other words, inefficiently working filter beds. As was to be expected, all the effluents from the recently cleaned beds exhibited, on Jan. 25, as many as from 500 to 1,200 bacteria per cu. cm., but, on the other hand, despite the access of this flood-water, the filters which had not been interfered with, exhibited an excellent filtrate only 90 and 100 per cu. cm., respectively, being found. Dr. Kurth states that he repeatedly found that the admission of flood water to the filter beds did not affect the filtrate if it occurred when the filters were working at their best, say during the middle or towards the end of the period in which they are in use, but that its effect was readily visible when the filters were not yet in condition. Thus, on another occasion, between Feb. 24 and March 1, the bacteria in the raw river water rose from 4,000 to 29,000 per cu. cm., the filters, however, which were all 13 to 20 days old, that is to say, 13 to 20 days had elapsed since the last cleaning, yielded excellent filtrates, containing from 66 to 86 bacteria per cu. cm.

In conclusion, reference may be made to some interesting investigations of Dr. Kabrhel, which have been recently published, on the length of time necessary for the disappearance of particular bacteria, present in the raw water, from the filtrate. These experiments are of importance as in the event of pathogenic micro-organisms being present in the raw water it is of great consequence to ascertain whether the filtrate may become infected, and, if so, for how long.

For this purpose he constructed an experimental filter and supplied it with water infected with a particular microbe, easily destinguished from ordinary water microbes by the pigment it produces on gelatine surfaces. He states that for a considerable time after he ceased supplying the filter with this microbe and had passed ordinary water through, he found this particular micro-organism in the filtrate. Thus he inclines to the opinion that should water infected with disease germs gain access to a filter, the latter may retain them for considerable periods of time in its interstices and that the passing of succeeding volumes of water would tend to wash them into the filtrate and even after a considerable lapse of time render the latter obnoxious.

The efficient sand filtration of water is a hygienic precaution of the highest order, but it must yet only be regarded as a precaution and not necessarily endowed with infallibility. Valuable as such measures undoubtedly are in the purification of water, they do not render us independent of the nature of our supply, and the oldest consideration must still remain the first, the acquisition of the purest source possible for our public water supplies.

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*The conclusions drawn from the Lawrence experiments on water filtration indicate that the efficiency of new filters, or filters after cleaning, depends quite as much, to say the least, upon the formation of a coating upon the surface of each sand grain as upon the surface of the whole bed, this sticky matter evidently retaining the bacteria.—Ed.

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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

The somewhat startling announcement was made a few weeks ago that sand dredged from the Passaic River and used in paving work at Newark was responsible for a marked increase in typhoid fever in that city in 1895. This statement was credited to Dr. H. C. H. Herold, President of the Newark Board of Health, to whom we at once applied for information. Dr. Herold kindly sent us an extract from a report made by him on April 21, 1896.

An examination of the extract leads us to doubt whether there was any relation between the sand in question and typhoid fever. The report states that there were 88 cases of typhoid fever in 1894 and 36 deaths, while in 1895 there were 148 cases and 39 deaths, or an increase of nearly 70% in cases and only 8% in deaths. The figures indicate a mortality of 40% in 1894 and 25½% in 1895. Even the latter figure seems to be an excessive percentage of fatal cases. We suspect that not all the cases occurring in 1895 were reported, but that there was an improvement in this respect over 1894.

Turning now to the arguments in support of the sand theory we find that these are: (1) The detection, on examination, of the bacillus "coli communis" and a bacillus "resembling typhoid" in the sand in question and the absence of such bacteria in other sand and dirt about the city; (2) the increase in the number of cases was in the latter part of the year and the paving was carried on from July to December. Regarding (1) it may be said that as the sand was taken from the bed of the sewage-polluted Passaic, the bacteria named were naturally present, while as the other sand had not been subjected to sewage or other excrementitious matter the bacteria were naturally absent. As to (2) it is well understood that typhoid fever is more prevalent from August or September until November or December; in addition, the improvement in reporting cases may have begun in July.

A further argument against the theory advanced is that the typhoid bacillus develops in the digestive and not in the respiratory organs, so that it is unlikely that the extra cases could be accounted for by the theory under discussion. Moreover, if the people of Newark succumbed to germs which float from river sand on the few streets where paving was being put down, what would be expected in Jersey City, where the sewage-polluted water was being used throughout the whole city at the same time?

The extract concludes with a request for "the immediate stoppage of the use of this sewage sand on our streets," on the ground that it causes typhoid fever, an assumption which we do not think is borne out by the data presented, or is even remotely probable.

So much has been said in the newspapers of late concerning the prospects of compressed air as a motive power for street car propulsion, that a few words as to just what is being done and what is likely to be done may be of interest. In the first place the reason why the New York street railway companies are experimenting with compressed air is that Manhattan Island is the only place in the United States where street railway companies are not allowed to erect overhead wires. The cable is in use on some of the north and south lines; but its first installation is enormously expensive, and in view of the rapidly waning popularity of cable traction for street car lines, the managers of street railway properties hesitate before incurring an enormous expense for a plant which may be obsolete in a few years. Further, for many of the cross-town lines the traffic is hardly sufficient to support a cable railway.

The managers of the various street railway lines have several alternatives offered them. They can keep on using horses, which means heavy expense and also loss of traffic; they can adopt some underground electric system, such as the General Electric's conduit system, or the Westinghouse magnetic switch system; but either of these systems are regarded as more or less experimental, and the managers hesitate to put down any sort of plant in the street where any possibility exists that it may all have to be torn up again.

In this dilemma the managers of the air propulsion systems come along with great claims for the excellence and economy of their plan; and, we presume, with guarantees to stand the expense of the trial in case the success claimed is not secured. The street railway managers, therefore, feel that they have everything to gain and nothing to lose. If the air motors handle their traffic at a reasonably low cost, they will doubtless adopt it, at least for the cross-town lines with light traffic; if it proves a failure they suffer no loss, and there is no trouble over torn-up tracks, as would be the case in experimenting with any cable or electric system.

Mileage tickets are about to be issued by the Northeastern Ry., of England, and from a note in London "Engineering" this appears to be an entirely new departure on British railways. The books are to be for 1,000 miles, are for first-class passengers only, and the price, which will seem high to an American, amounts to $25.45 in United States money. It is to be remembered, however, that the British first-class car is nearly equivalent to our parlor car; and as American parlor car rates are usually about ½ ct. per mile, it would seem that the rate is almost identical with what an American traveler pays who uses a mileage book at 2 cts. per mile) and rides in a parlor car. The English mileage books, however, have so much red tape in connection with them that it is doubtful whether they will prove popular. Their use is restricted to the purchaser, members of his family or his guests; but a certificate must be made out and signed by the purchaser for every such user except himself. Further, the purchaser of a book is not relieved of the bother of going to the ticket-office before every journey as is the case here. Instead, he must be on hand at the "booking office," present his mileage book and his "certificate" duly signed, and witnessed we presume, have the ticket-seller tear off coupons for the journey he proposes to take, and receives at last a first-class ticket in exchange. What would happen in case after partially completing his journey he should decide not to stop at the place his ticket called for, we do not know; but we presume he would have to go back to his starting point and begin all over again. It may be noted, further, that the books are limited to one year, and that for any journey of less than 10 miles, 10 coupons are taken from the books; also that these books are not entrusted to the ordinary ticket-seller. Applications for them must be made in writing to the Superintendent of the Northeastern Ry., accompanied by a remittance, by the full name and address of the applicant, and we presume also his pedigree, though this is not stated.

Probably the Englishman who travels first-class on the Northeastern Ry. will vote the mileage book system a nuisance, and will wonder how it is that travelers in America use mileage books so extensively.

In another column of this issue a correspondent points out the difficulties which lie in the way of the adoption of the metric system and proposes, as a solution of the difficulty, that a duodecimal system of arithmetical notation be adopted in place of the present decimal system.

The scheme is an interesting one—as a curiosity; but we see no likelihood that it can ever be anything more. The practical aspect of this proposal is considered editorially in the last number of London "Engineering," which says among many other things:

> In a country that had no records the introduction of such a system would be quite easy. But we are the heirs of the ages, and have a vast patrimony of knowledge that would become depreciated by the change. It must be remembered that quantities expressed in decimal notation cannot be converted into their duodecimal equivalents by any process of subtracting a percentage. Except in simple cases, the conversion cannot be carried on mentally, but must be done on paper by means of repeated divisions by 12. All the numerical results of scientific research would require to be altered with the new notation, and the elaborate tables of calculated results which are possessed by engineers and others would become almost valueless, and often it would be as easy to recalculate any particular example as to reconvert it.
>
> Engineers, however, take readily to changes when they see the necessity of them. Their career is a prolonged attack on new problems, and as a rule they welcome novel weapons of attack, provided they are more effective than the old ones. It is the general community that needs to be considered in the present case. If the duodecimal system were introduced, we should have our familiar numerals bearing their old significance when they stood in the position of units, and a new significance when they were in any other position. The figure 6, for instance, would be the friend of our youth, but 60 would be an utter stranger, assuming the name and carrying the face and habiliments of a former acquaintance. We are told that metrical measures are beyond the comprehension of the masses, but, at any rate, they have an individuality of their own which prevents them from being confounded with any others. No one reading that a piece of land is 100 metres long can make the mistake of imagining it to be 100 yards. The man who is invited to partake of half a litre of beer will not expect half a pint. The dressmaker would easily comprehend that 10 metres of silk went as far as 11 yards used to do. But we very much question whether a senior wrangler could be relied upon to put down a sovereign for an article priced at 18s. As for ordinary folks, even a surgical operation could not put into their heads that a shilling and sixpence were sixteenpence.

The only way, says "Engineering," by which this confusion could be avoided would be to select entirely new characters and names for the numerals of the duodecimal system. But this again lands us on the other horn of a dilemma. The greater mass of the adult population would never learn the new notation. Not all the powers of the strongest government could compel the abandonment of their old methods of notation.

It appears to us that this is by no means an overstatement of the difficulties which would beset such a revolution in the arithmetic of the civilized world. There is one other thing respecting this proposed change, however, which should of itself be sufficient to dismiss it from consideration as a practicable scheme. That is the fact that such a reform would be certain to be opposed by the masses of the people. It was possible for a Napoleon to turn things topsy-turvy, in the reckoning of time and in a thousand other of the affairs of every-day life; but to-day practically all the civilized world is under popular government. What congressman would dare to sign his political death warrant by voting to compel people to reckon by dozens instead of by tens!

We, some weeks ago, expressed the opinion that this factor of popular opposition was likely to opperate to delay indefinitely the adoption of the metric system. We feel still more certain that it will prove a perpetual barrier against any such sweeping innovation as a duodecimal notation.

THE EVILS OF FICTITIOUS ACCURACY.

If a man were to drive a load of hay upon a public weighing scale and were to be informed by the weighmaster that the load weighed 2117.635 lbs., he would either conclude that the weighmaster was either a fool or a joker, for everyone knows that such scales do not weigh to the hundreth or the thousandth of a pound, and even if they did the value of articles commonly weighed there is such that it would be ridiculous to attempt to weigh them to a fraction of a pound. All through practical everyday business life, in the measuring and weighing of commerce or manufacture, the rule holds good that no one thinks of giving or asking for any greater accuracy than the value of the articles measured makes needful, or than the tools used for measuring will furnish. We measure the wheel-base of a locomotive, for example, in feet and inches, the capacity of a tank in cubic feet or gallons and of great reservoirs (practically) in thousands or millions of the same units.

Thus, in numberless instances that we might name, the rule holds good that accuracy is sought only when it is needed, and it is not claimed directly or indirectly, unless it has been fairly obtained.

But when we turn now to certain departments of engineering, for the most part those departments which have been transferred in recent years from the laboratory to the field of commercial testing, we find a remarkable neglect of those common-sense rules with respect to accuracy which we have observed above. We find, for example, engineers writing down the elastic limit of a piece of steel as 34,396 lbs., when the method of determining the elastic limit is such that there may be a variation of perhaps 500 to 3,000 lbs. between the results obtained by different observers from the same piece.

Again let us take the steam engine indicator, an instrument which has accomplished wonderful results in the improvement of engine practice. Let us sum up the errors due to lost motion in the joints, spring in the arms, friction and inertia of the piston, friction and condensation of the steam in the pipes,* breadth of the pencil line of the diagram, erratic motion in the tracing point of the planimeter and errors in the planimeter mechanism, and then decide whether it is wise to set down the horsepower computed from the diagram to hundreths.

For a still more striking example we may take the tests by calorimeter of the moisture in steam. We find in one test which we select almost at random, the quality of the steam set down to three places of decimals. In another, a pamphlet received only this week, we find the following:

Quality of the steam (dry steam = unity)	1.01443
Moisture in the steam	0.000000
Degrees of superheat	26.499
Percentage of superheat	1.443

Now we will suppose, for the sake of argument, that the modern calorimeter will measure the moisture in steam with a probable error of a tenth of a per cent provided a fair sample of the steam is secured. The fact still remains that according to the best information attainable, no experimenter can ever be sure that the sample of steam he is testing does not vary in moisture by from one-half to one per cent. from that which the boiler is actually delivering. In the light of this knowledge, how absurd appears the setting down of figures which pretend to give the quality of steam to hundredths or thousandths or ten thousandths.

The errors in determination of the heat value of fuels by another sort of calorimeters were discussed in our issue of June 11, and it was then shown that to base records of boiler efficiency on such determinations was like measuring cloth with a tape measure of rubber-elastic.

So we might continue and show how in many other departments of engineering work, some engineers (not all by any means) habitually set down figures and report results with an apparent accuracy which is warranted neither by the limit of error of the instrument nor by the importance of the matter at hand; but it is unnecessary to carry the illustrations farther. Every engineer will recall many instances, we are sure.

And now let us see what harm is done by this practice. The first and greatest harm, it appears to us, is to effect an actual deception. If an engineer reports that an engine develops 512.78 HP., anyone is justified in concluding that the test is made with instruments and methods which effect the determination to a hundredth of a horse-power. If a layman is told that a piece of steel showed an ultimate strength of 72,185 lbs., he supposes, of course, that ultimate strength is determinable to a single pound. If an engineer in a report sets down that a certain boiler made 0.34% dryer steam than another boiler and the maker of the first boiler prints this report and puts these figures in large display type, is not the public justified in supposing not only that the test was accurate to a hundredth of a per cent., but that there is some practical importance attaching to a variation of a hundredth of one per cent. in the quality of steam?

In the second place, we are much inclined to believe that engineers do harm to themselves and to the profession by this objectionable practice. Any man of common sense who finds that the figures in an engineer's report appear to show an accuracy which is far from being reached, has his faith in the entire report materially shaken. After he has found repeated instances of this in the reports of different engineers, his confidence in the engineering profession begins to fail. The public is still too much inclined to look on engineers as "a lot of theoretical chaps." Such things as these in engineers' work give some excuse for supposing that the profession is better versed in mathematics than blessed with common sense.

Still another respect, in which harm is done when engineers' reports are loaded with useless decimals, is that the important figures are obscured. The number 100, for example, is easily grasped by the mind. The number 101.376198 is of very nearly the same in value, but it is an effort for the mind to grasp that fact. Now all written matter whatever, be it the report of an engineer or anything else, has only one purpose—to convey ideas to the mind. And the more simply and directly the important ideas are presented, the more readily and surely will the mind grasp them. The engineer who encumbers a report or a paper with a lot of decimals or tacks meaningless cents onto figures which run into the thousands of dollars, weakens by so much the force of his work, and the extent to which it will be read and understood.

But in fairness to those we are criticising, it is well to inquire how it comes about that so many engineers are addicted to the immoderate use of decimals. There is nothing to show that the practice was or is ever adopted with the intention to deceive either clients or the public with an exaggerated notion of the accuracy of an engineer's work. It appears to us that it comes merely from the habits formed in the school, of carrying out results to several places of decimals to reduce the errors of computation. In all work with engineering instruments, of course, whether they be the transit, the planimeter or the balance, the correct process is to read the indication either as closely as the importance of the work in hand requires or else to the finest degree possible, regardless of what percentage of error the instrument itself may have. Then in the computation of results from these observations it is also entirely proper to use a number of places of decimals suited to the degree of accuracy it is desired to finally obtain.

It comes about, therefore, very naturally, that engineers in writing reports should set down the figures used in computation, decimals and all; and we doubt not that very few of those who habitually do this have ever had a thought of the effect which this must have upon the mind of an outsider, and which we have explained above. On the other hand, many engineers, especially those who are in close touch with commercial and practical life, have, we are sure, seen the wisdom of eliminating from their work when putting it into shape for final record all of this that we have designated as fictitious accuracy. We notice, for example, in one report of a steel test coming from the laboratory of a large steel works that 250 lbs. is the smallest variation used in giving elastic limits. We note this only as a single example; but an examination of the reports and papers of the best and ablest engineers will show, we believe, that as a rule they use common sense in laying their work before the public, and avoid encumbering it with what is properly only mechanism of computation. We trust their example may be followed by other members of the profession. It is to be hoped also that the professors in the engineering schools may turn their attention to this matter and see to it that their pupils properly understand it. The secretaries of engineering societies, too, can aid in the reform by properly editing the papers presented; but the strongest incentive toward a change should be felt by the practicing engineer. If each man would try to put himself in the place of his client and consider how the practical hard-headed business man will look upon strings of decimals carried out to three or four places, we are sure all fictitious accuracy would disappear from engineers' reports.

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*Note in this connection the article on the effect of long pipe connections on indicator diagrams on another page of this issue.

LETTERS TO THE EDITOR.

A Question of Professional Ethics.

Sir: I would like to have an opinion on a question of engineering ethics. The Engineer of our Department of Parks has accepted the position of Chief Engineer of an electric railway company organized to run through the park, while still retaining the first-mentioned position. Is this in strict accordance with the ethics of the profession? I would like some information on this point, and think that an opinion would be of great value to young and inexperienced engineers. Will you kindly submit this matter to the profession for its verdict.

Very respectfully, E. K.

July 21, 1896.

The Spread of Dry-Rot.

Sir: In reference to the letter of A. F. W. in your issue of July 23, the result of my experience may be of value. I have frequently had occasion to observe the effect of dry-rot on timbers, and as a general thing find that the hard pines, if affected at all, are only affected to a small degree when properly ventilated. This is, however, not at all true of the softer pines. Cases have come under my notice where softer pines butted against the side of yellow pine have rotted over one-third the area at the end and extending some feet into the interior of the piece, while the hard wood was not affected at all. I have several times had to remove the large white pine timbers from a structure for this very cause, though it was not necessary to touch the yellow pine or oak. In one case in particular I was informed that the timbers had not been disturbed for. 60 years. Oscar Lowinson.

39 and 41 Cortlandt St., New York city, July 25, 1896.

Low Charges for Engineering Work Again.

Sir: Referring to the letter headed "Low Charges for Engineering Work," in your issue of July 16: The writer of that letter did not include the whole of the proposition of the engineer: The proposition was also for "furnishing all legal advice free of charge up to the time of the completion of the plans and specifications and advertising for bids."

This city had the preliminary surveys made in the winter by a firm from a city in New York. The "engineers" were related in some way to one of the councilmen, and made these surveys for the sum of $200, paying their own expenses to and from the work, several hundred miles, and while engaged in making said surveys. Their "bid" for the designing of the plant was $400, but it was found out that they were related to men in official position and their figure was not considered. This firm made an estimate of the cost of the system and it was $50,000 less than that of the present engineer.

Your comment on the letter is timely, in that it shows that the cheap engineer is not always among the so-called "outsiders" (that is, those not members of the engineering societies).

The writer has been asked to join the Am. Soc. C. E. on several different occasions. From what he has seen he is of the opinion that it is not to his advantage in any manner. There is no code of "professional ethics," nor is business courtesy shown among those whom he has met (with two exceptions). The members are for the almighty dollar and work for it in the same manner and use the same means as those outside; one or two of the new members joined with the expressed determination of making trouble for some of the older members. True there is much to be gained from the Transactions of the society, but any energetic man may purchase literature on any of the subjects handled and study the subject for himself.

Yours truly, F. L.

July 18, 1896.

A Possible Solution of the Problem of Weights and Measures.

Sir: The paradox of the day is the contrast between ubiquitous resolutions in favor of the metric system, even from bodies of the most practical men, and the complete absence of its use in actual industry. The explanation is obvious, however. The cost of transferring our tremendous industrial system from our present measures to the metric system would be incalculable. Every machine, tool, pattern, template, and drawing becomes "scrap" immediately upon its adoption. Every atom of accumulated stock, from a wood-screw to a locomotive, becomes an odd size, no longer to be matched or repaired without a resurrection of obsolete tools.

The only requisites of a perfect system of measures are (I.) that they shall be consistent; i. e., all based upon the standard unit of length, and (II.) that the ratio between various units shall always be the same and be the base of the system of notation, which at present is ten. There is nothing sacred or scientific about the metric system except that it fulfils these conditions.

A certain coincidence, viewed in connection with these requirements, becomes of great significance. In the first place, a very common ratio in our otherwise chaotic system of measures is twelve; dozen and gross, foot and inch, year and month, day and hour, shilling and pence, are all such necessary tools for daily life that every child is taught its multiplication tables as high as twelve, instead of stopping at ten.

In the next place there has long been a wide dissatisfaction with our decimal system of notation, and agitation for the substitution of a duodecimal system. In other words, ever since man has counted on his fingers, we have used tens, ten × tens (hundreds), and ten × ten × tens (thousands), etc., with which to count. It is proposed, as incomparably more convenient, to count by twelve, twelve × twelves, twelve × twelve × twelves, etc. To do this we should need twelve digits instead of ten; say, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, φ, and ‖. φ and ‖ being "ten" and "eleven." Thus, in the new system, 2375, for instance. instead of meaning 2 ten × ten × tens, plus 3 ten × tens, plus 7 tens, plus 5 units, would mean 2 twelve × twelve × twelves, plus 3 twelve × twelves, plus 7 twelves, plus 5 units; which is expressed in the decimal system by (3977).* Without attempting a comparison of the two systems the following lists of fractions, those in most common hourly use in the shop, will illustrate the main argument for duodecimals:

Vulgar fraction.	Decimal equivalent.	Duodecimal equivalent.
½	0.5	0.6
⅓	0.333333 (indeterm.)	0.4
¼	0.25	0.3
1-6	0.166666 (indeterm.)	0.2
1-8	0.125	0.16
1-12	0.83333 (indeterm).	0.1
1-16	0.0625	0.09
1-32	0.03125	0.046
1-64	0.015625	0.023

It is therefore proposed that the English-speaking races, who have more money invested on the basis of the two-foot rule than have all the rest of the world on the meter, adopt the much more scientific duodecimal system of numbers, found a duodecimal system of weights and measures on the standard yard at Washington (which is just as good as the standard meter at Sevres), reprint their arithmetics, and keep their two-foot rule in their pockets. To illustrate:

For linear measure, the units would be the yard, the 1,000-yard (in decimal numbers 1,728 yds. = 5,184 ft., or so nearly a mile that off-hand conceptions of distance would not have to be altered), the 0.1-yard (= 1-12 yard = 3 ins.), the 0.01-yard (= ¼-in.), and for minute measurements the 0.001-yard (D = 1-48-in.). Thus, a drill-rack, without any alteration in the tools themselves, would be re-labeled as follows:

Present mark, in inches.......(1″)	($\frac{3}{4}$″)	($\frac{5}{8}$)	($\frac{9}{16}$)	($\frac{17}{32}$)	($\frac{1}{2}$)	($\frac{15}{32}$)	($\frac{7}{16}$)	($\frac{3}{8}$)	($\frac{1}{4}$)	($\frac{1}{8}$)	($\frac{1}{16}$)	($\frac{1}{32}$)	($\frac{27}{64}$)	($\frac{43}{64}$)	etc.
New mark, in 0.01-yds......... 4	3	2.6	2.3	2.16	2	1.φ6	1.9	1.6	0.1	0.6	0.3	0.16	1.83	2.83	
Or, in 0.001-yds...............40	30	26	23	21.6	20	1φ.6	19	16	10	6	3	1.6	18.3	28.3	

Although this may seem confusing at first, the more it is studied the more it will be liked.

For surface measure the units should be the square yard and its duodecimal fractions: The 0.01-sq. yd. (= 3-ins. square), and the 0.0001-sq. yd. (=¼-in. square). For land measure the acre would be replaced by the 10,000-sq. yd., a square 100 (144) yds. long, on a side, and amounting to 6.1% more than four acres; 100 (144) of these land-measure units equal one (new or duodecimal) square mile.

For measures of volume, the cubes of the linear dimensions are convenient. Thus, the cube of 0.1-yd. = 0.001-cu. yd., has a volume not far from one pint, or 3-7 of a liter. One cu. ft., for instance, equals 54 (64) such cubes. The complete lack of consistency in our present bulk-measure renders this application of the new system the most independent of any.

For weight the unit should be the weight of one "cube" of distilled water at maximum density. This would be within 2½% of 1 lb. avoirdupois, or very convenient for off-hand estimates, and might be called a "poid." The short ton would be replaced by the 1,000-poid, a weight about one-sixth smaller, or about ⅝-tonneau metric. 0.1-poid equals about 1⅓-oz. 0.001-poid is nearly equivalent to 4 grains or ¼-gram metric.

For time the table would run: 50 secs. = 1 min., 50 mins. = 1 hr., 20 hrs. = 1 day, 265.3 days = 1 year, 10 months = 1 year.

When the reform of our system of measures is undertaken, let it be done scientifically and finally for all time. This will not be unless the new system be based on duodecimals. It is easier, and vastly cheaper, to reprint our mathematical books than to refurnish our factories and restock our warehouses. Yours truly,

Sidney A. Reeve.

Worcester Polytechnic Institute, Worcester, Mass., July 14, 1896.

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*To avoid confusion, numbers in the decimal system will be surrounded by parenthesis; those in the duodecimal system are printed free. If this be forgotton the letter becomes meaningless.

The Benefits of Dry and Superheated Steam.

Sir: Your editorial article on "The Efficiency of Steam Boilers," in your issue of June 11, together with several other articles that appeared about the same time in other journals upon this and the kindred subject of superheated steam, lead me to offer the following upon the general subject, as the results of years of observation.

1. The quality of the steam furnished by a boiler (whether wet, dry or superheated) is a factor that enters more largely into the question of efficiency than is generally understood.

2. The importance of this factor will depend largely upon the use that is made of the steam and, therefore, a statement of efficiency based simply upon the number of heat units transferred from the coal to the water may be misleading.

3. The commercial efficiency of the boiler will depend upon the amount of coal required to do a given amount of the work required of the boiler.

4. If the steam is used to supply heating coils or jacket pans, or in boiling dye-stuff, the importance of the quality of the steam will be at the minimum. For, suppose three boilers, each of which is imparting 9,660 units of heat to the water per pound of coal, it will make no material difference in this case whether No. 1 shows 3% of moisture, No. 2 makes dry steam, or No. 3 superheats 20°, for during condensation to atmospheric pressure, the same number of heat units will be surrendered by each per pound of coal used.

It is true that even for such use dry or superheated steam has the advantage of an increased efficiency of apparatus due to drier surfaces and more free circulation, but the cost of doing the work will be practically the same, and the usual statement of efficiency (66%) will be correct.

5. If, however, the steam is used in a steam engine to generate power, differences of great moment will be observed. In such cases, which are far more frequent than the other, the loss of heat in the exhaust leaves but a small percentage available in the engine, and of this small proportion which should appear in useful work, a large part is lost in condensation in the cylinder, etc. With wet steam these losses are increased and with superheated steam they are largely decreased.

Numerous experiments are recorded which show a saving of 25% and upwards by the use of superheated steam (see Prof. Thurston's recent paper before the American Society of Mechanical Engineers), and while much has been written on the subject, no satisfactory explanation has been given, either of the cause of cylinder losses, or of the saving due to superheating.

I have given this subject considerable thought and have some experience and records which I may submit in the future as to the cause of cylinder losses, but for the present will only venture to give a reason(?) for the gain by superheating steam, as it bears directly upon the question of boiler efficiency.

Dry steam at 100 lbs. (gage) pressure, carries 1,184 units of heat per pound.

Steam at the same pressure superheated 20°, carries 1245. heat units per pound.*

Assuming feed water at 212° (in the boilers Nos. 2 and 3 referred to in paragraph 4), we would have for No. 2, 1184.—180=1004.; and for No. 3, 1245. — 180 = 1065, units of heat imparted (from the coal) to each pound of water, and an evaporation of 9660.÷1004.=9.62 lbs. of water per lb. of coal for boiler No. 2, and 9660. ÷ 1065. = 9.02 lbs. for boiler No. 3, or 6% more steam (in weight), from No. 2 than from No. 3. The initial volume of the steam would however be nearly the same, but we propose to neglect this item as inconsiderable.

If this steam is used in heating coils, the entire storage of heat (above 212°) is surrendered for useful work and no material economy of fuel is realized.

If the steam in either case is used in a non-condensing engine and expanded to atmosphere, it will still contain an average of 1,050 h. u. per lb. when exhausted, 180 of these units may be returned to the boiler in the feed water, which leaves 870 h. u. necessarily wasted out of each pound of either dry or superheated steam used. The amount of heat surrendered for use in the engine by each pound of the dry steam is, therefore, 1004. — 870 = 134 units; from the superheated steam it will be, 1065. — 870 = 185, showing an excess of 51 units or 38% more of available heat in each pound of the superheated steam. To be more exact we have 134 × 9.62 = 1289. units per pound of coal available through the dry steam and 185 × 9.06 = 1676. through the superheated steam, an excess of 30%.

The cylinder losses will be practically the same with each kind of steam, as will be seen from the subjoined analysis of Mr. Dixwell's experiment, and the result will be an economy of 30% or less by using the superheated steam, the entire credit for which should be given to the boiler.

We have reached the point where the value of superheated steam is well understood by our best engineers, though the cause of its superior efficiency may be still considered in doubt, and a real service will be done the art if a revision of our methods of determining boiler efficiency can be had.

Steam jackets are valuable for the same reason given above, i. e., they increase the available heat in the steam they use, but their value is largely destroyed by the moisture laden product of many of the boilers in use of late years. Jackets may be dispensed with if the steam is moderately superheated.

Compound and triple expansion engines require less of superheat in the initial steam than do single cylinders, the range of temperature being comparatively small, it is easy to deliver dry steam to the receiver, which, if properly jacketed with boiler steam, will superheat the steam for the lower cylinder and thus prevent condensation through the entire range of expansion.

The steam condensed in the receiver jacket surrenders 1245. — 308 = 937 units per pound, which if it is used to superheat dry steam, is all available in the low pressure cylinder; but if the steam comes to the receiver wet and the jacket serves only to re-evaporate entrained water, it will be of little value, for of the 937 units imparted, 870 will be lost in the exhaust, and it would be as well to send the extra steam through the cylinders.

Using a boiler that has 15 to 20% of its heating surfaces in the steam space and that makes uniformly superheated steam, but whose efficiency is not particularly high (as ordinarily expressed), I am able to predict and realize a large saving of fuel, and being properly designed with reference to the circulation of water and the proper cooling of the gases before reaching the superheating surfaces, this type of boiler is quite as durable as any other. Twenty years of personal experience in the use of superheating boilers justifies this statement

The test of a Corliss engine in the Institute of Technology of Massachusetts, made by Mr. George B. Dixwell (Proceedings of the Society of Arts, M. I. T., 1887, 1888), under the supervision of C. H. Loring, Chief Engineer U. S. N., and a board of naval experts, give the most complete data upon this interesting subject. The engine was run non-condensing and a calorimeter was used to measure accurately the amount of exhaust and the heat contained in it. The accompanying table shows the results:

Results of Tests to Determine Economy due to Superheating

No. of test.	Kind of steam used.	Pressure by gage.	Deg's of superheat.	Duration of experiment (mins.)	Point of cut-off.	H.P. Developed.	Water per H.P. developed.	Heat units in the exhaust.	Per cent of gain.
1.	Saturated	...50.4	....	137	.217	7.65	48.2	1046.	..
2.	"	...50.2	....	83	.443	12.7	42.2	1084.5	..
3.	"	...50.3	....	63	.689	15.68	45.3	1101.4	..
4.	Superheated	50.4	179°	180	.218	6.83	35.2	1138.6	27%
5.	"	50.	142°	108	.439	12.37	31.7	*1159.4	25%
6.	"	50.2	107°	75	.672	15.63	35.8	*1170.8	21%

*In experiments 5 and 6 the thermometer showed no sensible superheat in the exhaust steam. Steam at atmosphere superheated 1° or less (by thermometer), carries 29.3 units in excess of saturated steam.

The most economical use is made of superheated steam when the exhaust carries about 1,100 units of heat, for in such a case the adiabatic condensation is available and no water accumulates in the cylinder.

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*The total heat of superheated steam is found by the formula ($H = 1074.6 + .48\ T$), in which T is the observed temperature of the steam. This formula was constructed by Prof. Rankine and its correctness theoretically demonstrated. Later experimental evidences also confirm it, Mr. D. K. Clark confirms it and the experiments of Mr. Dixwell which are here cited most clearly demonstrate it. The Dixwell experiment also shows that the provisional formula, $H = H_1 + .48\ (T - T_1)$ which is used by some engineers is certainly wrong, for in this formula H_1 is the total heat of saturated steam at the observed pressure, T_1 is its temperature and T the observed temperature of the superheated steam, and if we apply it to experiment No. 6 we find the total heat to be, $1172.7 + .48\ (406 - 298) = 1224.5$, from which take the heat found in the exhaust, (1170.8) and we have 53.7 units used in the engine per pound of steam, and since 35.8 lbs. were used per horse power per hour, we get, (53.7×35.8) equals 1922.4 h. u. per hour, or 32 h. u. per minute, used to generate 33,000 ft.-lbs., whereas we know that 42.7 are necessary. In short, if this formula is correct, this engine was delivering (in power and to the exhaust) more heat than it was receiving from the boiler, which is of course absurd.

It is, therefore, apparent from Mr. Dixwell's table, that in all the experiments with superheated steam the point of cut-off was too late to use the steam to the best advantage, especially so in Nos. 5 and 6, where the exhaust was superheated 12 and 24 units respectively. The decrease in the per cent. of savings was due to this cause, and if the point of cut-off had been properly adjusted in each case, the saving would have been greater and the per centage more even. Of course this could only be done by sacrificing power.

The advantage in using superheated steam lies entirely in the fact, that it carries a larger proportion of available heat and may surrender what is required to maintain the heat in the pipes and cylinder without losing its elasticity.

The accompanying analysis of Mr. Dixwell's experiment is given to show more clearly how the small number of extra heat units in the superheated steam (as compared to the total), becomes of so great importance when compared to the available heat.

Analysis of Mr. Dixwell's Experiments.

Number of experiment	1	4	2	5	3	6
Power developed, HP	7.65	6.83	12.7	12.37	15.68	15.63
Quality of steam	Saturated	Superheated	Saturated	Superheated	Saturated	Superheated
Gage pressure of steam	50.4 lbs.	50.4 bs.	50.2 lbs.	50. lbs.	50.2 lbs.	50.3 lbs.
Point of cut-off, part of stroke	.217	.218	.443	.439	.689	.672
Temperature of steam	298.°	478.°	298.°	441.°	298.°	406.°
*Total heat in live steam, per lb., B. T. U.	1172.77	1304.	1172.77	1286.28	1172.77	1279.4
Total heat in exhaust steam, per lb. “	1046.	1138.6	1084.5	1159.4	1101.4	1170.8
Consumed in engine per lb. of steam “	126.7	165.4	88.2	126.0	71.3	108.6
Steam used per HP. per hour, lbs	48.2	35.2	42.2	31.7	45.3	35.8
Heat consumed per hour per HP., B. T. U.	6106.9	5822.	3724.9	4019.56	3229.9	3887.
Heat consumed per minute per HP. “	101.2	97.	62.	66.8	53.8	64.7
Equivalent energy in ft.-lbs., per minute	77972.	74884.	47864.	51569.	41533.	49938.
Converted into power ft.-lbs. per minute	33000.	33000.	33000.	33000.	33000.	33000.
Lost from cylinder condensation, etc., ft.-lbs.	44972.	41884.	14864.	18569.	8533.	16938.
Per cent. of waste in cylinder	55.%	53.%	31.%	36.%	20.%	33.%
Steam saved per HP. per hour, lbs	....	13.	...	10.5	...	9.5
Per cent. of saving	....	27.	...	25.%	...	21.%

*The total heat of the superheated steam is found by the formula of D. K. Clark: $H = 1074.6 + .48\,T$, in which T is the temperature of the steam.

Comparing Nos. 1 and 4, we find that the heat consumed per minute, per horse power, was practically the same, and that the losses in the cylinder were also very nearly the same with each kind of steam and that the actual saving was in proportion to the amount of heat consumed per pound of steam used. (A confirmation of the correctness of the formula $H = 1074.6 + .48\,T$.

It follows clearly, from the foregoing, that of the heat applied to the water surfaces of a boiler to generate steam not more than 12% can be used in the engine (single cylinder, non-condensing), and that ALL the heat imparted to the steam after it is generated can be used in the engine, and that therefore a heat unit in superheat is eight times as valuable in an engine as a heat unit in dry steam.

It is also clear that it does not pay to superheat beyond what is required to prevent condensation in the cylinder; and finally that of two boilers having the same apparent efficiency, the one that furnishes moderately superheated steam will be far superior to the other if it furnish simply dry steam.

Wm. H. Berry, Consulting Engineer.

Chester, Pa., June 24, 1896.

Notes and Queries.

The present address is desired of Mr. F. D. Lyphart, C. E., lately at 15 East 7th St., Cincinnati.

THE LEGAL DUTIES OF ENGINEERS AND ARCHITECTS.*

It would be difficult to exaggerate the importance of the duties and functions of architects and engineers. In the practice of their professions, technical skill and learning, good judgment and honesty are necessarily required. No science, that I know of, is more difficult to master, or requires, in practice, a higher order of ability, than those of architecture and civil engineering.

If a man holds himself out to the world as an architect, he is presumed to be qualified in every proper sense. His client necessarily relies on his skill. If, therefore, he should be wanting in skill, and, in consequence, his client suffers injury, he would be liable. The relation between the architect and his employer is similar to that of lawyer and client, or of physician and patient. The professional man who is employed, as such, by another, must bring to the task he has engaged to execute, all the skill and learning necessary to do it. It would be a gross fraud and great injustice to permit an architect or engineer, who had been employed by another, confiding in his skill, to escape the consequences of his own ignorance and unskilfulness. The rule rests upon the broadest principles of equity.

Besides learning and skill, an essential quality in an architect or engineer is honesty. The law requires the observance of the utmost good faith on the part of the architect to his client. An unfaithful architect could easily bring upon his client ruin and disaster, without the ability on the part of the latter to avert it. One of the commonest rules of the law of principle and agent is, that a man shall not serve two masters. It has sometimes happened that architects and engineers have undertaken to serve the man who employed them to design and supentend the construction, and at the same time have taken a fee from the contractor. Such conduct is reprehensible, both in morals and in law. One of the consequences of the violation of this rule is, that the architect is not permitted to claim compensation for his services, however meritorious, from either party. The law forfeits his compensation as a just penalty for his unfaithfulness.

An architect, while bound to observe the best faith to his employer, the builder, is bound to treat the contractor fairly. He cannot exercise his power so as to wrong or defraud the contractor. Thus, where, by the building contract, the architect or engineer is made the arbitrator of differences between the proprietor and the contractor, his position is that of a judge, bound to act with impartiality; and if he should make an agreement with the proprietor to give him the advantage in his decision, such agreement would be illegal, and his decision or award would be void. Where the architect is made an arbitrator, he ceases to be the agent of either party, and his decision must be made in a spirit of fairness, and without regard to his former relations.

Where the architect or engineer is employed by the proprietor or projector to superintend a proposed work, the relation of principal and agent is established. It oftentimes becomes a matter of importance to define the limits of the agent's authority and to what extent he may bind his principal.

The general rule is, that in the absence of stipulations to the contrary the authority of the architect will be determined by the character of the work, and the objects intended to be accomplished.

One limitation upon the power of an architect or engineer seems to be without exception. Where it is not expressly permitted, he cannot delegate his authority to another. The position of an architect or engineer is one involving special trust and confidence in his skill and honesty, and if he were permitted to assign his duties or substitute another in his place, injustice and wrong would often be done his employer.

An architect transcending his authority makes himself personally liable to the contractor. He is presumed to know the extent of his powers better than the contractor, and if the latter does work at the instance of the architect, which he had no authority to order, he will be personally liable.

It becomes the duty of the architect and engineer, during the progress of the work, to issue to the contractor what are known as progress certificates, and, when the work is completed, to issue final certificates. These certificates are evidences to the owner of the progress of the work and of the right of the contractor of payment. Most contracts provide that payment shall be made only on the certificate of the architect or engineer, and the issuance of the certificate thus becomes a condition precedent to payment. The certificate, when issued, is binding on both the owner and the contractor, and unless it can be shown that the architect acted fraudulently or corruptly neither party can complain. The decisions have gone to the extent that, where the certificate is made a condition precedent to payment, the contractor cannot maintain a suit unless he produces a certificate. Of course, where the certificate is corruptly and unreasonably withheld, the contractor may, upon averring that fact, bring suit. And the architect may make himself personally liable by capriciously and wrongfully withholding the certificate.

A usual stipulation in contracts is that the work shall be completed on or before a certain time. Accompanying the stipulation as to time there is usually, and ought to be, a stipulation subjecting the contractor to the payment of a certain sum as liquidated damages, in case of failure. Such provisions are wise, because they act as a spur on the contractor. The propriety of fixing an amount as liquidated damages in case of default is apparent, when you remember that unless the damages are agreed on, they can hardly be settled without litigation. Where a certain amount is agreed on in the contract as liquidated damages, there is no room for controversy. Such provisions have been uniformly sustained by the courts.

Where the contract is silent as to the time of performance, the law infers that a reasonable time is meant.

The stipulation as to time in a contract may be extended or waived, and such waiver or extension may be in parol—that is, not in writing.

It is a general rule that a building contract cannot be specifically enforced; that is to say, the contractor cannot be compelled, against his will, to perform or complete, nor can the other party be required to permit the contractor to do the work. If the parties choose to disregard the contract, they may do so, but at the risk of being called upon to pay damages.

The question that has given architects most trouble, and occasioned most controversy and litigation, is extras. It is a common saying that a house usually costs double the contract price, because of extras. Dearly bought experience has caused the insertion in most building contracts of special stipulations to avoid them. The usual provision is, that no alterations or additions shall be made without the consent of the owner. Sometimes it is provided that the consent shall be in writing. The architects are sometimes hedged about with very stringent restrictions; a common provision is that no addition or extra shall be made or allowed by the architect. When he is authorized to do so, it is usually provided that the architect shall agree to it in writing. The owner may, of course, waive the stipulation forbidding extras, and he may do it as he pleases, either in parol or in writing. But the architect has no such authority, except with the consent of the owner. If he should waive it, the owner would not be liable for the extras, and the architect might be liable in damages to the contractor, for authorizing them.

The builder is bound to scrupulously follow the specifications, and cannot justify a departure therefrom by substituting other details, although as good as those called for. He is as firmly bound by the terms of the specifications, as by the covenants of the contract—for they are, in fact, a part of the contract. Nor can the architect change them, except by special authority from the owner. Where there is obscurity in the drawings and specifications, the contractor must apply to the architect for directions, or he undertakes the work at his own peril.

Where, however, the work has been performed in full compliance with the specifications, no responsibility will attach to the builder if the structure falls, or is practically worthless owing to defectiveness and insufficiency of the plans and specifications. It is the contractor's duty faithfully to execute the work for which he has been engaged, and he is not responsible if the undertaking is valueless, nor is he liable for any defect in the building caused by defectiveness in the plans furnished him by the owner. So far as the plans are adopted by the owner, they become his, and he is responsible for claims accruing to the contractor or others for defect in the plans.

I have diverted to the question of damages. It may not be improper to note a distinction on this subject which, perhaps, is not known to all of you. Although the parties to the contract have a perfect right to determine, beforehand, what shall be the damages which shall be paid to the other by the one who violates it, the law does not enforce such agreements when they amount to the imposition of a penalty or forfeiture. Where the amount stated to be paid for a breach of the contract is evidently what the parties assess as the damage caused thereby, the stipulation will be upheld as liquidated damages; but where the object is to secure its performance by the imposition of an amount in excess of the loss likely to be sustained, it will be considered a penalty, and will not be enforced.

The distinction between liquidated damages and penalties attached to contracts for the breach of same, is not always easily drawn. The following rules have been deduced from the decisions of the courts on that question, viz.:

Where the sum fixed as liquidated damages is manifestly above the injury sustained, it will be held to be a penalty, and only actual damage can be recovered.

Where the contract is for a matter of uncertain value, and a sum is fixed to be paid on the breach of it, the sum is recoverable as liquidated damages.

Where the payment of the money appears to have been intended only to secure the performance of the contract, it will be construed as a penalty.

Where a contract contains a number of conditions, and the penalty is applied to only one of them, it is not recoverable as liquidated damages.

Forfeitures are abhorred, especially in courts of equity, and will not be enforced. The object of the courts is to make the parties whole, and where that is accomplished the ends of justice have been met. Hence, it is difficult, in any case, to recover, upon a breach of the contract, more than the parties have been actually damaged.

It is frequently the case—indeed, it may be stated that it is generally so—that security is required of a contractor for the faithful performance of the work. The general rules of law relating to suretyship appertain to cases arising under building contracts. Where a surety guarantees that the builder will execute his contract to the satisfaction of the employer, and the contract is materially altered without the surety's consent, he will be discharged, whether the change or variation in the contract is prejudicial to him or not. The reason is that a new contract has been entered into without his consent. The same thing is true if the time of performance is increased without his consent.

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*Condensed from an address delivered before the Engineering Association of the South by Hon. Jas. C. Bradford, Nashville, Tenn.

Where, by a contract, the surety guarantees the performance of the building agreement, which was to be paid for in installments, and the owner paid the installments before they were due, it was held that this act discharged the surety. So also, where the owner failed to insure the property, as agreed. So also, where he made larger advances to the builder than contracted for.

It may be stated, as a general rule, that the surety is discharged whenever the owner and the builder change, in any respects, the terms of the contract. It is, therefore, important that the contract should always be strictly followed and observed, and an architect or engineer should be scrupulously exact in his construction of contracts and in the enforcement of their execution; because, as the agent of the owner, he may, by some act on his part, discharge the surety and thus materially damage his principal.

Of course many intricate questions must necessarily arise which it would be impossible for an architect or engineer to decide. Even the application of old and well-settled principles becomes frequently very difficult. In such cases, the best advice I can give you is that you should advise your clients to apply to another worthy class of professional men for advice, viz., the lawyers.

In conclusion I beg to add a few words upon the character of your professions, and the necessity of promoting and maintaining a high standard of education and ethics. The arts of architecture and engineering have been associated with some of the noblest achievements of the human race. In both we find the evidences of man's progress from a savage condition to a high state of civilization and culture. Like the other arts, architecture did not spring into existence at an early period of man's history. The idea of symmetry and proportion, which were afterwards embodied in material structures, could not be evolved until at least a moderate degree of civilization had been attained, while the efforts of primitive man in the construction of dwellings must have been at first determined solely by his physical wants. Only after these had been provided for, and materials amassed on which his imagination might exercise itself, would he begin to plan and erect structures possessing not only utility but also grandeur and beauty.

It is only by a thorough study of the history and the techniques of their arts that the architect and engineer can achieve rank and distinction, or even such knowledge and skill as will enable them to perform successfully the ordinary calls that are made upon them. Thorough training is not only important to the architect himself, but to the public as well.

No less important than knowledge and skill is a high standard of morals. Every profession ought to have an ethical code of a high order for its government. I doubt not that with you it is so.

THE ADOPTED PLANS FOR THE NEW EAST RIVER BRIDGE.

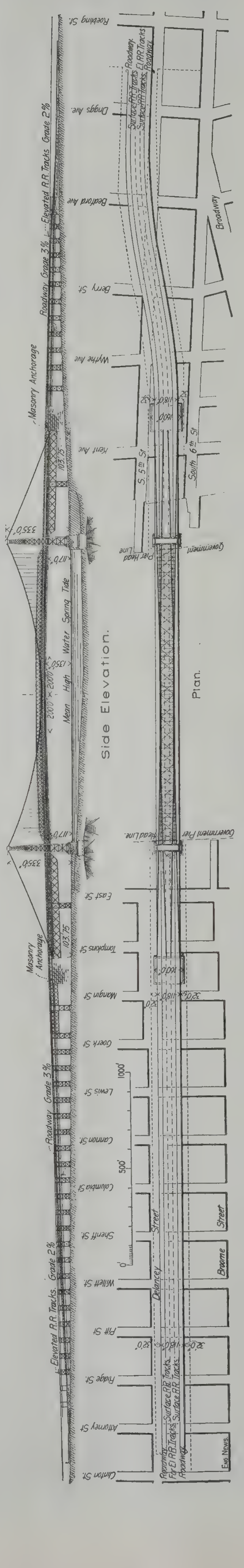
We show in the accompanying drawings a plan, elevation and sections of the new East River Bridge, which have just been officially adopted by the Commission in charge of the work. It is, perhaps, not generally realized that this bridge will have the longest span of any bridge in the world save the Forth Bridge. It will be the longest suspension bridge in the world, exceeding the present East River Bridge, however, by only 4 ft. 6 ins. The new East River Bridge will be 1,600 ft. from centre to centre of towers. The present bridge is 1,595 ft. 6 ins. measured from the same points. The other principal dimensions of the new structure will be as follows:

Length of entire bridge, between terminals	7,200 ft.
Width of bridge, outside to outside of carriageways	118 "
Minimum height of bridge above mean high water of spring tides at pier-head lines	117 "
Minimum height of bridge above mean high water of spring tides for 200 ft. on each side of centre of main span	135 "
Height of masonry in tower foundation above high water	20 "
Height of centre of cables at top of towers above high water	335 "
Width of carriageways, each	18 "
Width of 2 footwalks, each	12 "
Width of 4 trolley car tracks, centre to centre	10 "
Width of 2 elevated railroad tracks, c. to c.	12 "
Two stiffening trusses between towers, distance apart from centre to centre	72 "
Grade of approaches	3%
Grade of elevated railroad tracks	2%

The new structure will have towers of masonry from the foundation to a point 20 ft. above high-water. The towers above this point and the entire suspended structure, except the flooring, will be of steel. The cables will be of straight steel wires, No. 6 B. W. G. The shore spans and approach viaducts from the end of the suspended structure to Bedford Ave., in Brooklyn, and to Ridge St., in New York, will be of steel, and the remainder of the viaduct approaches will be of masonry.

The cables are to be four in number, and 17½ ins. in diameter, each made up of 19 strands. The borings thus far made show that rock foundations will be found at from 70 to 100 ft. below high-water mark. The total height of the towers above high-water mark will be 336 ft.

As most of our readers will remember, Mr. L. L. Buck, M. Am. Soc. C. E., is the Engineer-in-Charge of the work and Mr. O. F. Nichols, M. Am. Soc. C. E., is his principal assistant. The Commission under whose authority the work is being carried on consists of Col. Andrew D. Baird, Salem H. Wales, F. B. Thurber, Richard Deeves, Henry Batterman and James H. Sperry, with Mayor William L. Strong, of New York, and Mayor Frederick W. Wurster, of Brooklyn, as ex-officio members.



THE ADOPTED PLANS FOR THE NEW EAST RIVER BRIDGE.

Leffert L. Buck, M. Am. Soc. C. E., Chief Engineer, Othniel F. Nichols, M. Am. Soc. C. E., Principal Assistant Engineer.

FLOWAGE TEST OF A 14-IN. RIVETED STEEL MAIN AT NEW WESTMINSTER, B. C.

By A. McL. Hawks.

The following excerpt from a report to the City Council of New Westminster, B. C., upon the test of the 14-in. riveted steel supply main forming a part of the water-works system of that city may be useful in view of the small amount of information available regarding the actual delivery of steel mains.

Before giving the results of the test a short description of the main itself will be necessary for a thorough understanding of the subject. The water supply to the city of New Westminster was constructed in 1892, under the direction of Mr. Arthur Hill, M. Inst. C. E., chief engineer. The headworks on the Coquitlam River are simply a perforated length of pipe laid in the bed of the river; about 300 ft. of pipe leads into a cast-iron circular well or gate chamber in which are situated the screens; thence the supply main extends for 70,700 ft. to a reservoir on the hill above the city. The top of the supply main at the screen chamber is at elevation 424.8 ft. (city datum); the bottom of the reservior is at elevation 385 ft.

The supply main is of soft steel, 14 ins. clear diameter of the smaller ring, with double riveted longitudinal seams and single riveted circumferential seams. The double riveting is spaced about ¾-in. between rows, 1 in. between heads, and staggered. The circumferential rivets are ¾-in. c. to c. upon the exterior surface, or about ½ on the interior surface, varying slightly with the gage of steel, which runs from No. 9 to No. 12. All rivet heads are circular or "snap heads," and as the rivets are of ¼-in. diameter the heads form almost a complete ring upon the interior of the pipe and practically reduce the clear opening about ¼-in. Seven rings of steel plate, four of the greater and three of the lesser diameter, formed a length of pipe of 24 ft., as made up in the shop. One end was reinforced by a welded steel plate ring 5 ins. wide and 14 ins. clear diameter, the end lengths of the pipe being of the greater diameter and the rivets near the outer ends being practically countersunk. In making up the pipe the longitudinal seams were "in line" in alternate rings and quartering one another in adjoining rings. All lengths were dipped and very thoroughly coated in an asphaltum bath; and all were thoroughly tested before leaving the shop.

The mode of laying was as follows: The pipe was placed in the trench with the longitudinal seams underneath, forming angles of 45° with the vertical plane; the reinforcing ring in the end of one length, which projected about half its width from the pipe length, would be forced into the next until the pipes were practically in contact; an exterior, welded ring of heavy plate about ⅝-in. thick and 5 ins. wide, which had previously been slipped over one end, would be pushed forward to cover the joint; and a calked lead joint would complete the laying.

From the foregoing it will be seen that the obstructions to flow through the pipe would consist of: (1) the double line of longitudinal rive heads along the lower quarters of the pipe; (2 the circle of rivets making the transverse joints about 3½ ft. apart; (3) the lap of the outer over the inner ring at these transverse joints; (4) the reinforcing ring at the end joints, 24 ft. apart.

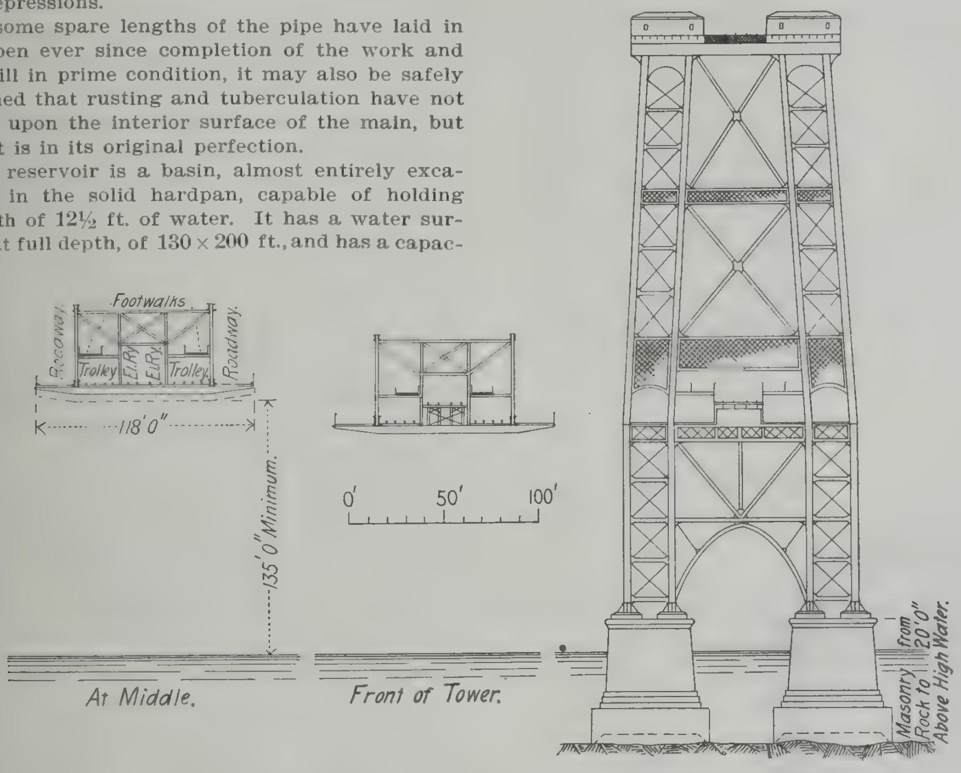
The profile of the pipe line is fairly smooth, long stretches running on benches with easy grades. There are four principal summits and five principal depressions between the intake and the reservoir; two of the summits approach hydraulic grade line, and two of the depressions are at or near zero of the datum plane. In only two places are the changes of grade abrupt. Along the line all the summits are provided with automatic air valves, and all depressions are fitted with blow-off gates.

The alinement is very easy, no quick bends occurring in the whole length. The only places requiring sharp curvature are in streets approaching the reservoir, where the 90° curves are made in six 15° cast-iron pipe lengths. For the above reasons all calculations may be made without any account being taken of friction from bends.

The pipe line is patrolled daily, and all air valves and blow-offs frequently inspected and tested, so it may be assumed that there are no "air spaces" at the summits and no mud deposits in the depressions.

As some spare lengths of the pipe have laid in the open ever since completion of the work and are still in prime condition, it may also be safely assumed that rusting and tuberculation have not set in upon the interior surface of the main, but that it is in its original perfection.

The reservoir is a basin, almost entirely excavated in the solid hardpan, capable of holding a depth of 12½ ft. of water. It has a water surface, at full depth, of 130 × 200 ft., and has a capacity of about 220,000 cu. ft. or 1,725,000 gallons. At a height of 10 ft. is a berm, which is paved with broken rock of small size, as is also the slope from the berm to the bottom of the reservoir; above the berm is a paving of large broken rock laid dry, extending to the top of the bank.



Cross Sections of Span.

Elevation of Tower.

CROSS SECTIONS OF NEW EAST RIVER BRIDGE.

In one corner of the embankment stands a rectangular wrought iron well, 3.1 × 4.2 ft. inside measurement, into which a 14-in. pipe leads from the reservoir; and out of which a 6-in. cast-iron pipe leads to a box drain. A partition divides this well into two compartments, the one on the inflow side (which contains the gage, zero of which coincides with the bottom of the reservoir) being 2.8 × 3.1 ft., and the one on the outflow side being 1.3 × 3.1 ft. At elevation 11½ ft. on the gage is the bottom of a rectangular notch in the partition, which is for the purpose of regulating the overflow of waste water. This notch is in a sheet of No. 8 steel and is 15 ins. wide in the clear. Although not designed for the purpose, it served admirably as a weir over which to measure the whole volume of water delivered by the supply main.

The following regarding the test is extracted from my report to the City Council of New Westminster, dated April 14, 1896:

> On April 2 I visited the intake and headworks on the Coquitlam, going over that portion of the line between the junction and the intake. The depth of water in the screen chamber was taken at 7.98 ft., which would make the surface of water 429.15 ft. above datum. As you will see from calculations given later on, it takes about 24 hours for water to flow from the intake to the reservoir. So I assumed that no considerable variation took place between the hour upon which we observed the height of water on the afternoon of April 2 and the evening of April 3, when we tested the flow. No storms had occurred and no considerable variation of temperature to affect the melting of snow upon the mountains. With the lake and the river near the normal stage, I deem such assumption to have been safe. As a change of 1 ft. would only vary the hydraulic grade by .000,014, and the probable change was 0.1 ft. or less, it may be disregarded.
>
> On the evening of April 3 the actual tests of flow were made. The square notch of plate iron in the overflow well situated at the corner of the reservoir, was used as a weir for the tests. It is admirably suited for such purposes, as it has the prerequisites of being a thin plate with square corners and level along the lower edge; and having a clear opening over three times the head upon the weir; and furthermore the clear outfall is more than half the head of water on the weir; the distance from the side of the weir to the side wall of the chamber is more than equal to the head; and the depth from the lip of the weir to the bottom of the chamber is more than twice the head. All these conditions being fulfilled the "Francis" formula for discharge over thin plates.
>
> $$D=3.36\times(l-1\text{-}5\,h)\times\sqrt{h^3}.$$
>
> l being the length of the weir in feet and h being the head of water over the weir, measured on the gage, was used and the results are derived therefrom.
>
> Preparation was made for the test by drawing the reservoir down until there was about 4 ins. over the weir, which was approximately the least possible discharge which could be expected. The supply to the city was then cut off and the total inflow allowed to waste over the weir. As was expected, the head on the weir increased slowly, but an unexpected factor entered into the problem, which delayed matters for some time. Screens of small mesh wires had been placed over both the inner, or reservoir, and outer, or overflow well ends of the 14-in. cast iron pipe at time of construction. These retarded the flow to such an extent that where little or no difference in level between the surface of water in the reservoir and well had been anticipated there was an actual variation of over 0.08 ft., or about 1 in. The balancing of levels was uncommon and worthy of note. First the water in the well would remain stationary for a few minutes and that in the reservoir would slowly rise; then in the well it would rise ⅛-in. very quickly; again it would remain stationary in the well and rise once more in the reservoir; then in the well rise another ⅛-in.; and this process continued for about two hours. At the end of this time it remained stationary at a depth of 4⅝ ins. for a period of 15 minutes. To determine that this was full depth the weir was closed for ten minutes and the reservoir allowed to fill; then the weir was again allowed to flow freely and the surface of water slowly sank to the former depth.
>
> As the surroundings were so favorable, permission was sought and granted to make another test. Upon the following evening the city supply was again shut off and the full inflow allowed to accumulate in the reservoir. A careful reading with hook gage was taken about ten minutes after the supply to the city was cut off; intermediates were taken by eye on the gage in the well every 15 minutes; and a final hook gage reading made at the end of 2½ hours. The water was then entirely shut off from the reservoir and it was allowed to stand until morning to ascertain if there was any leakage to be allowed for during the tests, the supply to the city being furnished through the 6-in. cut off. No leakage was found, the gage reading the same as when left at night.
>
> The elevation of water as observed at the screen chamber on April 2 was 429.15 ft. above datum; the surface of water in the reservoir on April 3 at the time of the weir test was 396.95 above datum; which would make the grade in your main 32.2 ft., or a hydraulic gradient of 0.000,455, or .455 ft. per 1,000, giving by "Kutter" a velocity of 0.84 ft. per sec.
>
> The reading over the weir was 4⅝ ins., or 0.39 ft., which gives a discharge of 0.96 cu. ft. per sec.
>
> The test by filling the reservoir gives a volume of about 8,900 cu. ft. for a period of 9,000 seconds, or a rate of 0.99 cu. ft. per sec. As these two results agree with less than 3% they may be taken as reasonably accurate.

The raising of the water 0.35 ft. in the reservoir over an area of 25,225 ft., gave a volume of 8,829 cu. ft. to which was added 65 cu. ft. for the filling of voids in the slope paving.

From the foregoing it will be seen that the two methods of testing the flow through the main checked very well, and give a good foundation for computing the flow through a small main at low velocity.

If, in "Kutter's formula," a coefficient n, be taken at .015, then the equation

$$V = c\sqrt{RS},\ \text{becomes}\ V = 73\sqrt{.292\times.000{,}455},$$

or,

$$V = 73\times.0115 = .8395\ \text{ft. per sec.}$$
$$\text{Discharge} = 1.069\times.8395. = .897\ \text{cu. ft. per sec.}$$

This is less than the weir discharge calculated, by 6%; and less than the rate found by filling the reservoir, by nearly 10%. It would show that the coefficient, n = .015, was very near the truth for this particular case. A part of the difference between this last result and the former ones is explained by the fact that in constructing the pipe an attempt was made to compensate for the rivet heads by making the smallest rings a slight fraction of an inch larger than 14 ins. In the lighter metal this difference is about ⅛-in., and in the heavier, about half of that. As a considerable portion of the pipe is under light head this allowance may mean an increase of several per cent. (3 to 5) over the calculated flow.

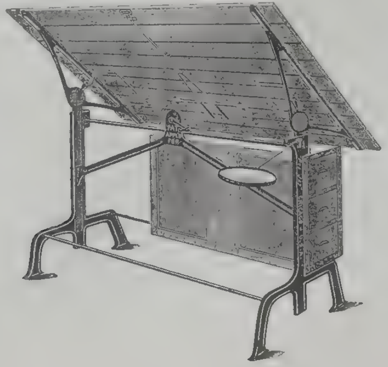
These experiments were not made in an ultra-refined manner, but were such as can be carried on at small expense and in ordinary practice. Neither was there time or money for making the test extremely accurate. It was only desired that the city know its supply with reasonable accuracy and as quickly as possible.

The tests show that it is unsafe to calculate on a coefficient of friction of less than .015, even for small mains at low velocity. Later experiments may determine (as outlined by Rudolph Hering, C. E., in Engineering News of Jan. 23, 1896,) that 0.16 is more nearly true. But for the present nothing less than .015 should be used for riveted steel mains having protruding rivet heads on the interior surface of the pipe.

* * *

THE PEN-JAY ADJUSTABLE DRAWING TABLE.

We illustrate herewith an adjustable drawing table which has been put on the market recently by Post & Jacoby, of Chicago, and which is claimed to be especially easy to adjust and unusually firm and rigid in position for an adjustable table. The illustration shows an underneath view. To raise and lower the table it is only necessary to turn the small crank shown. By means of a continuous screw this crank revolves the horizontal shaft carrying pinions at its end which gear into and operate the rack attached to the uprights which carry the top of the table. The inclination of the table is adjusted by means of clamps operated by the handle shown just underneath the front edge. A pull on the handle loosens the clamps, which fly back into position as soon as the table is brought to the position desired and the handle released. The illustration shows clearly the cabinet, which is of polished hard wood. This table is put on the market in four sizes, ranging from 31 × 42 ins. to 48 × 72 ins., and these two sizes cost, respectively, $20 and $42. A number of these tables are used in the engineers' offices of the Sanitary District, of Chicago, and have proved very satisfactory.



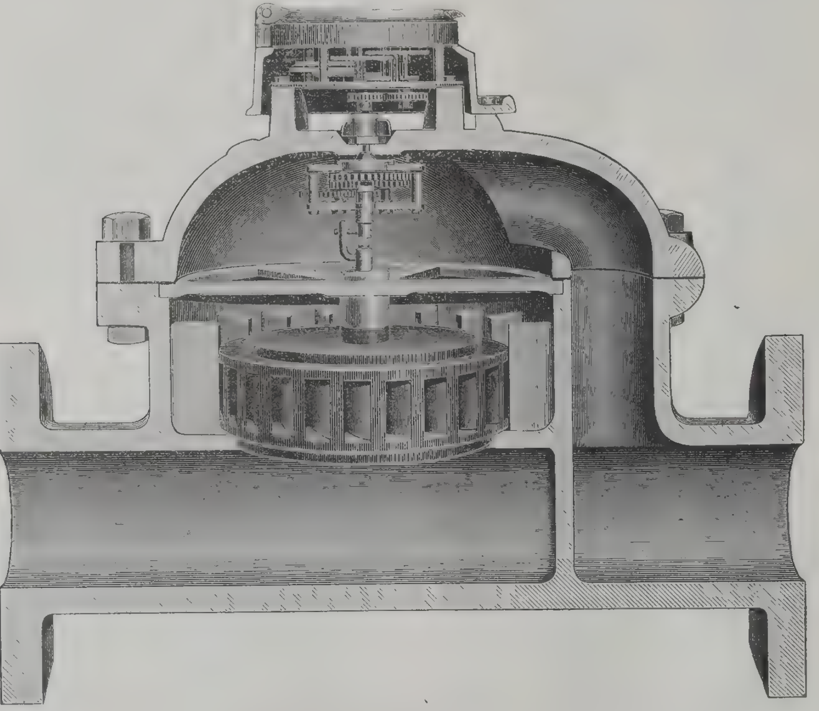
View of Underside of "Pen-Jay" Drawing Table, Showing Adjusting Mechanism.

Post & Jacoby, Chicago, Ill., Builders.

THE TORRENT WATER METER.

The increasing favor with which water meters are being received is stimulating manufacturers and inventors to attempt improvements to old forms, and to devise new ones. One of the latest candidates for favor among water-works officials is known as the Torrent meter, and is shown by the accompanying cut.

This meter is designed to record large volumes of flow with very slight loss of pressure. It is a current meter, with a horizontal wheel piston, running between directing and receiving vanes. The piston subdivides the current into small jets, which pass through it in horizontal lines, thus obviating vertical thrust on the bearings. The meter is made by the Hersey Manufacturing Co., of South Boston, Mass.



THE TORRENT WATER METER.

THE POETSCH FREEZING PROCESS FOR SHAFT-SINKING AT VICQ, BELGIUM.

In its "Abstracts of Papers" the Institution of Civil Engineers publishes an interesting account of a recent application of the Poetsch freezing process to the sinking of a shaft through nearly 300 ft. of water-bearing ground. The Anzin Mining Co. proposed to open a new mine at Vicq, in the valley of the Scheldt. The ground overlying the coal deposit was of a loose and water-bearing nature, and in sinking neighboring pits the outlay had amounted to $1,100 per yd. of depth, and a long time was required for completion.

A preliminary boring, made in 1892, gave the following section of materials to be penetrated:

	Ft.
Fine sand and alluvial gravel	22.14
Compact argillaceous sandstone	13.12
Chalk, loose and incoherent	65.44
Chalk, compact	138.74
Chalk, marl, with flints	59.04
Blue marls	82.00
Plastic clay	190.24
Green sand	44.75
Coal measures marked at	615.49

These measures were all water-bearing down to 298½ ft. below the surface, when a secure foundation for tubbing could be found in the blue marl under the flinty chalk. Flowing springs were found at two levels; one in the sandstone, of 2,700 gallons per hour, and one in the loose upper chalk; the latter being under pressure, rising 2½ ft. above the surface and flowing.

To provide the feed and condensed water for the freezing plant, an estimated demand of 3,500 gallons per hour, a well was sunk at a distance of 820 ft. from the site of the shaft. This well, though only 6½ ft. in diameter and 39 ft. deep, cost $2,000; the last 15 ft. being bored while the upper part was secured by an iron cylinder with a cutting edge.

Two pits of unequal size were to be sunk; one, 12 ft. in diameter, was intended for the pumping, ventilating and passenger hoists, and the other, 16.4 ft. in diameter, was to be fitted with eight tubs capable of raising 300,000 tons of coal per annum. The first thing done was to bore 36 holes for the reception of the circulating pipes; 20 of these were arranged around the larger pit in a circle 21.3 ft. in diameter, and 16 around the smaller pit in a circle 16.73 ft. in diameter. They were all of the same depth, or 298½ ft., and the two pits were 121 ft. apart. All springs encountered were trapped to prevent a circulation of water through the ground.

The freezing circuits, the most important element of the plant, were made of steel pipes, arranged in series; one, 1.17 in. in diameter and 0.156 in. thick, being placed concentrically inside another, 4½ ins. in diameter and 0.273 in. thick. Each series was connected by a goose-neck to its own ring-main, and the freezing fluid was passed down the inner pipe and returned through the outer one back to the refrigerator. Extreme care was taken in making and testing these tubes. The ring-mains were 7.8 in. in diameter; and the cold fluid moved at a speed of 4 ins. per second in the small tubes and 4.43 ft. per second in the larger pipes. The calculations by the engineer called for the abstraction of 110,000,000 calories from the ground about the larger pit, and 90,000,000 from about the smaller one; or, allowing 25% for losses, about 250,000,000 calories as the total heat to be removed. The time required to freeze the ground was estimated at 1,000 hours, or about 40 days.

The Linde freezing machinery was used. The calcium chloride solution in circulation measured 16,380 gallons and contained 25 tons of the dry salt, costing $30 per ton and the density of the solution was 1.25. The progress of the freezing operation was watched by sinking a series of thermometers 6½ ft. deep and about 3 ft. 3 ins. outside the ring of freezing tubes.

The freezing machine was started with one compressor on May 28, 1894, the ground temperature then being 11.65° C., and the cold developed being represented by 285,000 h. u. per hour. The next day the temperature had fallen to −47° C. in the refrigerator and to −1° in the return pipe; a second cylinder was then started, which reduced the temperature of the solution to −7°, and to −4° on the third day, when the third compressor was started. In 10 days more −10.6° was obtained in the cold solution, and then the whole four compressors were worked from June 12 to July 1, when the temperature was −15° C. in the supply pipes and the freezing of No. 2 pit was complete. Until July 17, only two compressors were now used, and on this date the initial freezing operation was considered finished and the ice-walls were maintained by working three compressors until Sept. 2 and two until Dec. 1, when the machine was stopped during the day and on Sundays and holidays. On Dec. 28 its use was discontinued, after working 7 months with 76½ hours stoppage in that time. The thermal equivalents of the work done in this period is shown in the following table:

	Calories.	
Heat absorbed in:	Pit No. 2.	Pit No. 1.
Formation of ice	43,040,000	70,075,200
Cooling ground, outside circuits	16,825,615	28,285,845
Cooling ground, inside circuits	14,473,982	22 917 860
Cooling work utilized	74,339,597	121,278,905
Surface losses	25,574,640	32,793,936
	99,914,237	154,072,841
Work done by engines:		
May 28 to July 2	100,379,694	....
May 28 to July 16	....	161,354,901

Sinking was commenced in the smaller pit on July 2, and in the larger on July 16, the grounds then being frozen in a ring 4 ft. thick, extending 18 ins. outward from the freezing center and 30 ins. inward in one case and 22 ins. and 40 ins. in the second case. By keeping the source of cold entirely outside the ground to be excavated, a large part of this ground was loose and the shovel could be used. Hard ground was wedged down, no explosives being employed. The chalk strata contained vertical fissures and here the maximum rate of sinking was 6½ to 8 ft. per day; but in the flinty strata below this the rate fell to 12 to 20 ins. per day. At this point the temperature in the pit was −12° C., the lowest reached. In this flint stratum the diameter of the unfrozen part was only 5.4 ft. in the large pit, and the small pit was entirely frozen. As showing the difficulties encountered, as many as 3,000 picks and wedges were blunted in one day in Pit No. 1. The blue marls at the foot of the shaft were entirely unfrozen, no ice being found at a greater depth than 34 ins. below the bottom of the freezing circuits in either pit. The actual time consumed in sinking the two pits through the 298 ft. of frozen ground was from July 2 to Oct. 5 for the small pit, and from July 16 to Oct. 16 for the larger pit, including 9 days of stoppage for building the first ring of tubbing. This tubbing was of cast-iron rings, built up of segments and backed on 8 ins. of concrete, the latter mixed with water containing 10% of calcium chloride to prevent freezing.

The total cost of sinking was about $142,000, or about $183 per ft. A summary of items is given as follows in meters and francs:

	Per cent. of total.	Total francs.	Per meter francs.
Patentee's royalty	4.6	32,760	139.20
Temporary plant and buildings	2.7	19,582	83.25
Boring for freezing tubes	10.4	73,673	313.10
Freezing plant	35.0	248,765	1,057.20
Measuring apparatus	0.3	1,898	8.10
Freezing	4.7	33,030	140.40
Sinking and tubbing	40.5	287,454	1,221.65
Carriage	0.6	4,562	19.40
Tools	0.7	5,257	22.35
Sundries	0.4	2,865	12.15
Totals	100.0	709,850	3,016.80

In this statement the whole cost of the plant is charged to this single use; its subsequent employment in future sinking would be worth 1,000 francs per meter, leaving the work done here to cost about 2,000 francs per meter. The items especially chargeable to the freezing operations amounted to about 660 francs per meter, or, say, $40.24 per ft. About 20% of the cooling effect was lost at the surface owing to the distance of the machines from the work; the engines used being intended to eventually drive air-compressors in working the mine. The authors of the paper, MM. Saclier and Waymel, also think that each pit should have had its separate freezing plant, so as to be enabled to get to work as soon as an ice-wall of sufficient thickness had formed over the surface. They could then have excavated in softer ground and advanced more rapidly. Especial stress is laid upon the necessity for absolutely vertical borings for the freezing pipes; and the maximum distance between holes should not be more than 4 ft. to depths of 328 ft., and for greater depths it would be well not to exceed 3.28 ft. The original of this paper is to be published later in full, with 14 plates, by the Institution of Civil Engineers.

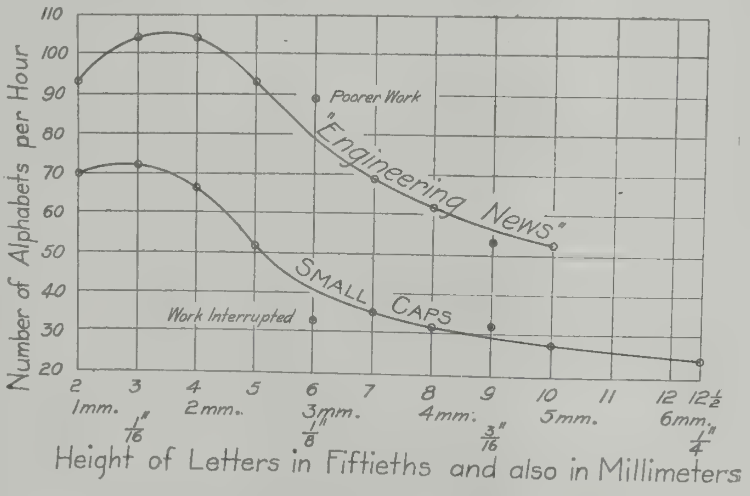
RELATIVE ECONOMY OF DIFFERENT HEIGHTS AND STYLES OF FREE-HAND LETTERS.*

By R. C. Vial.**

It is well known by any one who has done free-hand lettering that different heights and styles of letters require different lengths of time for execution. The writer, not having seen any data on this subject, made a series of experiments to determine the relative time required to form letters of different styles and sizes. These experiments comprised the formation of 1,200 alphabets or over 31,000 free-hand letters. The experiments were undertaken for the writer's personal benefit and satisfaction, and were not originally intended for publication.

The object of the work was to determine the relative economy of letters of different heights and styles. Two styles of letters were used viz.:—inclined small capitals (single stroke Gothic letters) and inclined lower-case letters of "Engineering News" style. In the execution of the work it was desired simply to do fair work combining quantity and quality. In each experiment greater quantity could have been obtained by sacrificing quality, or better quality of less quantity might have been shown. The rate of work was somewhat faster than ordinary office work of similar character. Nothing was permitted to interrupt the work during an experiment. In each case the length of an experiment was one hour, i. e., 60 consecutive minutes, the pen not being laid down between the time of the beginning and the end of each experiment. For uniformity throughout the tests, the letters of each experiment were made in alphabetical order. Guide lines for top and bottom of letters were penciled previous to the beginning of an experiment, but none of the letters were penciled. With each alphabet the work began with letters 2-50-in. high, the height being increased 1-15-in. for each succeeding experiment. A Keuffel and Esser lettering pen was used on the smallest letters. The remainder of the work was done with a Spencerian No. 1. The quality of work was kept as nearly uniform as possible.

In the accompanying cut the results of the tests are graphically shown. The heights of letters, in fiftieths of an inch with equivalents in sixteenths and in millimeters, are platted as abscissas, and the number of alphabets formed per hour as ordinates. The curves passing through the points thus located show that of the two alphabets used the "Engineering News" style is much the faster; and that in each case the most economical letter for the writer is one about 3-50-in. high. The difference in speed for the two styles is accounted for by the different number of strokes in each alphabet. In an alphabet of the small capital letters there are about 60 strokes, and in the "Engineering News" alphabet less than 35. In other words it takes about half as many strokes of the pen to form an alphabet of "Engineering News" style as it does to form one of small capitals. In forming a letter the most care is required at the beginning and at the end of each stroke.



RELATIVE SPEED OF FORMING DIFFERENT ALPHABETS.

Probably no other person would, in a similar set of experiments, get the same results as those here given, nor is it certain that the writer himself could produce exactly the same data a second time. The actual results given apply to him only, but it is believed that the comparative results are farther reaching. It is with the latter point in mind that this paper has been presented.

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*Condensed from "The Technograph" of the University of Illinois.

**Assistant in General Engineering Drawing, University of Illinois.

WORK ON THE MELAN BRIDGE at Topeka, Kan., is to go forward at once. Legal difficulties in connection with the issuance of bonds for the work have delayed matters several months; but these are now at an end. The bridge was illustrated and described in our issue of April 2.

ASPHALT FROM CLINE, UVALDE COUNTY, TEX., is to be laid on eleven blocks of First St., at Troy, N. Y. The bids were opened July 14 and were published in our Construction News Supplement of last week under Contract Prices.

COAL HAS BEEN FOUND at Vicksburg, Mich., in boring a test well for the new water supply system for which Messrs. Alvord & Shields are the engineers. The coal was found at a depth of about 50 ft., the vein being 3 to 4 ft. in thickness.

THE CABLE UP THE AMAZON RIVER, from Para to Manaos, which was laid last winter by the cable-laying steamer "Faraday," was only in operation 32 days when it parted. Five different breaks have been found and the cable is not yet in operation. At some points the current is said to reach 8 to 10 miles per hour, and this, with the sunken drift, etc., makes the life of the cable uncertain.

AN 1,800-HP. VERTICAL ENGINE has recently been built for the Whitman Mills, New Bedford, Mass., by the Rice & Sargent Engine Co., of Providence, R. I. The use of vertical engines of large size is very common abroad, especially in textile mills; but comparatively few have been built in this country. The engine is a compound, with cylinders 28 and 60 by 48 ins., and the speed is 100 revolutions, making a piston speed of 800 ft. per minute, with steam of 160 lbs. pressure. The engine drives a flywheel 16 ft. in diameter, grooved for 44 1¾-in. ropes. All the valves of the engine are in the cylinder heads. The clearance space is only 3% in the h. p. cylinder and 2% in the l. p. cylinder. A reheating receiver is bolted to the rear of the column supporting the h. p. cylinder. The governor regulates the cut-off of both cylinders and the cut-off of the l. p. cylinder is also adjustable by hand.

A SYSTEM OF ELECTRIC LIGHTING is to be established in the City of Mexico. Bids are asked for a plant furnishing 150 incandescent and 600 arc lights. Of the arc lights 480 are to be of 2,000 c. p. and 120 of 1,200 c. p. At the expiration of eight years the city is to have the option of buying the entire plant.

A NEW METHOD OF WOOD PRESERVATION is described as follows: The heavy oils and waxes which are left after the distillation of petroleum or other oils are dissolved in naphtha, and the solution is forced into the seasoned timber in the same manner as in creosoting. The timber is then heated and the naphtha evaporates and is recovered in a cooling chamber, the process being in fact similar to distillation. The heavy oils and waxes are left in the cells of the wood and make it thoroughly water-proof, but clean to work and handle, light and elastic. We take the above from a stray newspaper clipping, the origin of which we do not know; but the scheme seems to be a meritorious one. It may be pointed out, however, that the very great risk of fire and explosion in handling naphtha would make the process hardly applicable on a large scale to compete with creosoting, burnettizing and similar processes, and it would probably be better adapted to the treatment of woods for cabinet-making and similar uses.

BOOK REVIEWS.

ALDEN'S LIVING TOPICS CYCLOPEDIA.—A Record of Recent Events and of the World's Progress in All Departments of Knowledge. Abbas to Coudert. New York: John B. Alden; 12mo.; half leatherette; pp. not numbered; $1.

The first few pages of this publication were noticed in our issue of April 2, 1896, so no further comment is necessary.

SPECIFICATIONS.—A Practical System for Writing Specifications for Buildings. By W. Frank Bower. New York: Edw. A. McLean, 14 Lafayette Place; 4to.; cloth; pp. 229; $5.

The preface to this book states that it is not intended to be a treatise on specifications, but simply an arrangement of the matter commonly used in writing specifications in such a form that the latter may be easily and quickly performed without omitting essentials. The specifications proper are printed on the left-hand page in large type, with ample room for interlineations. Italics are used to indicate items likely to vary with different jobs. On the right-hand page are notes thought to be of value in writing specifications, or where none are deemed essential the page is left blank.

VITRIFIED PAVING BRICK.—A Review of Present Practice in the Manufacture, Testing and Uses of Vitrified Paving Brick. By H. A. Wheeler, E. M., Clay Specialist of the Missouri Geological Survey. Indianapolis: T. A. Randall & Co. 8vo.; pp. 84. $1.

This is a most excellent little book along the lines indicated in the sub-title, and especially meritorious for its discussion of the various clays employed. The information here given on clays and their manipulation, including the whole process of manufacturing vitrified paving brick, is really needed by any one who has to make use of this material in engineering work and especially for street paving. The various methods of testing paving brick are discussed concisely and intelligently. The book would be a good one for street superintendents and for commissioners of streets and public works who have to do with the selection of paving materials, as well as for engineers.

STATISTICS OF THE AMERICAN AND FOREIGN IRON TRADES FOR 1895.—Annual Statistical Report of the American Iron and Steel Association, containing Complete Statistics of the American Iron Trade for 1895; also a Brief Review of its Present Condition; also a General Review of the Iron and Steel Industries of the United States from Colonial Times to the End of 1895. Published by the American Iron and Steel Association; General Manager, James M. Swank, Philadelphia, Pa. Paper; 8vo.; pp. 78. $3.

This statistical report was issued in May, and is brought very closely down to date, including many figures and prices of the first quarter of 1896. We have, as usual, published an abstract of the report (Eng. News, June 11), showing the general condition of the iron and steel and allied industries, as brought out by the many detailed statistical tables. There are seven pages of a necrology, which is defective in that all the notices of deaths are arranged in two unbroken paragraphs (one for 1895 and one for 1896); it would have been much better and more convenient to have given a separate paragraph to each notice, which would occupy but little more space. At the end of the report is a review of the American trade, written by Mr. Swank, General Manager of the Association, which commences with the attempts in iron-making made at Falling Creek, Va., in 1622, and at Lynn, Mass., in 1645. This review occupies 12 pages.

JOHNSTON'S ELECTRICAL AND STREET RAILWAY DIRECTORY FOR 1896.—Containing Lists of Electric Light Central Stations, Isolated Plants, Mining Plants, Street Railways (Electric, Horse and Cable); Telegraph Companies, District Messenger Companies, Telephone Companies; Manufacturers of and Dealers in Electrical and Street Railway Apparatus, Machinery and Supplies. New York: The W. J. Johnston Co., 253 Broadway. 8vo.; cloth; pp. 828. $5.

Aside from being a directory of the industries named, this volume gives the paid-in capital stock of the electric light and street railway companies and a slight amount of information regarding the character and extent of the several plants. For central lighting plants the system in use, the number of arc and incandescent lamps and the horse power of the plant is stated; in addition an asterisk indicates that the company has a contract for city lighting and a dagger that it furnishes current for power purposes. For street railways the mileage, number of cars and system in use is given.

We do not find in the book any figures for the number of industries included, of the several kinds named, but we learn from the publisher that there are listed 2,711 central electric light stations, located in the United States, Canada, Mexico and Cuba; 1,140 street railways, of which 828, with a mileage of 14,850, are operated by electric, and 312, with a mileage of 2,300, by horse, steam or cable power; and 7,150 manufacturers, dealers, electrical engineers, etc., the latter being arranged, first geographically, second, according to business, and third, alphabetically.

One of the most valuable features of the work, to some, is the information regarding the rates charged for public lighting in 350 cities. It seems surprising that this list should be so short.

SEWERAGE AND SEWAGE PURIFICATION.—By M. N. Baker, Ph. B., Associate Editor, Engineering News, Joint Author "Sewage Disposal in the United States." Author "Sewage Purification in America." New York: D. Van Nostrand Co. 16mo.; boards; pp. 144; 50 cts.

This little book is written to replace No. 18 of the well-known Science Series, the original volume, by Professor Corfield, having appeared in 1875, and being entirely unadapted to existing American conditions. The present volume has been prepared absolutely without reference to the old one, further than to cover the ground indicated by the title, and perhaps a little more.

The book is popular, rather than technical, and is not designed for engineers well up in sewerage and sewage purification. Engineers who have followed other lines of practice may find this little volume a convenient means of ascertaining the general outlines and principles of the subject in the light of modern theory and practice. Sewer commissioners and public officials whose duties make desirable some knowledge of the subject, may make this volume, with its references to more elaborate treatises, a basis for more extended reading, if they find it does not contain all they need or awakens such interest in the subject as to create a desire for more information.

While originality in the subject matter is, in such a well-worked field, out of the question, the method of presentation in some respects differs from previous attempts, so that even the sewerage engineer of long experience may perhaps find here new ways of presenting old facts when called upon to impress municipal authorities with the necessity of providing a good system for both the collection and final disposal of sewage.

The above remarks, with the title of the volume, will be sufficient to indicate the character of its contents.

ARTESIAN WELLS AS A MEANS OF WATER SUPPLY. —Including an Account of the Rise, Progress and Present State of the Art of Boring for Water in Europe, Asia and America; Progress in the Australian Colonies; a Treatise on Water Bearing Rocks; Permanence of Supplies; the Most Approved Machinery for and the Cost of Boring, with form of Contract, etc.; Treatise on Irrigation from Artesian Wells; and on Sub-Artesian or Shallow Boring, etc. By Walter Gibbons Cox, Assoc. Inst. C. E. Brisbane: Sapsford & Co.; 8vo.; cloth; pp. 146; illustrations; 7s. 6d. For sale by D. Van Nostrand Co., New York; $3.

Considering its pretentious title page and its American price this volume contains but a small amount of information of use to engineers, and for much of that the author is to be credited simply with having brought it together, mostly from the Government reports of various countries. Yet the entire absence of a modern book on the subject, and of any book in English,* so far as we know, may render this one of considerable interest and some practical value to engineers who do not have access to the government publications treating this subject.

In our issues of Feb. 14 and 21, March 14 and 28, and April 4, 1891, we published abstracts of a U. S. government report on the artesian wells of the West. Our abstracts related more especially to geological conditions, and the development and practice in West, but the report reviewed artesian well experience elsewhere, and contained, probably, nearly everything of value to Americans in the volume being noticed, besides much in addition. These reports of our government, however, cannot now be obtained easily, if at all, we believe, and have the great disadvantage of being very prolix and poorly edited, largely owing to the haste with which the investigation was made.

FINAL DISPOSITION OF THE WASTES OF NEW YORK.—Report by Department of Street Cleaning, George E. Waring, Jr., Commissioner. 8vo.; paper; pp. 159; tables and 13 illustrations. Address the Commissioner.

This is without question the most valuable report on the disposal of garbage, ashes and the multitudinous other forms of city refuse not coming under the comprehensive term sewage which has ever been published in this country and we know of nothing equal to it yet published abroad. Most reports on investigations of this kind are limited to a general discussion of the subject and more or less superficial descriptions of garbage disposal plants seen on a hurried trip through the country. "Junketing trip" is the name commonly applied to such journeys, especially by the newspapers in opposition to the city government of the time.

The main part of the report is dated Feb. 28, 1896. In our issue of Feb. 20, 1896, we abstracted from advance pages some of the information given in the report. There has since been added a number of illustrations, mostly views of garbage utilization plants, and an appendix giving the various steps which led up to the recent award of a contract for the disposal of garbage alone, by the Arnold utilization process (see Eng. News, March 28, 1895), the contractor being the New York Sanitary Utilization Co. Some other valuable matter has also been added, and some revised and extended.

As the report now stands it describes a number of garbage utilization processes and gives some figures of results obtained from the treatment of large quantities of garbage. It discusses the grease, fertilizer, old bottle, paper and junk trade in general, and presents estimates of the quantities of some of these materials to be derived from the wastes of New York and their market value. An interesting section treats of the uses to which clean ashes can be put in this vicinity. Besides this there is some general discussion of the subject in hand, with sensible remarks on its possibilities and limitations.

AMERICAN STREET RAILWAY INVESTMENTS.—Published Annually as a Supplement to the "Street Railway Journal." Third Edition. New York: Street Railway Publishing Co.; cloth; 4to.; pp. 333; 47 maps; $3.

The general structure of this edition is practically the same as that of last year, the principal change being in the presentation of balance sheets and the arrangement of operating statistics for four years instead of for three. The publishers call special attention to the fact that out of 1,112 operating and leased street railway corporations whose financial reports are given, only 8½% have not been heard from officially. Of the 1,444 reports, including new corporations, presented, 988 have been corrected up to some month in 1896 (chiefly April and May), 305 have been corrected up to some month in the last half of 1895, while only 151 bear a "date of information" prior to June 30, 1895. This is said to be the only financial manual in the steam or street railway field in which all information is dated, so that old reports may be distinguished from new and the present authentically determined. In general, the following information is given in regard to street railway companies: A brief history of the company; a statement of the capital stock authorized and issued; a description of the funded debt direct, assumed and guaranteed; a statement of any peculiarities of the mortgage bond issues, sinking fund requirements, purpose for which treasury bonds may be issued, etc.; of leased properties with terms and conditions under which they are operated; of the franchise terms and obligations; a general operating report for the last four financial years with later earnings wherever possible; detailed operating expenses for the last four financial years; statistics of traffic for the same period; balance sheets for the last two or more years; description of the plant and equipment; officers, directors, and location of general office; also reference to descriptions of the company's property, or of other matter of general interest found in the files of the "Street Railway Journal" for the last five years. This edition contains 47 maps, some of which are especially large and interesting.

PRESS-WORKING OF METALS.—A Treatise upon the Principles and Practice of Shaping Metals in Dies by the Action of Presses, together with a Description of the Construction of Such Implements in Their Various Forms, and of the Materials Worked in Them. By Oberlin Smith. Illustrated with 433 engravings. New York: John Wiley & Sons; 8vo.; pp. 275; $3.

Mr. Oberlin Smith is well known to the mechanical engineers of this country as the president of the Ferracute Machine Co., of Bridgeton, N. J., whose specialty is the manufacture of presses, punches and dies. With a personal experience of many years in this line of work, and with exceptional ability as a writer, he is well qualified to produce just such a work as the one before us, on a subject of which the existing literature is extremely scant. There is scarcely a machine shop or a manufactory in which metals are used which does not have one or more punching, drawing or embossing presses and some one person at least who is interested in the theory and practice of the art of shaping metals by means of these implements. To such this work will be very welcome. It is written in a style which everyone can understand; it contains a great variety of useful information, and the typography and engravings are excellent. Mr. Smith is an expert on the subject of wire gages—he has invented one himself—and he has collected and published in this book a table containing no less than 25 different gages, devoting a whole chapter to their discussion. The following extract, which is a good example of the author's style, gives his opinion of the latest American "Standard" gage.

> It was Carlyle, if I remember right, who said that the population of England was so many millions—mostly fools. However indignantly we may repudiate the descriptive portion of the distinguished cynic's remarks as applied to the people of our mother country in general, we can scarcely but admit the partial foolishness of that portion of the population that has been engaged at various times during a century past in the industry of inventing wire gages. In America, too, we find that either heredity, or example, or both, has caused a further development of this pernicious industry, and that the crowning absurdity of all its products has been legalized in the United States by an act of Congress taking effect July 1, 1893. One of the chief points about this remarkable latest "Standard" is that it is almost everything it should not be, utterly ignoring many attributes that should be embodied in a good gage.

PUMPS AND PUMP MOTORS.—A Manual for the Use of Hydraulic Engineers. By Philip R. Bjorling, Hydraulic Engineer. In two volumes; 4to.; Vol I., Text, pp. 369; Vol II., Plates; 261 plates, with 1,006 illustrations. London, E. & F. N. Spon; New York, Spon & Chamberlain. $18.

The most notable thing about these two volumes is that the two together measure 12¾ × 10½ × 3 ins., weigh 11½ lbs., and cost $18. The author has previously written four other books on pumps, viz.: Practical Handbook on Pump Construction; Practical Handbook on Direct-Acting Pumping Engines and Steam Pump Construction; Pumps, Historically, Theoretically and Practically Considered; The Construction of Pump Details. We cannot but admire the vast amount of labor that has been expended upon the drawings for this work; each one of the 1,006 illustrations is a photolithograph of a line drawing, made apparently especially for this work. The drawings, however, seem to have been made by a mechanical draughtsman without any knowledge of the artistic details necessary to make the work have a good appearance when reproduced and printed in a book. The section lining and the lettering are especially bad. The illustrations are printed only on one side of the paper; they are on the average about double the scale, or four times as large in area as there is any need for, thus making the volume of plates eight times as bulky as it need be. If these illustrations had been reduced to half their present lineal dimensions they would have had a much better appearance, and could then have been printed with the text describing them in the first volume, in which there is enough blank paper at the end of most of the 45 chapters, and in the extremely wide margins, to have made room for them all. The user of the book would then not have been obliged to handle two books to understand the text of one, and the cost of the work might have been greatly reduced. As an example of how not to build a book, this work is about the best that has come under our observation of late. It might be expected that an author who has already had the experience of writing four other books on pumps would by this time know how to write a good one, but in this expectation we are disappointed, for his method of writing is about as faulty as his method of book-making. His style is labored and verbose, and in many cases the meaning is difficult to comprehend. Of the 369 pages in Vol. I., about 50 pages are taken up with tables which are found in most engineers' reference books, so that the total amount of text is but little over 300 pages. To students of pump design the 1,006 illustrations may be valuable as a collection of pump drawings, and the text may be useful to explain the drawings.

HOW TO DRAIN A HOUSE.—Practical Information for Householders. By Geo. E. Waring, Jr., M. Inst. C. E., Consulting Engineer for Sanitary Drainage. Second Edition, with Annotations. New York: D. Van Nostrand Co. 12mo.; cloth; pp. 223; 33 illustrations; $1.25.

Although the main part of this book relates to conditions existing when it was originally written, in 1884, it still contains much valuable information for those who are about to build a house or who, having built, desire to satisfy themselves that proper sanitary precautions are in force. Notes are presented at the end of some of the chapters designed to record the progress made in the past ten years.

While the book is intended primarily for householders, engineers who have not had occasion to pay attention to plumbing questions will find many valuable hints here: doubly valuable, oftentimes, for the happy way in which they are expressed, making them available to bring home with force a lesson to some client or some city official or board which has asked for advice in drawing a plumbing code or health ordinance.

Some engineers will doubtless be both surprised and amused to see the following, given as a foot note in connection with the use of strips of muslin wound around drain tile joints when laid:

> This use of muslin is patented, but it is hereby dedicated to the public to the extent of its use under or within the foundation-wall of buildings.

As this note was written, presumably, in 1884, possibly the patent may have expired before this. In this connection a short chapter on the author's practice in patenting devices of his own invention and alluding to them in his book may be mentioned. One paragraph from this chapter is as follows:

> My own devices were in no case invented with a view to securing a valuable patent, nor for any other purpose than to improve my own professional practice. The few of these devices which have approved themselves to my later judgment, and which I am now introducing in my work, I have patented to secure an incidental commercial advantage. I shall therefore describe them without hesitation and without further comment, treating them exactly as I treat such of the inventions of others as I believe to be good. I shall trust to the good sense of the reader not to misunderstand my motive.

Whatever may be said for or against the taking out of patents by engineers, the frankness of the author in this chapter is certainly commendable.

A subject of much contention among engineers and plumbers is the desirability of placing a trap on the main house sewer, or the connection between the interior plumbing and the street sewer. The majority of engineers and sanitarians still favor the use of such a trap, so far as we can judge, but there are a number of eminent men who hold that it is far better to omit the trap, leaving an uninterrupted opening between the street sewer and the upper end of the soil pipe, where it extends through the roof. Col. Waring believes in the latter plan, as a general rule. There is much to be said for it, although the arguments are by no means all on one side.

The largest chapter in the book is the concluding one, on sewage disposal for isolated buildings, by sub-surface and surface irrigation.

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*In 1847, M. Degousee published a work on artesian wells in French.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXVI., No. 6.

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AN OPPORTUNITY FOR AMERICAN ENGINEERS and investors is offered by the Government of New South Wales, which advertises for proposals for the manufacture and supply of 150,000 tons of steel rails, and the track fastenings to be used with them. All the material must be manufactured in New South Wales, and the delivery is to extend over a period of ten years. The proposals will be opened on Dec. 30, 1896. It is to be hoped that some American tenders may be submitted in this competition. Further particulars are given in another column and the specifications by which bidders will be governed can be seen at this office.

◆

PRICES OF M. C. B. COUPLERS are asked for by the Secretary of the Master Car Builders' Association, Mr. John W. Cloud, who is sending the following circular letter to M. C. B. coupler makers:

> Section 13, of Rule 5, of the revised code of Rules of Interchange, which goes into effect on Sept. 1, 1896, provides that "M. C. B. couplers, or parts of same, shall be charged at manufacturer's current market prices, or replacement prices, which are to be quoted by the Secretary Sept. 1, and March 1, of each year. When the coupler manufacturers do not quote a replacement price, and do not require the return of the scrap for the price quoted, the credits for scrap shall be allowed at the rates given in the above list."
>
> Under these revised rules of interchange, all car owners are chargeable with the repairs to their cars when away from home necessitated by ordinary wear and tear from fair service. Will you kindly quote, sometime prior to Aug. 20, the figures which I should publish to the members, as the current market prices, or replacement prices, for your coupler and parts thereof. John W. Cloud, Secy., M. C. B. Association, Rookery Building, Chicago, Aug. 3, 1896.

◆

PLANS FOR TRACK ELEVATION on the Erie R. R. in Jersey City are reported completed and ready for the approval of the city authorities. The present station will not be changed, but the tracks will rise from the station and cross Henderson St. at an elevation of 13 ft. above their present level. From this point the tracks will run on a steel viaduct to Monmouth St., where the descent to the tunnel will begin. The estimated cost of the work is $1,000,000.

◆

A GRADE CROSSING BATTLE took place at Bradford, Pa., on July 28, between the Western New York & Pennsylvania R. R. and the Bradford Electric Street Ry. Co., the former company trying to prevent the latter from laying a crossing over its tracks. In view of the constant dangers attending such grade crossings, managers of steam railway companies cannot be blamed for opposing them by every means in their power; but the only really effectual fighting is that done in the courts. The battle with employees at the crossing invariably does harm and seldom or never amounts to anything in preventing for any length of time the making of the crossing.

◆

THE BOYNTON BICYCLE RAILWAY at East Patchogue, Long Island, was sold by a court officer on July 30 to satisfy a judgment against the owners. The road is 1½ miles in length and was built to exhibit the bicycle railroad system. It was bid in for $3,310 by W. H. Boynton.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week, and the most serious that has occurred in the United States for eight years, or since the rear collision at Mud Run, on the Lehigh Valley R. R. in 1888, was a collision at a grade crossing of the Philadelphia & Atlantic City and West Jersey railways, near Atlantic City, N. J., at 6.50 p. m., July 30. The disaster was due to the engineman of a fast express train failing to apply the brakes soon enough to stop his train before reaching the crossing. The list of casualties is 46 killed and about 60 injured, according to the best information attainable. The circumstances of the accident are described at length in our editorial columns.

◆

A RAILWAY WRECK was caused on the Illinois Central Ry., Aug. 1, near Clinton, Ill., by failure to obey orders. Two passenger trains collided head on. Two persons were killed and seven injured. On Aug. 4, near Shamokin, Pa., a fast freight on the Philadelphia & Reading R. R. was derailed by a freight car door which had dropped on the track. A car loaded with powder exploded and set fire to the train. Two persons were killed and one injured.

◆

A RAILWAY BRIDGE FAILED on the Vandalia Ry. near Crawfordsville, Ind., July 29. Fearing that the bridge was unsafe a locomotive was run across ahead of a passenger train to test the bridge. The locomotive was running at about 30 miles an hour and when near the center of the bridge it collapsed. Three of the five men who were on the engine were killed.

◆

A HEAVY STORM occurred throughout Ohio and Indiana on July 29. At many places buildings were blown down or washed away by high water. A number of people are reported as killed and injured at various places.

◆

THE EXPLOSION OF A POWDER MAGAZINE occurred at Funfkirchen, Hungary, on July 30. Five persons were killed and about 100 injured.

◆

AN EMPTY STILL EXPLODED in an oil refinery at Jersey City, July 31, seriously injuring five men. A workman was inspecting the interior of the still while another held an incandescent lamp through the manhole. The lamp swung against a piece of iron, the glass was broken, and the glowing carbon ignited the mixture of gas and air in the still.

◆

THE STRIKE AT CLEVELAND by the employees of the Brown Hoisting & Conveying Machine Co. has been resumed. On July 31 the company issued a letter to the press stating that the strike had been settled on the terms offered by the company the day after the commencement of the strike. These terms had been agreed to by the attorney for the strikers, who were ordered back to work. When the men applied for reinstatement the Brown company asked each individual if he understood the terms of the agreement, which stated in particular that all contracts by the company would be with individuals and not with the union. This brought on the strike anew and there is said to be danger that all union men in the city will quit work.

◆

THE SEPARATION OF ASHES, GARBAGE and rubbish and the placing of it in three separate receptacles, was inaugurated in New York city, Aug. 1. The garbage will be treated by the Arnold utilization process, under the contract recently awarded. It is expected that the ashes will be used for filling purposes. Bids are now invited for the privilege of sorting the rubbish.

◆

A 66-IN. RIVETED STEEL WATER MAIN, about 15 miles long, will be laid for the city of Brooklyn, as an extension to its present water supply system on Long Island. Bids for this extension were received on June 11, and were published in our Construction News Supplement for June 18. The successful contractor is Mr. John McNamee, of Brooklyn. From the reports at hand it appears that asphalt will be used to coat the pipe.

◆

THE PASSAIC VALLEY SEWAGE COMMISSION, appointed a few weeks ago to report on a plan for preventing the pollution of the Passaic River, has held a number of meetings in the various municipalities interested and taken a trip to New England to visit sewage disposal plants. A few days ago it appointed Mr. A. Fteley, M. Am. Soc. C. E., as Consulting Engineer, and Mr. Chas. E. A. Jacobsen, formerly engineer of the Newark water department, as engineer to the commission.

◆

PLANS TO PREVENT THE FURTHER POLLUTION of the Elizabeth River at Elizabeth, N. J., have been prepared by Mr. Francis Collingwood, late Secretary Am. Soc. C. E. The plan is said to include an intercepting sewer some three miles long, 2½ × 3¾ ft. at its upper and 5½ ft. in diameter at its lower end, with a pumping station about one-half mile from the lower terminus.

BIDS FOR A NEW WATER SUPPLY for Jersey City will be received on Aug. 24. Bids are invited for a gravity supply on three different plans and for a filtered supply from the Passaic River, the present source. The plans for a gravity supply call for water delivered at 127 ft. and at 210 ft. above mean high tide, and for at least one-third of the supply delivered at 210, and the balance at 127 ft. The system must have a daily capacity of 35,000,000 gallons, and be increased, on order, to 50,000,000 gallons. The city will have the option to buy the works at intervals during the contract. The filtered supply must be of 35,000,000 gallons capacity and must be lifted to existing reservoirs with triple expansion, high-duty, condensing engines capable of working against 140 lbs. pressure. A boiler plant must be provided and a conduit to the city reservoirs. The character of the filter plant is not restricted further than that it must yield the requisite amount of water with no more than a trace of nitrites, and that the water must be transparent and free from color, odor, turbidity, alkaline or acid tastes. The contractor must agree, further, that the filtered water shall conform to a standard of purity laid down by him, which must state its contents, organic matter, free and albuminoid ammonia, nitrates and bacteria.

◆

THE PROPOSED INTERNATIONAL DAM across the Rio Grande at El Paso, Tex., is still under discussion. In the July number of the "Irrigation Age," a journal published at Chicago, a brief article reviews the history of the scheme, and sets forth its present status. In 1888, 1889 and 1894, the article states, the river was dry for a considerable period, while since June 1 of this year there has been no flow. The seasons named, or some of them, are said to have been exceptionally dry, and no statement is made regarding the usual dry weather flow of the stream. It is said that the Mexican government has formulated a claim against the United States for $22,000,000 damages on account of the loss of crops during the past ten years through diversion of the waters of the stream above the boundary line. It is also stated that Mexico will waive these claims if the United States will dam the river and give Mexico half the surplus water stored. A dam site has been proposed about two miles above El Paso, where it is said a structure 60 ft. high and 500 ft. long would form a reservoir 15 miles long with a storage capacity of 4,000,000,000 cu. ft., sufficient to irrigate 100,000 acres on each side of the river, also giving a large amount of power. Since this plan was formed it is said that a scheme has been put under way to irrigate from another reservoir the very lands that would be submerged by the international dam.

◆

THE PROPOSED WATER POWER FRANCHISE at Sault. Ste. Marie, Mich., noted in our issue of July 30, has been passed unanimously by the city council. Work must be started within six months. It is said that a large amount of power will be developed, and that Mr. E. V. Douglass, of Philadelphia, is president, and Mr. F. H. Clergue, of New York, is vice-president, of the Lake Superior Power Co., which will carry out the provisions of the franchise.

◆

THE PLANS FOR RAISING THE STEAMSHIP "AILSA are almost completed. It is proposed to raise the vessel by means of large barrel shaped wooden cylinders, 30 ft. long and 8 ft. in diameter. The cylinders will be filled with water and submerged so that they can be fastened by chains beneath the hull. Compressed air will then be forced into the cylinders. Twenty-four cylinders will be employed. The "Ailsa" was sunk on Feb. 29, 1896, by the French steamer "La Bourgogne," in the channel leading out of New York Bay. The "Ailsa" is lying in comparatively shallow water.

◆

A TEST OF THE ADHESION OF CONCRETE TO IRON has recently been made in connection with a piece of concrete and iron construction now going on in Milwaukee, Wis. A block of concrete, 16 × 3 × 4 ins., with a 1-in. square bar of twisted iron passing lengthwise of it was heated to a red heat for about 20 mins. in a furnace, and was then plunged into a bath of cold water until it was cooled throughout. Upon removal the concrete was found to be somewhat soft and friable, but it soon became hard again. There were no signs whatever of any separation of the iron from the concrete nor was the concrete cracked along the line of the iron bar or anywhere else. The least depth of the iron from the surface of the concrete was about 1 in. It will be noticed that the construction was the well-known concrete and twisted iron construction of the Ransome & Smith Co., of Chicago, Ill.

◆

AN AERONAUTICAL CONVENTION is to be held in Boston, Mass., in September, under the auspices of the Boston Aeronautical Society. A prize of $150 will be given for the best designed kite, and a special prize of $100 is offered by Mr. Octave Cleomite, Past-Pres. Am. Soc. C. E., for the best monograph on the kite.

◆

THE HOLMAN FRICTION-GEARED LOCOMOTIVE is said to have attained a speed of 94.7 miles per hour on the South Jersey R. R., near Cape May, N. J., on July 29.

THE NEW STEEL ARCH OVER THE NIAGARA GORGE.

By Orrin E. Dunlap.

(With inset.)

One of the greatest bridges to be erected this year is the new steel arch to span the Niagara chasm on the site of the present railway suspension bridge now leased by the Grand Trunk Railway of Canada. The fact that a steel arch is to succeed this grand structure is remarkable in itself, for this suspension bridge was the first work of the kind in America, and was built to facilitate travel between the East and the growing West. It is a structure which, despite all the changes it has undergone in construction, has ever since the day of its completion afforded a constant service to trains, carriages and pedestrians.

It was on April 23, 1846, that the company received its American charter, and on June 9, 1846, a charter was obtained in Canada. In commencing work on the bridge the first difficulty that presented itself was to secure a means of communication from cliff to cliff, and this obstacle was overcome by a boy named Homan Walsh, who one afternoon while flying his kite allowed it to settle on the Canadian bank. This little kite string served to pull a cord across the river, which in turn was followed by a rope and later by a wire cable. On the wire cable so erected a car was operated both as a ferry and to facilitate the great work of building the bridge. This cableway, probably the first in America, was used for the first time on March 13, 1848. The basket used was designed by Judge T. G. Hulett, who is still living in Niagara Falls. This basket was made of strips of band iron varying in width from an inch to an inch and a half, fastened with rivets. As seen in Fig. 3, it is higher at the ends than in the center. There is a seat at each end, their depth being about 2 ft. The manner in which its shape was decided upon is most interesting. In December, 1847, Judge Hulett and General Ellet met at the old Eagle tavern at Niagara, and the latter had the contract for erecting the bridge. During their talk the merits of a cable and basket as an aid to the great work came up, and the service was recognized as possible. What material should the basket be made of? was the question. General Ellet favored wood; Judge Hulett, iron. Calculations showed that Judge Hulett's plan would result in an iron basket 10 pounds lighter than one of wood built according to Ellet's plan. The form of the basket was then quickly decided by Judge Hulett and General Ellet arising from the old-fashioned rocking chairs in which they sat, and, drawing them together, Judge Hulett said "There is the form of the basket."

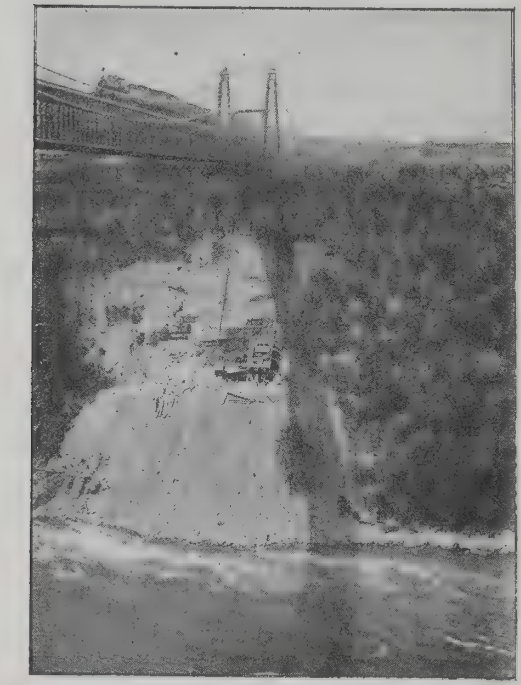

Fig. 1.—Building Concrete Foundation for Canadian Abutment of the New Steel Arch Over the Niagara Gorge.

While this aerial line of 1848 was not intended as a money-maker, it proved to be such, as the charge for transportation over and back was $1 for each person, and some days as much as $125 was taken. The basket is now in the possession of the Buffalo Historical Society.

Years were consumed in the work of building the bridge, and it was not until March 8, 1855, that the first train crossed it. As first erected, the bridge had wood trusses and towers of stone. In 1880 the suspended structure was changed to steel, and in 1886 the stone towers were replaced by towers of steel. The present bridge has a span of 821 ft. from center to center of towers. It is suspended on four cables, the diameter of each being 10¼ ins., and their ultimate strength 12,400 tons. The weight of the superstructure is 800 tons.

Mr. L. L. Buck, M. Am. Soc. C. E., is chief engineer of the new steel arch. Mr. Buck is thoroughly familiar with the suspension bridge and its locality, for it was from his designs and under his personal supervision that the suspended structure and towers were renewed, as above mentioned. It will be recalled that this work was completed without the slightest interruption to traffic, and it has gone down in history as one of the many brilliant things accomplished by Mr. Buck.

This grand new arch will have a span of 550 ft., between the end piers, and a trussed span 115 ft. long will connect it with the top of the bluff. The main span will be formed by an arch with horizontal upper chords. At the skewbacks it will be hinged. Each truss will have a batter of 1 horizontal to 10 vertical. The width between the centers of the top chords will be 30 ft., while between the centers of the rib at the crown the width will be 56 ft. 7¾ ins. From the centers of the skewbacks to the upper chords will be 134 ft., while the centers of the ribs at the crown will be 114 ft. above the skewbacks. On the American side the bed plates of the arch will rest on masonry built on the Clinton limestone, but on the Canadian side it has been found necessary to build a foundation of concrete, work on which is illustrated in Fig. 1. On this foundation the masonry will rest. It will be seen by the illustrations that the abutments are being built about half way up the slope on each side, between the water's edge and the top of the bluff. The ends of the shore span will be hinged to the arch by a pin at the point of intersection of the end post and top chord of the arch, while the shore end will rest on expansion rollers on masonry abutments.

As stated above, the new arch will have two floors or decks. On the upper chords of the arch transverse steel beams will be placed, and between these beams there will be four longitudinal lines of steel stringers. These will be 7 ft. apart and directly under the railway tracks, thus affording double track railway facilities, whereas there is but a single track on the suspension bridge now in use. A steel plate, reaching from end to end of the bridge and from the top of the upper chords to the tops of the ties will cover the ends of the railroad ties and the transverse beams.

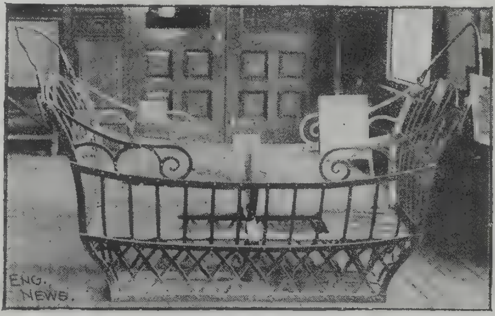

Fig. 3.—Basket in Which Passengers Were Carried Across the Niagara Gorge in 1848.

The ties of the railroad tracks will be 10 × 10 ins. × 10 ft., laid 14 ins. c. to c., and will rest on the stringers. Wooden guard rails 8 × 9 ins., notched over each tie, and secured by bolts, at every third tie, will be placed over the stringers and rest on the ties. Every fourth tie will be of increased length to carry a walk. These walks will be placed outside of each track and between the tracks, a feature especially provided to facilitate the customs inspectors' examination of trains crossing the structure.

The lower floor will have transverse beams and four lines of longitudinal steel stringers laid about 11 ft. apart. The inner stringers will be riveted to the webs of the beams and the inner line to the posts. The I-beams crossing the stringers will extend beyond the trusses and provide support for the sidewalks. The floor of the lower deck of the bridge, including carriage way and trolley track, to the width of 27 ft. will be laid on 4 × 10-in. timbers and planked with 3-in. oak plank laid lengthwise of the structure. Outside of these, and a few inches above the carriage floor, will be the sidewalks of white pine plank.

The material to be used in the bridge will include 5,560,000 lbs. of steel plates and angles in the form of columns, plate girders, braces and struts; 218,000 lbs. of steel castings; 182,143 lbs. of steel eye-bars and pins, and 30,000 lbs. of wrought iron rods and turnbuckles. The arch supports will be steel castings. The specifications provide that the steel for the rollers must have an ultimate strength of from 65,000 to 70,000 lbs. per sq. in.

Fig. 2.—View Looking Up From the Water's Edge on the American Side.

(The masonry in the foreground is the wall behind which is the roadbed for the electric railway which now runs through the gorge.)

The new arch is designed for a load on each track of two locomotives with four pairs of drivers each, and 40,000 lbs. on each pair, followed by a train of 3,500 lbs. per ft. In addition to this may be placed a live load of 3,000 lbs. per ft. on the lower floor.

In erecting this structure the end spans and the first panels and posts of the ends of the arch will be supported on falsework. It is then proposed to connect the end spans with the end posts of the arch, and by means of the approach girders, with the temporary anchorage, when the two parts of the arch will be built out as cantilevers. It is not intended that traffic on the suspension bridge shall stop while the work is in progress, and for this reason the upper floor beams of the arch will be left out until the suspended structure of the new bridge shall be raised sufficiently high to allow the beams to be placed under the upper chords of the suspension bridge. While this is going on, the cables and towers of the bridge may be taken down and removed. Then the old bridge will be shoved to one side far enough to allow the laying of a track on the pair of the new stringers, when the old bridge can be taken apart and the arch completed. During the construction it is likely that wire ropes of good strength and size will be run over the present towers with trolleys attached to carry material out over the gorge to the point of operation.

Mr. Thomas Reynolds is superintendent of the

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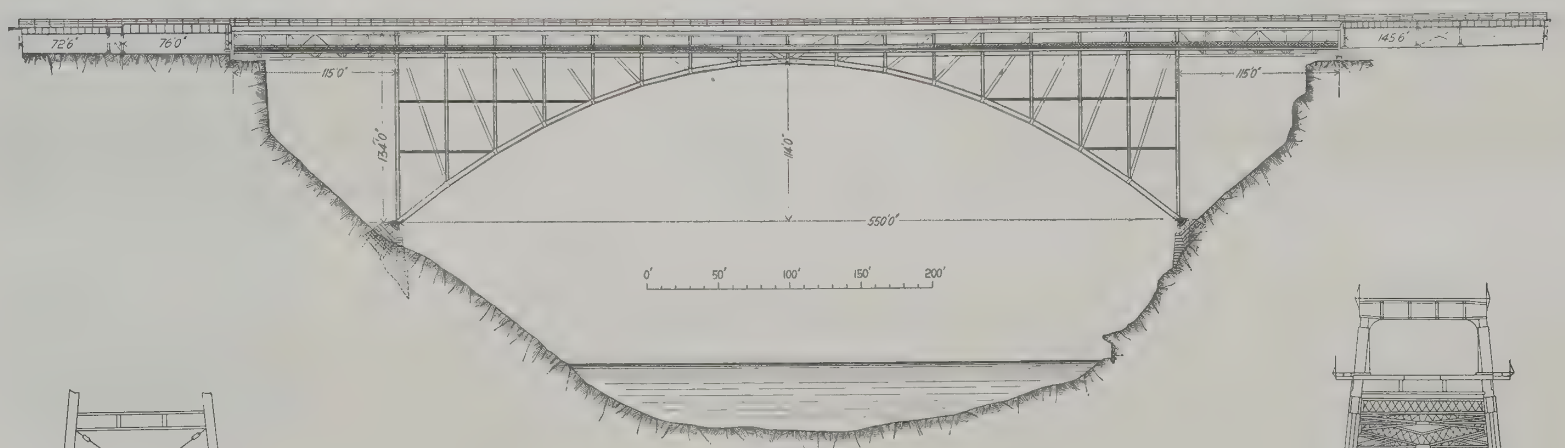
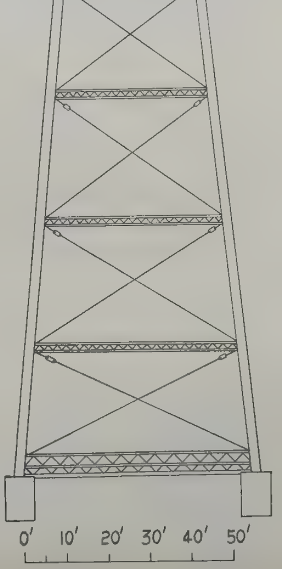
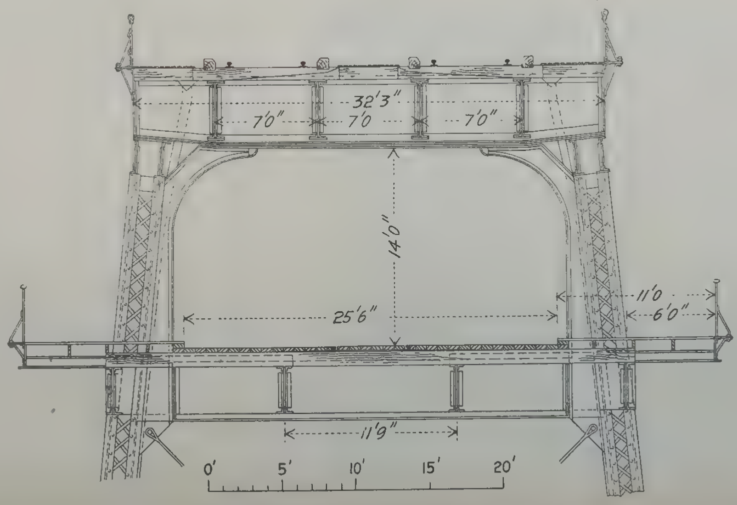
OF THE
UNIVERSITY OF ILLINOIS



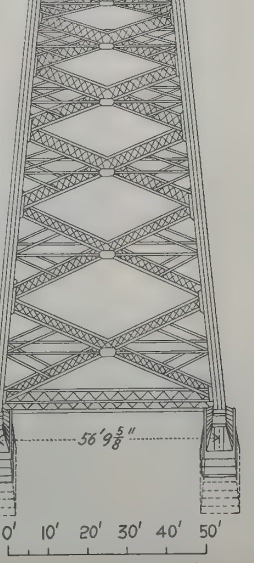
General Elevation.



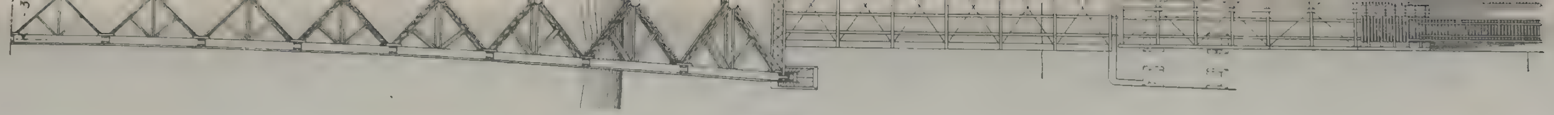
Elevation of End Bent.



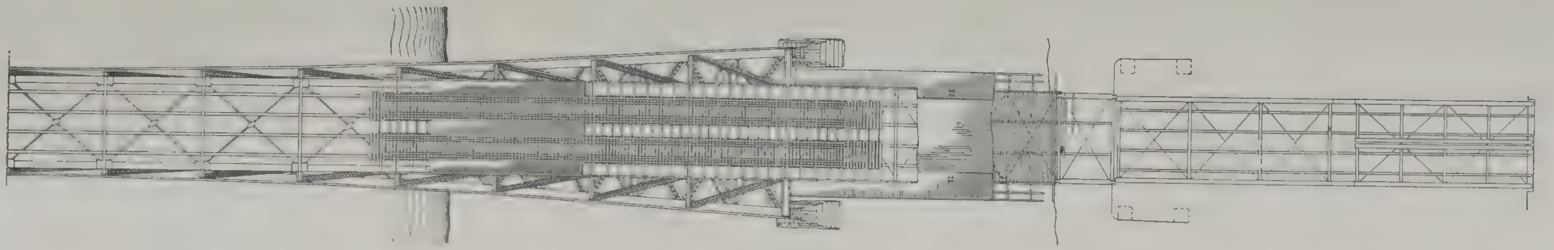
Typical Cross Section.



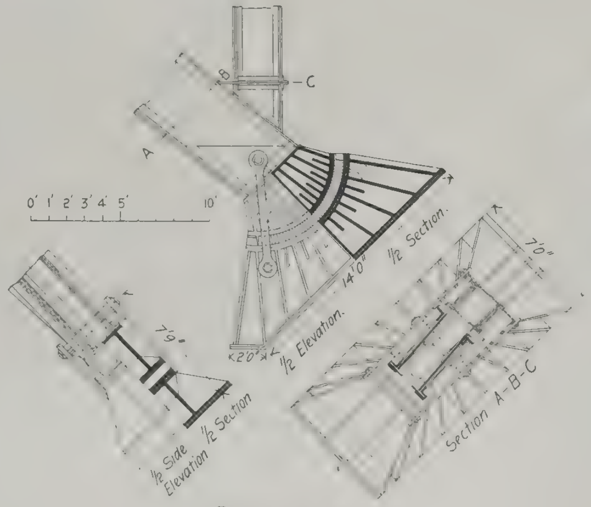
Section at Center of Span.



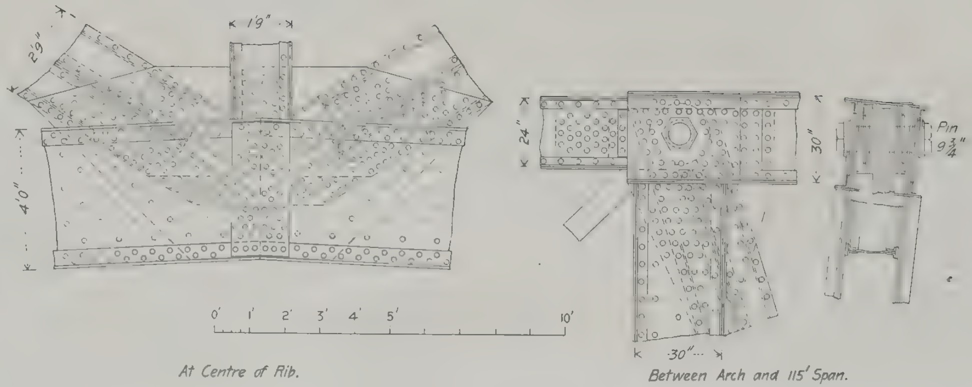
Half Plan.



Half Plan.



Details of Shoe.



At Centre of Rib.

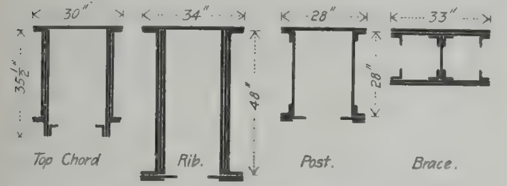
Between Arch and 115' Span.

Details of Connections.

THE NEW STEEL ARCH TO REPLACE THE RAILWAY SUSPENSION BRIDGE OVER THE NIAGARA GORGE.

Leffert L. Buck, M. Am. Soc. C. E., Chief Engineer. The Pennsylvania Steel Co., Contractor.

bridge. The stone for the American abutment is being brought from Chaumont, Jefferson county, N. Y., and that for the Canadian abutment from Queenston, Ont., quarries, the concrete being now ready for the stone work. By means of a derrick erected on the north side of the bridge, the huge stones are lowered to the slope below, where they are picked up by another derrick and lowered to the abutment.



Typical Sections of Main Members of Arch.

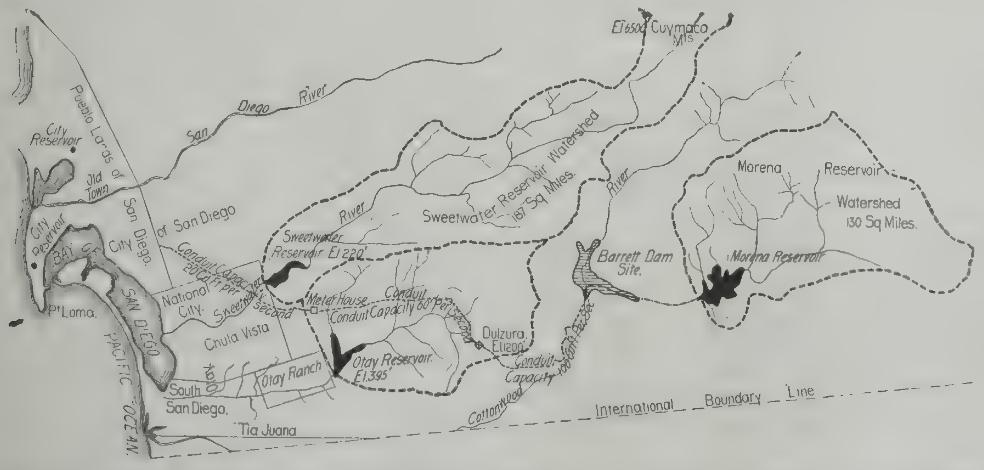
By Fig. 1 it will be seen that on the Canadian side a long trough or chute has been erected and extends from the bridge to the work on the slope. It is through this chute the sand is lowered, and at about the same point the cement is lowered in bags.

◆

THE WATER SUPPLY FOR SAN DIEGO, CAL.

The movement for the municipal ownership of water-works has been strong in California, as elsewhere in the United States, during the past few years. The largest city in California to take decisive steps towards owning the works supplying it with water is San Diego. On June 27, 1896, by 57 votes over the required two-thirds majority, the people of San Diego voted to issue $1,500,000 of bonds for water-works. This sum is to be divided about equally between the work of developing and bringing a supply to San Diego and the work of distributing it within the city limits. The principal interest attaches to developing the supply, as this includes a rock fill dam with an asphalt face, 3,100 ft. above the sea; a storage capacity of 632,448,000 cu. ft., or 4,730,000,000 gallons, above the 30-ft. contour line of the dam; and some 50 miles of conduit, made up of natural rock channels, cement-lined canal, wood and steel pipe.

The city of San Diego had a population of 16,159 in 1890. It has been supplied with water by a private water company since 1873. In 1891 it was reported that the city had leased the private works for 20 years, but this lease seems to have been discontinued afterwards.



MAP SHOWING THE LOCATION OF THE NEW STORAGE RESERVOIR AND SUPPLY CONDUIT FOR SAN DIEGO, CAL.

The $1,500,000 of bonds noted above were voted, practically, as a ratification of and a means of carrying out a conditional contract made with the Southern California Mountain Water Co. on May 9, 1896, for building the proposed new works and supplying the necessary water rights and land.

The contract calls for a daily supply of 1,728,000 cu. ft., or 12,950,000 gallons a day. The gathering area includes about 130 sq. miles of territory east of the city and beyond the drainage area of the great Sweetwater reservoir of the San Diego Land & Town Co., as shown on the accompanying map. The Otay reservoir, also shown on the map, to the south of the Sweetwater system, is already under construction by the Southern California Mountain Water Co. Water from it will be used for irrigating low lands in the southwestern part of the tract, shown by the map. The Otay reservoir will be filled, in part, it is said, from the Morena reservoir, as the new reservoir for San Diego is to be called, a conduit leading to the Otay reservoir from Dulzura Pass, at an elevation of 1,200 ft.

The conduit from the Morena down to the Dulzura Pass is to have a capacity of 100 cu. ft. per sec.; from this point to the meter house, shown on the map, the capacity is to be 60 cu. ft. per sec., and from there to the city line, 20 cu. ft. per sec. The daily capacities for these portions in gallons are about 65,000,000, 39,000,000 and 13,000,000 gallons, respectively. The portion of the conduit between the meter house and the city is not included in the contract for developing a supply. This section of the conduit, with four reservoirs and the distributing mains, is to be under a separate contract, but the Southern California Mountain Water Co. has bound itself, when bids for this work are invited, to submit a proposal of not over $728,000.

The contract between the city and the above company contains no detailed specifications regarding the character of the dam and the conduit to the meter house, but does contain specifications for the balance of the conduit and the distribution system. The conduit from the meter house to the city will be at least 29 ins. in diameter, of wood where under less than 100 ft. head, and where under high pressure of riveted steel. One of the four distributing reservoirs will have a capacity of 5,000,000, another of 2,500,000, and two of 500,000 gallons, each.

The city is given the right to adopt whatever measuring devices it may see fit for use at the meter house. It also has the option of buying an additional quantity of water delivered at the meter house, up to a second 13,000,000 gallons, at any time within 20 years.

Mr. E. S. Babcock, Manager of the Coronado Hotel, San Diego, is president of the Southern California Mountain Water Co., and Harris & Russell are engineers. Mr. E. E. Capps is city engineer of San Diego.

THE STRENGTH OF TIMBER AND A FORMULA FOR TIMBER COLUMNS.

In our issue of Oct. 24, 1895, we printed a table of average safe working unit strains of various timbers recommended by a committee of the Association of Railway Superintendents of Bridges and Buildings, and presented at the Annual Convention of the Association at New Orleans on Oct. 15. The pamphlet copy of the proceedings of the convention, now printed, contains a large amount of interesting matter on the subject of the strength of timber, much of it being a compilation of matter previously published, but also including some new information. Among the latter is a formula for strength of columns derived by Mr. A. L. Johnson from the unpublished results of the government timber tests conducted at Washington University by Prof. J. B. Johnson, supplemented by an examination of previous full-sized column tests. Mr. Johnson also gives a table of unit stresses recommended for various kinds of timber, which is also based chiefly upon the government tests. The formula is as follows. For timber columns with square ends (but not for fixed ends):

$$f = F \times \frac{700 + 15\,c}{700 + 15\,c + c^2},$$

where

f = ultimate breaking unit crushing stress on long column.

c = ratio of length to least cross-sectional dimension.

F = ultimate breaking unit crushing stress on short column.

The recommended values for F are those given under "crushing strength endwise" in the table printed below.

Recommended Values for Unit Stresses of Timber. A. L. Johnson, October, 1895. Ultimate Breaking Stresses in Pounds Per Square Inch.

Species		Modulus of strength at rupture in lbs. per sq. in.	Modulus of elasticity in lbs. per sq. in.	Relative elastic resilience in in. lbs. per cu. in.	Crushing strength endwise lbs. per sq. in.	Crushing strength across the grain lbs. per sq. in.	Tensile st'gth lbs. per sq. in.	Shearing strength parallel to fibre lbs. per. sq. in.
Long-leaf pine	D	7,750	1,440,000	1.30	5,000	645	12,000	500
Short-leaf pine	D	6,500	1,200,000	1.30	4,200	645	9,000	400
White pine	D	4,400	870,000	1.00	3,500	440	7,000	300
Norway pine		5,450	1,132,000	....	3,800	430	....	...
Colorado pine		4,900	888,000	....	3,150	540	....	...
Douglass fir		6,600	1,380,000	....	4,400	500	....	...
Redwood		7,200	452,000	....	3,250	345	....	...
Red cedar		5,000	670,000	....	3,500	750	....	...
Bald cypress	D	5,000	900,000	1.10	3,375	360	6,000	240
White oak	D	6,000	1,100,000	1.25	4,000	1,200	10,000	800

Note.—The values marked "D" were obtained from experiments made by the U. S. Forestry Division. The other values were obtained from various sources, chiefly from the tenth census report, but so modified as to give results comparable with the forestry division values.

These values are for 18% moisture, representing a half dry condition. For modifications of these values for other moisture conditions, and for fuller general description, see bulletin on "Timber Trestle Design," issued by the forestry division.

Mr. Johnson considers his formula as of nearly if not the true theoretical form, and the coefficients are entirely empirical, based upon actual tests. In the table given above the unit values given are for large-size sticks, such as are used in practice. The ultimate strength across the grain is taken as the stress producing an indentation of 37% of the thickness of the compressed stick.

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THE NEW IRON DISTRICT IN SOUTHERN RUSSIA.

In a recent number of the Consular Reports is an interesting article on the Iron Industry of Russia, translated from the "Vienna Handels-Museum." It describes the development of the industry in the department of Yekaterinosslav, in Southern Russia, where, since 1887, six large manufactories have been established. In 1893 their production amounted to 322,439 tons, in 1894 to 416,157 tons, and the production for the year 1896, it is estimated, will reach 645,000 tons, or double that of 1893. The iron beds of Southern Russia are very extensive and contain ore carrying as high as 70% of iron. The article also states that "the ore is comparatively free from foreign admixtures; on the other hand its fusibility is not great, about 45% of flux being required to melt it." About 55 lbs. of coal are required for the manufacture of each pood (36 lbs.) of cast iron. These statements about the amount of flux and of coal would indicate either that the statements concerning purity of the ore are not accurate or else that the method of operating the furnaces is uneconomical as compared with that of modern

American furnaces. The coal supply in the immediate neighborhood of the iron mines is abundant, the output in the Doneg basin in one year, 1893-4, amounting to over 5,350,000 tons. Limestone also is found in vast quantities on the spot. Under these circumstances, says the report, it is beyond doubt that the near future will see an immense development of the mining industry in Russia. At present, however, the total product falls short of the requirements, which are constantly increasing, and great quantities of cast and rolled iron are imported from Germany. The report states that there is a favorable opportunity for Austrian iron founders (and for the American founders also, says Consul Stephan), to extend their sales in Russia. The prices for iron charged by the Russian furnaces are so high that, notwithstanding the high duty on cast iron, wrought iron and steel, machine makers find it more profitable to buy imported iron. If, however, the statements given in the report as to the abundance of ore, coal and limestone in the same field, and the increase of production since 1887 are true, it would appear that before long Russia will be able to make all the iron and steel she needs for her own consumption, if in fact she does not even become an iron exporting country.

STEEL LOCK GATES FOR 800 x 100 FT. SHIP CANAL LOCK, SAULT STE. MARIE, MICH.

An illustrated description of the lock chamber, steel gates and power machinery for the new U. S. Government ship lock at St. Mary's Falls, Mich., was published in Engineering News of Sept. 26, Oct. 10, 17, 31 and Nov. 28, 1895. Since that time much additional information regarding the design and construction of the steel gates has become available and is presented here in part as a supplement to the previous articles. This matter should preferably be read in connection with the illustrations published in Engineering News of Oct. 10 and 17, but for the clearer understanding of those who have not these issues the article has been made complete in itself. For the information from which it has been prepared we are indebted to the reports of Capt. H. F. Hodges, Engineer Corps, U. S. A., and of Mr. David Molitor, United States Assistant Engineer, published in the report of the Chief of Engineers, U. S. A., for 1895, and to information received direct from Mr. J. L. Callard, United States Assistant Engineer.

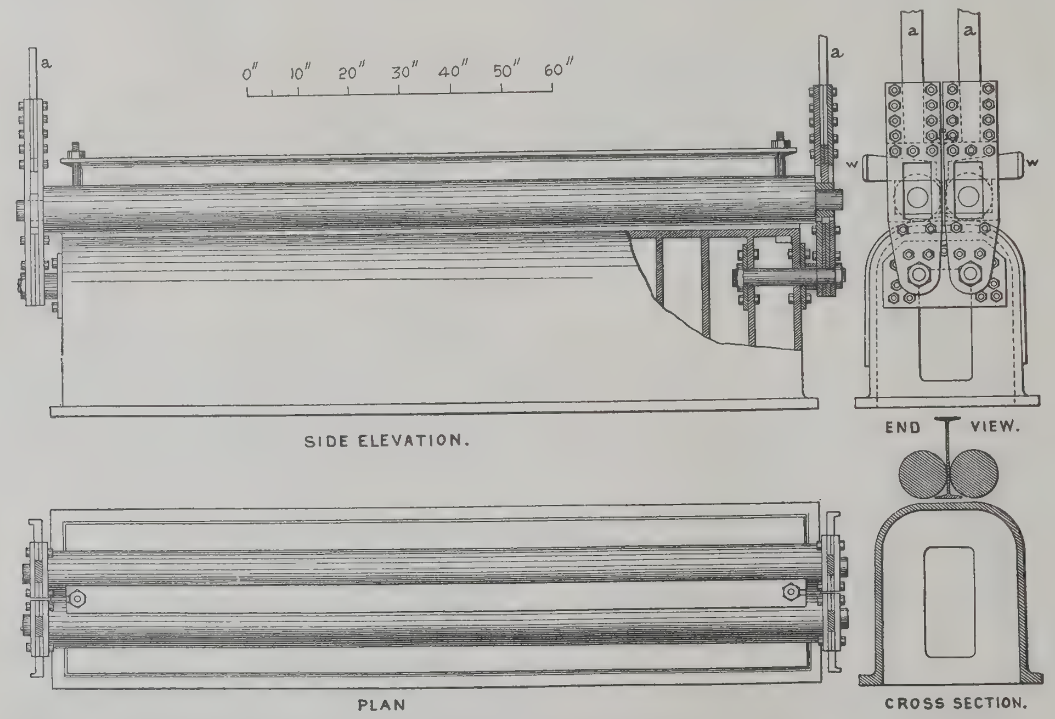

FIG. 1.—APPARATUS FOR BENDING SHEATHING OF QUOIN POSTS FOR ST. MARY'S FALLS LOCK GATES.
Detroit Bridge and Iron Works, Detroit, Mich.

Introductory.—Three sets of locks have been built at the St. Mary's Falls Canal, viz., the flight of two locks built by the State of Michigan in 1855 and now removed; the single lock built by the United States in 1881 and still in use, and the single lock which has just been completed and was built by the United States nearly on the site of the old state locks. The gates of the first locks were of wood and iron and closed an opening of 70 ft. The horizontals were constructed of solid built timber bowstring girders trussed with adjustable iron rods. Each leaf was swung without rollers from a pivot and set of suspension rods passing over a post rising from the masonry at the hollow quoins. The gates of the lock built in 1881 close a clear opening of 60 ft. Their structure is similar to that of the older gates, but the mounting is different, the fastenings being the ordinary pivot, gudgeon and collar, without suspension rods or rollers. Each leaf of the lower lock gate of this lock weighs 76 tons and cost about $8,000.

The new 800 × 100-ft. lock has five sets of gates, viz., an upper and lower guard gate and an upper, intermediate and lower lock gate. Of these the guard gates are used to isolate the lock when it is pumped out and the lock gates are used in passing vessels. The average lift of this lock is 17.61 ft., the depth of water over the sill is 22.24 ft., and the surface of the coping of the side walls is 45 ft. above the floor. It is clear, therefore, that the lower lock and intermediate gates must be of very large size.

Compared with the gates of other great locks these gates have the dimensions shown in the accompanying table. It is evident that a careful study was necessary before fixing upon the design of gates of such size.

Choice of Material.—Preliminary designs were prepared for gates of the kind now in use in the lock of 1881; for composite gates with timber arches and iron sheathing, and for metal gates with and without an air chamber. Estimates based on these designs at the prices of material ruling in 1886 to 1888 indicated that there would be but little difference in the first cost of gates of either material, the advantage lying with the timber, while it was probable that the metal structures would far outlast the others. This superior durability seemed probable from the fact that certain iron gates built in Germany more than 40 years ago are still in service and in excellent condition, while timber gates rarely last more than 25 years.

In this case also more than the usual number of objectionable features attached to the use of a roller to partially support the leaf, since the construction of trucks for such rollers would necessitate a modification of the projected filling and emptying system which was undesirable. Metal gates of the largest size may be constructed so as to carry the weight without the use of rollers, but with timber leaves of such large dimensions it is difficult to obtain the necessary rigidity of assemblage.

Experience in France has shown that, at the present day, leaves approaching the size of those under consideration can be constructed much more cheaply of metal than wood. In the United States the cost of timber is not so great as in France, but it is continually increasing. If the gates of the new lock were to be made of wood to-day they would need to be renewed in about 20 years, when the cost of timber would probably be so great as to compel the use of metal in the reconstruction, while the shape would have to correspond to the masonry and be still designed for the original wooden structure. Thus the shorter probable life of the timber gate, the difficulty in so assemblying it as to carry its great weight rigidly without a roller, and the fear of trouble in future renewal caused the selection of mild steel as the material.

Choice of Type.—Having chosen the material the type of leaf was selected with the view of attaining the greatest lightness and facility of operation consistent with safety. When the gates are first swung or when subsquently the lock is pumped dry, the stresses due to the full weight of the leaf are thrown on its pivot and anchorage. While maneuvering, a large part of the weight may be buoyed up by an air chamber, which is easily constructed in a metal gate; but even then an accidental blow may puncture the sheathing and throw nearly the whole weight onto the pivot and anchorage. It was, therefore, considered necessary to make the latter strong enough to carry the weight in air, and on this account even more than on the score of economy of material in the gate itself, it became desirable to reduce the weight of the leaf to a minimum.

Theoretically, the water pressure on lock gates mitering can be resisted with the least amount of material in the horizontal frames when the latter are in the form of segmental circular arches extending from quoin to quoin and subtending an angle of 133° 33′ 48″, of which each leaf, of course, subtends half. When the lock is 100 ft. wide, arched gates of this curvature will support a given normal pressure with about one-half the material which would be required in the lightest straight gates which can be designed with the same factor of safety.

In practice, with leaves of the span in question, so great a curvature has two objections, viz., it increases the depth of the gate recesses and it increases the tendency of the gate to warp under its own weight when swinging without a roller. By calculation it was found that the theoretical weight of arched leaves of the same span and different rises increases slowly at first and subsequently more rapidly as the radius increases. For example, if the weight of the lighted leaf with a curvature of 66° 46′ be taken as 100, the leaf 40° will weigh 122, while the leaf 22° will weigh 200. It being recognized as desirable to make the gates as light as possible, the type with fully arched horizontals was selected, but it was not pushed to the theoretical extreme on account of the objection to the great curvature.

The number of horizontals to employ was a question requiring consideration. There seemed but two alternatives, viz., to space either the horizontals or verticals closely enough to supply the main supports to the sheathing against local hydrostatic pressure. In the one case many horizontals would be used with a vertical system of less strength; in the other the horizontal strength of the leaf would be concentrated at the top and a vertical system would be used strong enough to receive the water pressure and transmit it to the sill and the horizontal member at the top of the leaf. The large amount of pressure thrown to the sill and the localization of the thrust against the masonry at the top of the hollow quoin are objections to the latter method when the actual load on the leaf is so great and therefore the former method was chosen.

For uniformity and simplicity of construction the same form was adopted for all the gates, although the selection was originally goverened by the great dimensions of the largest ones. The intermediate gate, 43 ft. high, is a duplicate of the lower lock gate. The upper lock and upper guard gates are 26½ ft. high and are duplicates, and the lower guard gate is the smallest, being 25½ ft. high.

Construction.—In Engineering News, Oct. 10 and 17, 1895, quite full drawings of the south leaf of the lower lock gate were published and may be referred to for information in addition to what is given here. This gate is designed to bear the pressure due to 21 ft. of water, and the maximum allowable stress adopted is 9,000 lbs. per sq. in., except in those parts which are most strained by the weight of the leaf, where the fiber stress exceeds this by 1,000 lbs per sq. in., when the leaf is in air.

Briefly described, the leaf is a steel structure having a framework sheathed on both sides with plates. It is curved in plain, the two leaves forming a continuous arch when closed. The upstream and downstream surfaces are portions of cylinders. The clear distance between the sheathing plates is 30 ins. at the ends and 36 ins. at the middle, this splay being given to make the interior more accessible and to allow for variations in the position of the curve of pressure. The body of the leaf is 43 ft. high surmounted by a footbridge 20 ins. high, the top of which is level with the coping of the side walls. The chord of the leaf measured between the centers of the surfaces of contact at the quoin and miter posts is 56 ft. 7.69 ins. The median circle measured between the same, a radius of 77 ft. 3.38 ins., and subtends an angle of 42° 59′ 40″. With the adopted construction the depth of the gate recess from the inmost element to the plane of the face of the lock wall is 8 ft. 7.13 ins. The weight of each leaf in air is 312,000 lbs.

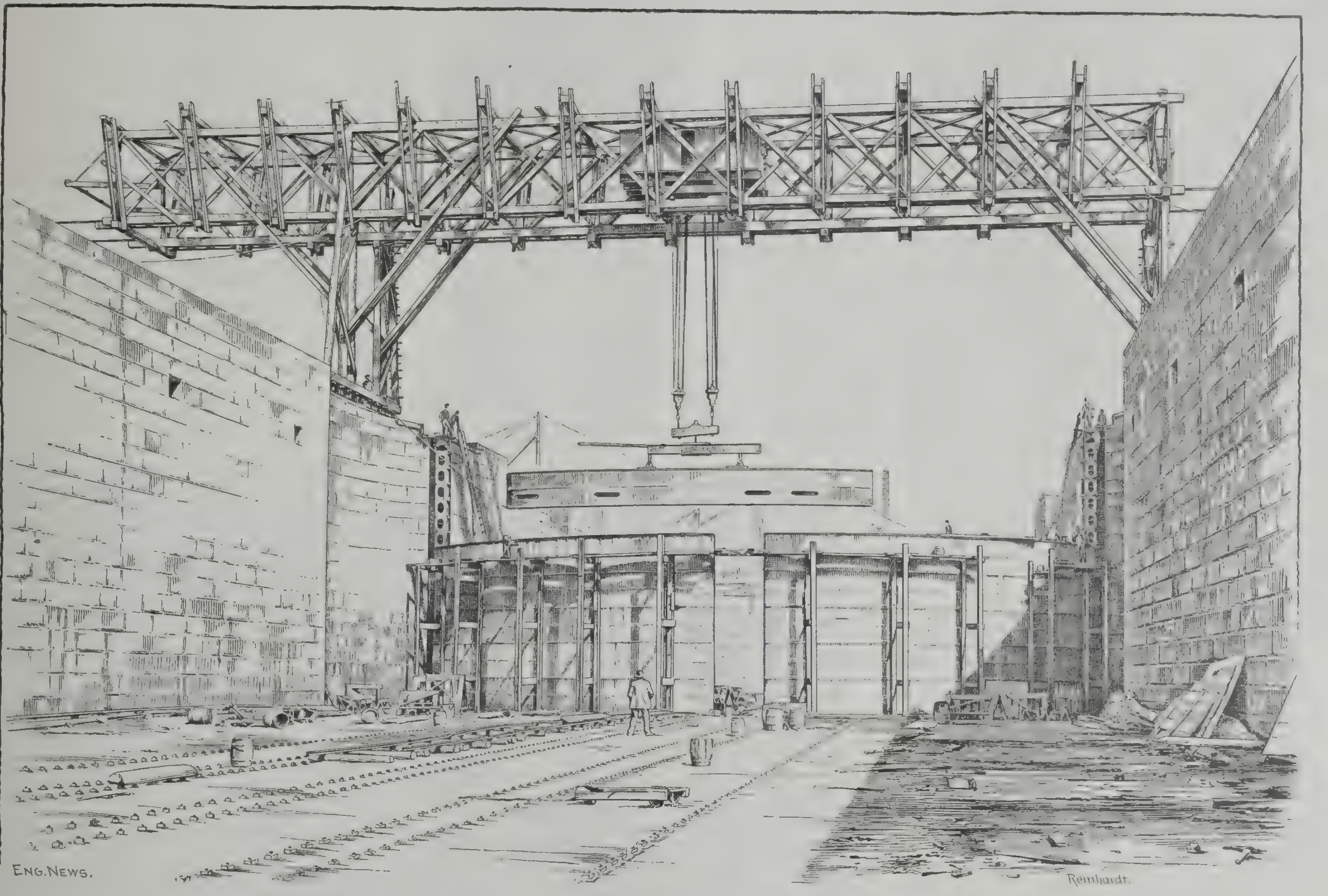

FIG. 2.—VIEW OF TRAVELER ERECTING STEEL GATES AT ST. MARY'S FALLS CANAL LOCK.

The framework of the leaf consists of 18 horizontal arches, the quoin and miter posts, seven vertical frames and a large number of intercostal stiffeners to strengthen the sheathing. The horizontal arches are uniformly spaced in a vertical direction 30 ins. apart, between centers, and are numbered from 1 to 18, beginning at the top. The space between arches 8 and 18 constitutes the air chamber which buoys up the leaf so that its weight in operation will be about 60,000 lbs.

The quoin post is made of ⅜-in. plates so curved in plan that the bearing of the post against the masonry is a plane surface 10 ins. wide. This plane is tangent to two cylindrical surfaces which round off the corners. There is no contact between the post and the hollow quoin until the leaf is completely closed. An oak cushion secures a water-tight joint when contact is secured. At the top of the post is a detachable gudgeon of forged high carbon steel 8 ins. in diameter, and at the bottom is a foot plate of like material having in its bottom a socket bushed with bronze. This socket fits onto a spherical pivot 10 ins. in diameter keyed into a circular bed plate of cast steel set in the lock floor.

The miter post is formed by bending the sheathing around the ends of the horizontal arches. Each holds by means of angles an oak cushion which forms the contact surface 12 ins. wide.

Between the quoin and the miter posts come the vertical frames. These consist of three full frames extending from top to bottom of the leaf and spaced at equal distances horizontally. These full frames divide the leaf into four water-tight bulkheads, each of which is provided with a pump. Between the full frames are four half frames which extend from the top to the bottom of the air chamber only and support its sides against the water pressure. To support the sheathing against local water pressure the intercostal stiffeners are used. These consist of angles extending vertically between the horizontal arches, and spaced to suit the pressure.

The sheathing is attached in horizontal strakes, each 60 ins. wide, except the bottom strake, which is 36 ins. wide. The joints are single riveted, covered on the inside by the horizontal arch angles and on the outside by cover plates. This sheathing performs a complex function; it acts as a web member against vertical shearing forces; it receives the water pressure and transmits it to the frames, and it acts with the frames to resist general structural strains.

In closing these paragraphs on construction a few words need to be said in explanation of the operation of the air chamber. When the leaf is closed and the rising level in the lock presses it against the sill, the bottom of the leaf as well as the vertical surface is exposed to pressure and a tendency to lift the leaf off its bearings is produced. As soon as the level of the water in the lock reaches the top of the air chamber it enters the leaf and thereafter as the water level rises the increasing weight of the water on top of the air chamber counterbalances the increasing pressure on the bottom. As the bottom of the air chamber has an area greater than the top and as the top of the air chamber is 2½ ft. above normal pool level the total upward pressure on the bottom of arch No. 18 exceeds the downward pressure on the top of arch No. 8, and the leaf requires a considerable preponderance of weight over buoyancy when swinging freely in order not to be lifted off its bearings when closed. This preponderance when moving is 22.7 tons at extreme high water and 52.2 tons at extreme low water, while the remaining stability when the lock is full is 5.8 tons.

Shop Work.—The principal features of the shop work arose in connection with the work of assembling and the bending of the heavy plates for the quoin and miter posts.

The posts were assembled in their natural positions with sheathing vertical. Four horizontal cells, i. e., two sections, beginning at the bottom of the leaf were first erected, carefully supported and leveled, and then the reaming and riveting done. The bottom section was then removed, the second section lowered into its place and the third section erected on top of the second section, and this process repeated until finally the top section of the leaf had been reamed and riveted. By this process there was never any excessive height of material at one time. The reaming was done mostly by portable reamers, some driven by compressed air and some by rope transmission. Wherever possible the riveting was done by compressed air riveters.

Several methods were devised and tried in bending the curved plates for the quoin and miter posts but the apparatus shown by Fig. 1

was the most successful. The heated plate was taken from the furnace and, having previously raised the rollers and I-beam sufficiently by drawing the wedges (w), was slipped onto the cast-iron frame. The wedges were then driven, the I-beam screwed down, and then the arms (a) simultaneously lowered to a horizontal position wrapping the heated plate tightly around the planed surface of the former. With this machine the work was done very rapidly and successfully.

Table Showing Dimensions, Cost, Etc., of St. Mary's Falls Lock Gates as Compared with Other Large Lock Gates in America and Europe.

Place.	Clear opening.	Height of body.	Length of chord	Material.	Weight per leaf (tons of 2,000 lbs.)	Cost per leaf.	Date of construction.	Remarks.
St. Mary's Falls Canal:	Ft.in.	Ft.in.	Ft.in.					
800-ft. lock	100 0	43 0	56 8	Steel	157.5	$19,369	In hand	Fully arched, double sheathed.
Lock of 1881	60 0	38 6	35 7	Timber	76.0	8,000	1880	Girders, trussed with iron rods.
Cascade Locks, largest leaf	80 0	54 0	51 4	Steel	158.5	*41,000	In hand	Fully arched, single sheathed.
David's Island	100 0	14 0	118 0	Timber	114.5	14,055	1885	Rolling caisson spanning lock.
St. Nazaire	82 0	33 6	44 11	Iron	...	30,000	1874	Plano convex, double sheathed.
Havre, France: Bellot	98 6	35 9	53 4	Iron	171.0	26,000	1886	Vertically framed, double sheathed
Transatlantic	100 0	34 9	56 7	Iron	175.0	31,000	1884	Vertically framed, double sheathed
Transatlantic, old	100 0	32 2	56 7	Timber	149.0	40,000	1861	Plano convex, back fully arched.
Dunkerque	69 0	27 9	38 4	Iron	49.0	6,500	1880	Vertically fr'm'd, with air chamber
Victoria Docks, old	80 0	31 0	46 4	Iron	110.0	10,800	1858	Fully arched, double sheathed.
Barry Dock	80 0	46 4	48 0	Iron	254.0	......	1889	Both faces curved, double sheathed
Avonmouth Docks	70 0	45 0	42 10	Timber	115.0	......	1877	Fully arched.
Manchester Canal: Eastham l'k	80 0	45 5	45 9	Timber	280.0	......	1893	Girders strengthened, iron plates.

Erection.—The quoin post of each leaf was built up complete with foot plates at the shops and shipped in one piece. The horizontal arches were built up as complete girders and each leaf was shipped in horizontal sections, composed of two such girders connected complete, with the cover plate that connects each section with the next section above riveted in place at the upper outside edge of each section, and the two angle irons and horizontal web plate similarly riveted on the inside, so that in erecting, when one section was placed on top of the other, the outside sheathing was simply dropped down between the cover plate and the corresponding angle irons. The riveting necessary to be done in the field was that of riveting each section to the quoin post, and one horizontal row of rivets on both sides of the gate between each section. The angle irons for holding the vertical wooden cushions in place at the toe were riveted to the gate after each leaf was erected.

After erection, the air chambers were calked water tight and subjected to a test of 25 lbs. per sq. in., hydraulic pressure, before being painted. All accessible joints were calked with a patent calking machine operated with compressed air. The calking was a very tedious and expensive operation. Fresh air had to be supplied to the men while working on the inside of the gates. This was accomplished by means of tapping the main air pipe leading from the air compressor at the electric light station to the drills working on the lock floor. The work of erecting the gates is not quite completed. The intermediate lock gate is yet to be calked and tested, and it together with the lower lock gate are not yet painted. The work of erection was begun in July, 1894, and was continuous to November 5, 1895. The average number of men per day engaged on the work during that time was 19. Fig. 2 shows the traveler for handling the section of the gates during the process of erection. The gates were shipped by rail and unloaded on the north side of the canal. A special derrick had to be erected alongside the railway for unloading the sections, and a tramway laid from there to and along the north side of the lock. The maximum weight of a section was about 17 tons. Each half of the upper and lower guard gates and the upper lock gates weighed approximately 100 tons, and those of the lower lock and intermediate gates, 175 tons each. The following is the approximate weight and cost of the gates:

2,404,657	lbs. soft steel at 5.9 cts. per lb.	$141,874.76
119,168	" high steel at 27¼ " " "	32,473.28
36,167	" cast steel at 9¼ " " "	3,345.45
8,665	" cast iron at 6 " " "	519.90
5,322	" phosphor bronze at 35 cts. per lb	1,862.70
7,215	ft. B. M. oak timber at $60 per M.	432.90
28	pumps and fittings	2,100.00
	Total	$182,608.99

The following are some of the principal weights and dimensions of the gates, which are collected here for easy reference:

Angle between chords of leaves when closed	170°	20′′
Clear width of lock	100 ft.	..... ins.
Width between centres of abutting surfaces in hollow quoins	105 "	4.81 "
Rise of median line measured from line joining above centers	20 "	9.08 "
Height of body of gate	43 "	..... "
Radius of median circle	77 "	3.38 "
Length of median circle developed	57 "	11.90 "
Length of chord	56 "	7.69 "
Weight of swinging part in air	156.0 tons	
Manoeuvering weight, air chamber immersed	22.7 "	
" " mean stage	37.9 "	
" " lowest stage	52.2 "	
Remaining stability, lock full	5.8 "	
Total thrust against masonry	1,650 "	
Horizontal pull on gudgeon in air	100 "	

The contractors for the gates were the Detroit Bridge & Iron Works, Detroit, Mich. All the soft steel was furnished to this firm by the Carnegie Steel Co., and the forged and cast steel by the Midvale Steel Co. The machining of the forged and cast steel was done by the Harlan & Hollingsworth Co., of Wilmington, Del.

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A SPECIAL SHEARING MACHINE for cutting up old boilers into scrap is in use at the famous Horwich works of the Lancaster & Yorkshire Ry. The machine was built by De Bergue & Co., of Manchester, and it is stated that by its aid three men can cut up a steel locomotive boiler in an hour.

TESTING MACHINE OF 200,000 LBS. CAPACITY FOR THE UNIVERSITY OF NEW YORK.

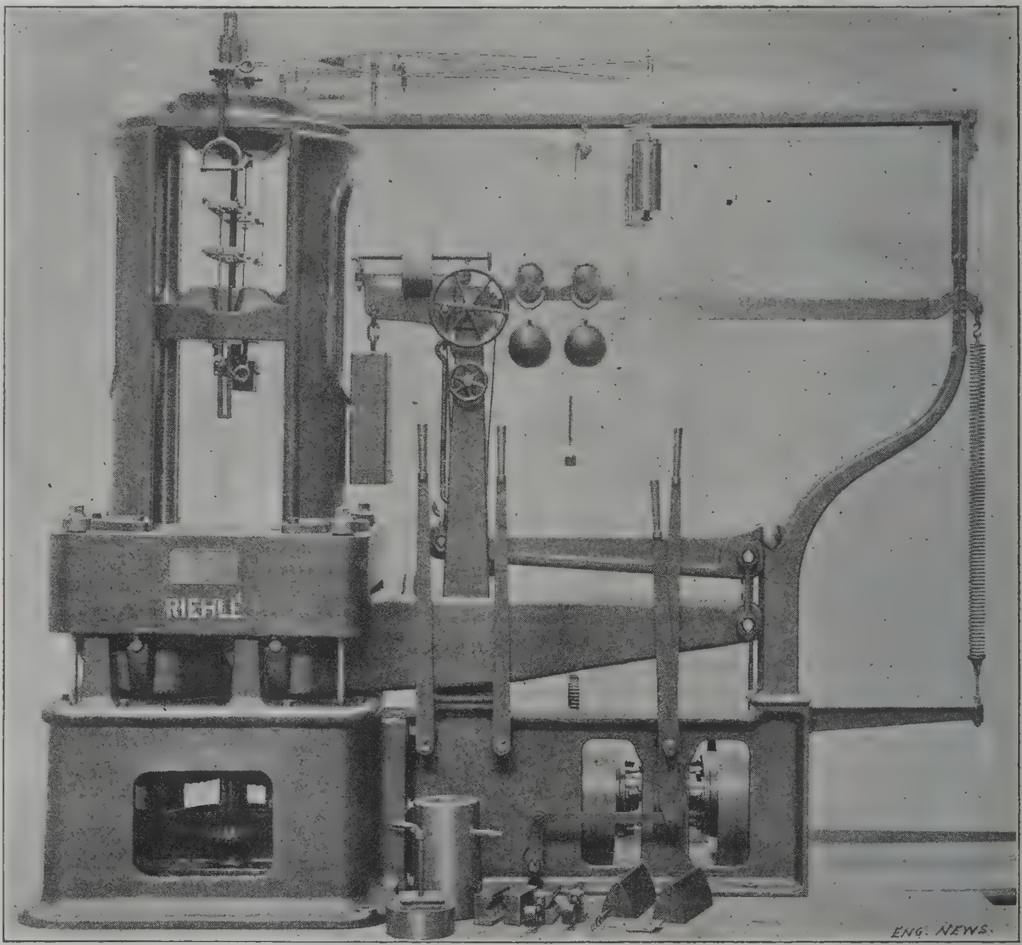
We illustrate herewith a new testing machine recently built by the Riehle Bros. Testing Machine Co., of Philadelphia, for the University of New York, in which are embodied a number of late improvements in machinery of this class, including the automatic recording attachment invented by Prof. Thomas Gray, M. Am. Soc. M. E., of Rose Polytechnic Institute. The machine was presented to the Engineering Department of the University by one of its undergraduate students.

The machine is 8 ft. 10 ins. high over all, and occupies a floor space of 3 ft. 7 ins. × 9 ft. 9 ins. Its shipping weight is 12,000 lbs. It will take tensile specimens up to 30 ins. in length, 2½ ins. diameter and 3 ins. square, transverse specimens 36 ins. long × 12 ins. wide, and compression specimens up to 24 ins. high. The various speeds obtainable are such that the head may be moved at 1-12, ¼, ⅓, ¾, 1, 2¼, 3¼, or 9 ins. per minute. The last speed, however, is not used for testing, but merely for setting the head. The extreme motion of the head is 2 ft. 6 ins.

The general construction of the machine will be evident from the engraving, but a few words of explanation may aid the reader. The top or fixed head is a steel casting resting on heavy columns, which are carried on the weighing table to which the name-plate is attached. The table rests on the knife-edges of the two main weighing levers, which transmit the pressure to the intermediate lever, which is in turn connected to the weighing beam.

The moving head is raised and lowered by two large vertical screws revolving in brass nuts secured to the head. The thrust bearings of these screws consist of hard steel balls rolling between the circular grooves of parallel plates. Spur-gears on these screws driven by a train of gearing leading to the driving pulleys effect the turning of the screws. Change of speeds or reversal of motion is effected by the hand levers seen in the cut, which operate clutches.

The apparatus seen at the top of the machine is the Gray automatic recording apparatus, which



TESTING MACHINE OF 200,000 LBS. CAPACITY, WITH GRAY AUTOMATIC RECORDING APPARATUS.
Built by the Riehle Bros. Testing Machine Co. for the University of New York.

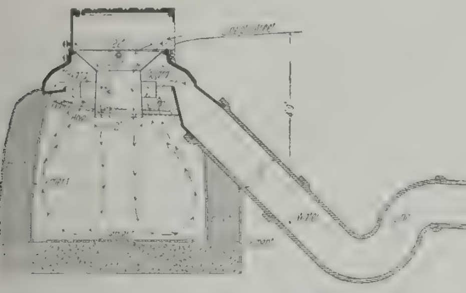
gives an autographic record both of the elongation within the elastic limit and of the total elongation up to the point of rupture. Briefly described it consists of two clamps fastened to the piece undergoing test and connected to a series of levers which magnify the elongation or compression of the specimen from 50 to 100 times, and move a pen up or down on a rotating drum, seen in the figure directly over the scale-beam. A detailed description with illustrations of this apparatus will be found in a paper by Prof. Gray, read before the American Society of Mechanical Engineers and published in its "Transactions," Vol. XIII., p. 633. It is also described in the "Digest of Physical Tests" for January, published by Frederick A. Riehle, Philadelphia.

A machine identical with the one illustrated, except that the Gray recording apparatus is omitted, has just been placed in the Washington gun factory of the U. S. Navy.

* * *

THE HERSHBERGER CATCH BASIN.

A catch basin especially designed to prevent blocking at the entrance while at the same time retaining all floating and suspended matter, is shown by the accompanying illustration. The water and matter carried by it enters the catch basin through a central inlet tube. The heavier dirt sinks to the bottom, and as the water flows to the sewer the lighter material is retained by the bottom and edge of the overflow channel and by the guard.



The Hershberger Catch-Basin. Made by the Bloomsburg Car Mfg. Co., Bloomsburg, Pa.

The overflow channel, or gutter, for the basin shown, is 5 ins. wide, 1 in. deep, opposite the outlet pipe, and 6 ins. deep at the outlet pipe, the bottom sloping towards the outside. The circular guard is attached to the inlet tube by means of three iron braces. Two holes, one of which is shown in the illustration, each 1 × 1½ ins., pierce the inner side of the gutter. They are designed to lower the water in the basin 5 ins., after the surface flow into the basin ceases, thereby lessening the danger from frost and reducing the amount of water to be bailed from the basin into the overflow channel when it is desired to clean the basin.

No bars are placed across the inlet, it being desired that all rubbish shall enter the basin. It is claimed by the inventor that the combined area of the space at the guard is more than double the area of the usual entrance to basins and it is about six times the area of the discharge pipe. Special advantages are also claimed for the frost resisting powers of the basin.

The device was invented by Mr. Jos. Hershberger, Plymouth, Pa., and is now being made and put on the market by the Bloomsburg Car Manufacturing Co., of Bloomsburg, Pa. About 60 of the basins are now being put in at Binghamton, N. Y.

* * *

HEATING A COTTON MILL FROM THE HOT WELL OF A CONDENSING ENGINE.

The following description of a novel system of mill heating is taken from a paper read by Mr. Geo. W. Weeks, agent of the Lancaster Mills, at a recent meeting of the New England Cotton Manufacturers' Association, and describes the system in use at those mills. We reprint the abstract from the "Providence Journal," and may remark that while the so-called technical matter published in the ordinary newspapers is apt to be worse than useless, the "Journal" is notable for the excellence of its articles on engineering subjects:

The Lancaster Mills are four stories high and have a basement, and are heated from the water discharged from the hot well of a compound engine driving the mill, and the air is forced through the heater and flues by the flywheel. A small engine and blower are used nights and Sundays when the large engine is not running.

The ordinary Corliss flywheel forced sufficient air for this purpose without alteration (it was found that the air pressure in one of the Corliss wheel pits equalled 1½ ins. of water), but the wheel of the engine used in the mill being made with arms so shaped as to pass through the air with the least resistance, it was necessary to add "wings" to them. This wheel is 16 ft. in diameter and runs at a belt speed of 4,000 ft. per minute. After the wings were attached there was obtained a movement of 8,000 cu. ft. of air per minute through the flues and mill with an expenditure of 3 HP., as shown by the indicator.

The air is taken mostly from the basement, where it enters from out-of-doors and largely from the connecting boiler house.

The heater is situated in the air duct leading to the flue, and consists of eight sections, each 42 ins. high by 28 ins. wide, with 204 ½-in. pipes, each 90 ins. long These sections are connected by pipe with the hot well, and so arranged that the end covers and diaphram causes the hot water to flow by gravity through half of the pipes in one direction and return through the other half, and then continue through the other sections in the same manner, and discharging where the air enters.

Small pipes were used in order to obtain the largest amount of heating surface in a given space, but as there is more heating surface than is needed, it would have been better, perhaps, to have used larger and fewer pipes so as to offer less resistance to the passage of the air.

With water from the hot well at 115° F., the air is heated to 100° F. In one test air was taken directly from out of doors, at a temperature of 26° and sent to the mill at 107°, with water taken from the hot well at 123¼° and discharged from the heater at 97½°. In practice the air is heated to within about 10° of the water used.

While heating the mill in December, before the large engine was started, the fan engine was run, exhausting the steam in the same heater. After the large engine was started, the fan was driven by belt from this engine, using hot water from the condenser of the heater, and while the walls were still wet, the mill having just been completed, with only a few looms in operation, 12,000 ft. of air per minute was forced into it, this being sufficient to heat it while in that condition. This required 8.81 HP., as shown by the indicator on the engine. As soon as the "wings" were put on the arms of the flywheel, the mill was heated with 8,000 cu. ft. of air per minute, as the looms were nearly all then in operation, and that was sufficient. It took 3 HP. only to furnish this air from the flywheel.

The blower was not arranged to be run at a speed to force 8,000 ft. per minute, but judging what it would take from the 12,000 ft., it would doubtless require 5¾ HP. to force 8,000 ft., or nearly double that required by the flywheel.

The use of the vapor on its way from the cylinder to the condenser, to add any heat needed to the air after passing the water heater, was suggested, but was not adopted, as the temperature at this point is only about 134°, while the weight of water in this vapor is very small as compared to the weight of water in the hot well, and this heater being a part of the condensing apparatus, would have to be absolutely tight, and as a consequence be rather costly. So, as the vapor was not utilized, a supplementary heater made exactly like the water heater was placed in the air duct between the water heater and the mill, taking the steam from the receiver between the two cylinders of the compound engine to heat it. This heater also takes the exhaust steam from the fan engine nights and Sundays. It was found that no steam was required in this heater while the mill was in operation, except in extremely cold weather, and last winter none at all was used in it.

It requires about double the heating surface to heat with water that it does to heat with steam, but as water heaters have to sustain no pressure, they can be furnished for a very little more than steam heaters made in the usual way.

Hot or cold water can be showered into the duct in the usual way when desired. When the weather becomes warm enough, so that no heat is required in the mill, the water from the condenser is turned off. and the engine flywheel continues to force the same amount of air through it for ventilating and cooling, and for this latter purpose cold water can be turned through the pipes in the same manner as water from the hot well.

During the time this plant has been used, it has required no repairs and has demonstrated that it will heat and ventilate the mill during the running hours with no expenditude for steam or power beyond the 3 HP. added to the engine as stated; that 100° temperature is sufficient to satisfactorily heat the mill, and that the air can be heated to this temperature, with water from the hot well with no loss of power, and the experiments tend to show that it is more economical (when the uptakes are built into the walls) to send a larger amount of air at a lower rather than a smaller amount at a higher temperature. Air heated to 97 7-10° at the heater is delivered to the fourth story at 94½°, showing a loss of only 3 2-10°, while the air at 124° at the heater was delivered at the fourth story at only 113°, showing a loss of 11°.

Much of the steam used to run the small blower engine, immediately after shutting down at night, and before starting up in the morning, is obtained without extra cost, as considerable of this would otherwise be blown off from the boilers at these times.

* * *

ROAD BUILDING IN LANCASTER, MASS.*

By Harold Parker.

The character of the country within the limits of Lancaster is favorable to the building of roads, as they can be easily drained. The soil is, in many places, composed of clean gravel, which, when properly selected and spread, will make a satisfactory road.

The town maintains nearly 100 miles of public highways, and expends for this purpose about $10,000 a year. New roads are constructed under special appropriations. The above amount is sufficient to keep all the roads in good condition, if they should be once made good. Nearly all the roads have been reconstructed within the past few years at considerable expense; and this has reduced materially the annual cost for maintenance, and made it possible to keep in good order a large number of routes and highways. This is mentioned to show that the sentiment of the people at large is changing in favor of permanent improvements.

The conditions are those of an ordinary country town. with the addition perhaps of the increased hauling of stone and wood to Clinton. There is also a very large amount of pleasure driving and bicycling.

The roads are classified roughly into three grades:

1. The main street and thoroughfares leading from it. The main street is a long road lined with houses, and so much used that the best gravel, spread in the ordinary way, will not answer except in summer. The following method has been successfully used: The roadbed was prepared with care both as to its crown and grade, stones about 4 to 5 ins. thick were placed on this, with the smaller part up when possible; on this were dumped smaller stones of nearly uniform size, and then evened off to give a surface corresponding with the finished cross section of the road; on this surface were placed still smaller stones which had been screened in the pit. These should be thoroughly rolled with a heavy roller and covered with a thin layer of clean gravel, which should also be rolled again after being thoroughly sprinkled. The objection to this road is that the gravel pounds up into powder, and this makes dust in dry weather and mud in wet. The cost of this road finished is from 30 to 35 cts. per sq. yd., which includes the cost of moving the old roadbed where necessary. The crown of this road is 1 in. in 2½ ft.

2. The roads outside the main line of travel. These are the ordinary gravel roads, and are made of the best selected gravel within reach. The larger stones are removed with a fork by a man placed on the cart while loading. Under the same conditions the gravel is screened. All cobble-stones collected either in the pit or elsewhere are used in road foundations and are covered by gravel. In this way all the roads are gradually getting stone foundation. Treated in this way, they stand up very much better while the frost is coming out in spring and are more easily repaired. In repairing in spring, where the roads are rutted, the road machine or scraper is used. Where the ruts are merely a displacement of the gravel, the scraper is made use of to replace it and remove the rut, but care is taken not to cut out a gutter or into the surface of the road in any way. A rake and shovel are then used, the surface is made even, and all loose stones, sods, and worn-out material are carefully removed; this refuse matter is dumped on the road side in two places, smoothed off and covered with loam on which grass readily grows, and this adds to the safety of the road as well as improving its looks. Particular care is used to prevent the grass from choking the water-way by the road side.

3. The unfrequented roads used mainly for hauling wood from wood lots to market and for pleasure driving in summer. Very few communities can do more than keep such roads good in summer, or from the time the frost is out of the ground in the spring until it freezes up in winter. The main thing to do is to keep as smooth and perfect a surface as is possible, fill up ruts as soon as made, remove all material that will interfere with the immediate escape of water, and all stones. In this case a road scraper can be used to great advantage, provided it is followed up at once with rake and shovel. The edge of the sod on road sides is cut with care, a line being used in order to get it straight, and offer as little obstruction to the passage of water as may be. Men are constantly employed in removing all loose stones from the roadway, which are carried to a point convenient for future use and are so piled that stones of the same size are placed by themselves. In this way the roads are gradually improving.

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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

We wonder how many mills and factories there are in this country in which the workers of all grades, from the manager down to the errand boys, are sweltering and suffering in these hot summer days, while just beside the mill there flows a stream of cool water. We wonder how many times in such mills men have looked out of the windows in hot August days and envied the fishes in the river below.

Probably thousands or tens of thousands have done this, and it is safe to say that quite a number must have had at least a wish that it were possible to distribute some cool breaths from the river through the hot stuffy rooms of the mill. And now it appears that up in New England some one has had the courage to break away from beaten paths and established precedents and actually do what thousands have wished were possible. He has done it moreover by methods and apparatus so simple that the wonder is that they have not been generally applied before.

In another column of this issue we print a brief description of this interesting new departure. Briefly told, it is a blower system for heating and ventilating, in which the pipes of the heater are filled with water from the hot well of the condensing engine instead of with steam. Of course, in hot weather it is a simple matter to force cold water from the river through the pipes instead of the hot water, and thus to distribute cool air instead of warm air. Another notable feature of the system—of course not an essential one—is the use of the fly-wheel of the main engine as a blower. Everyone who has stood near a great fly-wheel knows what a powerful blast it creates. The designer of this system has had the common-sense to utilize this to circulate the air over the heating pipes and through the conduits which distribute it to the various rooms of the mill.

It appears to us that there are some excellent features in this novel plant. In the first place we have the fuel economy of a condensing engine, combined with the economy due to the use of the waste heat of the engine for heating purposes, the same as when exhaust steam is used. It must be borne in mind that there is just as much heat in the water from the hot well, as there is in the steam that enters the condenser. It is at a lower temperature it is true; but to offset this it gives up its heat more readily, and as a heater using water does not operate under pressure it can be made very cheaply. By the use of the fly-wheel as a blower, not only is the cost of the power to run a separate blower, by a belt or a separate engine saved; but the cost of attendance and repairs, always apt to be heavy on machinery of this class, is also saved.

We regret that we have not yet been able to learn the name of the designer of this plant so as to give him the credit that is his due in publishing the description. It appears to us a most creditable piece of mechanical engineering, and one which could be studied with profit by any one interested in the problem of mill heating and ventilation.

◆

A correspondent calls our attention to the fact that our note of last week, in which we referred to Manhattan Island as the only place in the United States where the erection of overhead wires for electric railways is forbidden, is incorrect, as in Washington, D. C., a Congressional statute now forbids the erection of trolley wires. It is true that two street railway companies in Georgetown still use overhead wires; but their systems were built before Georgetown was made part of Washington. Our correspondent sends also the following additional note on the operation of the electrical conduit railways in Washington:

> The portion of the street railways operated within this city have horse, cables or underground electric systems. Congress seems to be firmly insistent on this policy. At the last session it authorized an experiment by one of the street railway companies in the use of compressed air motors, but required that in the event that system should not prove satisfactory to the municipal authorities that the company shall substitute an underground electric system.
>
> The underground systems in use here seem to give full satisfaction in their mechanical operation, and are not more objectionable in other respects than other street railways.

◆

The amended specifications under which Jersey City is for the sixth time inviting bids for a new water supply, noted briefly in another column, have been improved in some particulars, but still shut out all real competition for furnishing a gravity supply, and render the reception of bona fide bids for filtered water very unlikely. Under the new specifications the city reserves the option to purchase the works only at the end of each of the first three five-year periods of the contract, instead of at any time during the contract, as has heretofore been the case. This is in some respects a good change, as the contract will thus be surrounded with less uncertainty for the contractor. Another feature that might prove advantageous to the city is the giving of an opportunity to bid on delivering a part of the gravity supply to high and a part to low service, instead of all of it to either one or the other.

We are pleased to see that the filtration specifications are more liberal and reasonable than heretofore, though still requiring the construction of a pumping plant and force main to deliver the filtered water to the city reservoir and giving only three weeks or so for the preparation of bids. The standard of purity, it is interesting to note, omits the requirement that the contractor shall name the amount of chlorine that the filtrate shall contain, and adds one for the number of bacteria, both most sensible and excellent modifications. But the contractor is still required to guarantee the amount of nitrates in the filtered water, which, as we explained in our issues of April 30 and May 14, is a curious provision, to say the least. The filtration specifications appear to be drawn broadly enough to permit bids on any system until the specifications for the standard of purity are reached. These are so framed as to practically exclude mechanical filtration, or any system except slow sand filtration. Under the latter process contractors are left entirely free to design their plant as they see fit, instead of being limited in certain details, as before.

THE GRADE CROSSING COLLISION AT ATLANTIC CITY.

The most serious railway disaster that has occurred in this country for eight years, took place at a grade crossing of the Pennsylvania and Philadelphia & Reading railways, about two miles from Atlantic City, N. J., at 6:50 p. m., July 30, resulting in the death of 46 persons and the injury of about 60. The accident is the most fatal that has ever resulted from a grade-crossing collision, so far as our search of the records shows, and is exceeded in the number of its casualties by only five railway accidents that have ever occurred in this country.

The following account of the circumstances in connection with this terrible disaster we have gleaned partly from the very full newspaper reports which have been published, but chiefly from the reports of the Coroner's investigation, now in progress at the time this is written, and from facts reported direct to us by an engineer who visited the site of the disaster a few hours after the occurrence.

The Pennsylvania line, known as the West Jersey & Atlantic R. R., is a single track road, running from Atlantic City northwest and closely paralleling for a distance of several miles across the swamps the double track line of the Philadelphia & Atlantic City R. R., operated by the Philadelphia & Reading Co. The two lines cross at grade at a point just outside the limits of Atlantic City, as shown on the accompanying map, and just beyond that point the West Jersey line joins the tracks of the Camden and Atlantic R. R., also a Pennsylvania line.

The crossing is at an angle of about 15° and is protected by an interlocking machine operating home and distant signals on both lines, but with no derailing switches. The home signals are 197 ft. from the crossing on the west side, from which direction trains approach at the highest speed, and 107 ft. on the Atlantic City side. The distant signals are 1,050 ft. from the crossing, on the west side, and 950 ft. on the other side. Track instruments operating electric annunciators in the tower are placed 5,227 ft. distant from the crossing on the west side, and 5,066 ft. on the Atlantic City side.

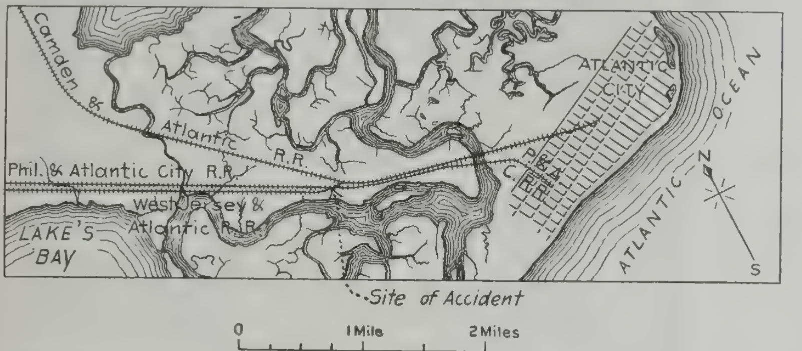
The crossing was established in 1886, under an agreement dated June 18, 1886, under which the Pennsylvania, as the company desiring to make the crossing, assumed the expense of its construction and also of its maintenance. The rules adopted for the use of the crossing and agreed to by the Superintendents of both roads, Aug. 11, 1886, were as follows:

> All engines and trains must approach the crossing carefully, prepared to come to a full stop at a distance of 150 ft. from the point of crossing, unless the proper signal for passing is displayed by the signalman in charge.
>
> In case of an engine or train approaching either crossing upon both roads at or about the same time, priority in the right of passage will be regulated as follows:
>
> 1—Passenger trains as a class.
> 2—Freight trains as a class.
> 3—All other trains as a class.
> 4—Engines without trains as a class.
>
> But as to each class the trains or engines of the P. & A. C. R. R. will have priority over the trains or engines of the W. J. & A. R. R. at the crossing north of Atlantic City, and the trains or engines of the W. J. & A. R. R. and C. & A. R. R. will have priority over the trains and engines of the P. & A. C. R. R. at the Baltic Avenue crossing, Atlantic City. No unnecessary detention to be caused to the trains of either road.
>
> The signals used will be the Semaphore Distant and Semaphore Home at the crossing north of Atlantic City, and the Semaphore Home at the Baltic Avenue crossing, Atlantic City.

The instructions as to signal indications which followed the above are merely those in practically universal use.

The events at the time of the accident were as follows: An excursion train, made up of a locomotive and six cars, heavily loaded, left Atlantic City, on the West Jersey road, about 6:30 p. m., and while crossing the southbound track of the Philadelphia & Atlantic City line at the above junction, it was struck between the first and second cars by an express train on that track. The locomotive demolished the second, and the third cars of the excursion train and the two following cars were telescoped more or less by the collision. It was in these four cars that practically all the casualties occurred. The locomotive and baggage car of the Reading train were wrecked and the engineer was instantly killed. The passenger cars of this train did not leave the track and their occupants were not injured.

After the accident the signals were found to be set to give a clear track for the West Jersey train, but both the home and distant signals of the Reading were at danger. The day towerman, Nicholas Long, testified before the Coroner's Jury that he left the tower in the charge of Geo. Hauser, the night towerman, at 6:40 p. m., and all signals were then at danger. Long had gone but 800 ft. from the tower when he heard the Reading train whistle and saw it coming a half mile away. At the same time he saw that the West Jersey train had the clear signals and was moving slowly toward the crossing. He watched, expecting to see the Reading train stop, but instead came the collision. He then went back to the tower and verified the position of the West Jersey signals. The distant signal on that road had then been thrown to caution behind the train, as is customary.



RAILWAYS IN THE VICINITY OF ATLANTIC CITY, N. J., SHOWING SITE OF GRADE CROSSING DISASTER OF JULY 30.

It will be apparent that the only question as to the responsibility of employees for the accident is as to whether the engineer of the Reading train ran onto the crossing in disregard of the warning of both distant and home signals, or whether Hauser, the night towerman, may have given a clear signal to the Reading train, and afterward changed the signals in the face of the approaching train to give a clear signal to the other road. It must be said that the evidence thus far presented appears to show very strongly that the former supposition is the correct one, and that the dead engineer disregarded both signals, and thus caused his own death and that of nearly fifty others. His train was a fast express train and was accustomed to the right of way. The other train was a heavy excursion train moving at a slow rate of speed. The towerman had both approaching trains in full view. If he gave the Reading express a clear signal when it was so near the crossing as to call the engineer ahead, he would not have had time to then change the signals so as to bring the slow moving West Jersey train on to the crossing in advance of the Reading. To put the case still more clearly, the Reading train must have approached the crossing ordinarily at a speed of 40 to 60 miles per hour. (It is scheduled to make the run from Philadelphia to Atlantic City, 55 miles, in 65 minutes.) The West Jersey train, according to various witnesses, moved slowly up to and on the crossing under clear home and distant signals. Of course, while the signals on that road stood at clear it was impossible for the towerman to have given a clear signal on the other line. Again, the day operator, Long, testified that if he had been in the tower he should have given the Reading train the right of way, and further that he had not stopped a Reading express train for three years. Evidently, then, it was an exceedingly unusual thing for the engineer of the Reading train to find the signals against him at this crossing. Experience has shown that habit is a most powerful factor in influencing men's actions, and the evidence seems overwhelming that the engineer approached this crossing at high speed, expecting to find it clear, as he had hundreds of times before, and in a moment of absentmindedness, he failed to notice and to realize the warning of the signals until it was too late to stop his train. We have said that he approached the crossing at a high rate of speed. The schedule time compelled fast running on the open road. The train left Camden 2½ minutes late and had made up 1½ minutes of this when it passed Pleasantville, three miles above the scene of the collision. But, although the train doubtless approached the distant signal at high speed, it is certain that its speed had been materially reduced when it struck the other train at the crossing. Had this not been the case the locomotive would have, in all probability, cut right through the other train, and it did not do this, but was itself diverted and thrown into the ditch without crossing the West Jersey track. Again, had the Reading train been moving at high speed, its cars back of the baggage car would, in all probability, have left the rails, and some casualties would have occurred to their passengers.

Since the above was written we have received the testimony given before the Coroner's Jury on Aug. 4, when Hauser, the towerman on duty at the time of the collision, gave his evidence, and the conductor, brakeman and fireman of the Reading express train and the engine crew of the West Jersey train were examined. The testimony of all these witnesses agreed very closely and fully corroborates the opinions stated above. It appears that the Reading train passed Pleasantville, three miles from the scene of the disaster, at a speed approaching 60 miles per hour. It was running probably not less than 50 miles per hour as it approached the distant signal. The point at which the engineer shut off steam and applied the brakes is uncertain, but it was probably not less than 900 ft. from the crossing and they may have been applied 100 to 200 ft back of the distant signal or 1,150 to 1,250 ft. from the crossing. The brakes appeared to have held well, as the brakeman on the train testified that he was thrown to the floor by the shock of their application, but the train was running at too high a speed to be stopped before it reached the crossing, and it struck the other train at a speed of 12 to 15 miles per hour.

It appears then that so far as the responsibility of employees are concerned, this terrible accident was due to an error of judgment of the engineer in approaching a distant signal at too high a speed, expecting, doubtless, to see the signals change to safety as he approached them. This is not the first time by any means in railway annals that disobedience to fixed signals has been the cause of serious accidents. We recall to mind among notable cases of this sort, a rear collision on the Fitchburg, near Boston, a few years ago; a drawbridge disaster near New Orleans at about the same time, and, as a still more notable cases the terrible disaster on the Grand Trunk Railway at the Richelieu River, in 1864, in which the number of killed and injured were greater than in almost any disaster in the history of railroading, and which was caused by the engineer running his train into the open draw in absolute disregard of a danger signal.

It may be said to be almost an axiom of railway practice that the two most dangerous points on a railway are a drawbridge opening, and a grade crossing of two railways. Many states have laws compelling trains to come to a full stop before crossing such points; but experience has shown that even this traffic-delaying expedient is far from being an infallible safeguard. On Nov. 21, 1862, a Boston & Maine train after stopping at the station at Charlestown, moved forward into an open draw at a rate hardly faster than a man could walk, and the accident caused the death of six persons. Not to enumerate other instances, it is sufficient to say that it is generally recognized to-day that the best protection for either grade crossings or drawbridges is an equipment of home and distant signals operated by an interlocking machine which also operates derailing switches, which are opened when the signals are at danger. In some states, notably in Illinois, where the law formerly required trains to come to a full stop when approaching a railway grade crossing, they are now allowed to proceed without stopping over crossings equipped with interlocking signals and derails.

The best practice in the protection of grade crossings and drawbridges now requires that either should have derailing switches interlocked with the signals, and in addition that electric locking should be applied to the machine to prevent the towerman from changing the position of the signals after he has given a clear track to a train until it has passed over the crossing.

Undoubtedly the greatest lesson for railway managers in this accident is that it is not safe to dispense with derailing switches at grade crossings. We are aware that some railway officers object that a derailment may cause as serious results as a collision. It is true that it may, but universal railroad experience shows that it very seldom does.

It is to be borne in mind always in considering this question that the moral effect of the derailing switch is such that it COMPELS obedience to the warning of the danger signals as no rules or discipline that the best manager can enforce can possibly do. The engineer knows that the normal position of the signals is at danger, and when he approaches them and sees them against him he too often thinks that it means nothing more than that the tower-operator has been a little dilatory in throwing his levers. But if he realize that to run past a danger signal means absolutely and invariably that his train is going off the rails, he has a much more powerful motive to induce him to keep his train under control as he approaches such signals.

The few advocates of automatic braking attachments to signals will doubtless use the Atlantic City collision as a warning text to prove the merit of their systems; but it is by no means clear that a safety device of this class would have prevented this accident. The engineer did apply his brakes, but he did not apply them soon enough. To have certainly prevented this accident an automatic brake-setting device would have to have been located probably at least 1,800 ft. from the crossing, and such an apparatus would be a serious hindrance to trains running at slow speeds.

When we take into account also the complications and difficulties which any automatic brake-setting attachment to signals must involve, it seems to be clear that the derailing switch is the best means yet devised for compelling obedience to a danger signal, and insuring also against a catastrophe in case of the sudden death or incapacity of the engineer, the failure of the brakes or other causes which may send a train past a danger signal without the engineer being blameable.

If any of our readers are still of the opinion that it is too dangerous to throw a train onto the ties, we can suggest nothing better than a trial of the German "sand track," described in one of our recent issues. It would be an inexpensive matter to add a few lengths of rail to the stub end of a derailing switch and cover it with sand, and experiments show that the retarding effects of such a track is greater than that offered to a train running over the ties.

Besides the necessity of the use of derailing switches, it seems to us that more care should be taken in defining the meaning and use of the distant signal in the instructions to engine men. There is a too prevalent idea, we fear, that the distant signal marks the point where brakes should be applied for a stop at the home signal, in case the semaphores are both against the train. Every railway manager should try to eradicate this idea from the minds of his men. The point where the brakes should be applied depends wholly on the speed of the train. Very slow trains have no need of or use for the distant signal, save in times of heavy fog or storm. It may be claimed that distant signals should be set back from the crossing far enough to enable the fastest train to be stopped by applying the brakes at the distant; but with some of the fast trains, running at speeds reaching 70 to 80 miles per hour, this would mean a great increase in the length of operating mechanism to the distant signal, additional trouble from temperature changes, etc., and greater difficulty on the part of the towerman in checking the movements of the distant signals. The better plan seems to be to keep distant signals where they now are (unless they are so located that they cannot be seen for some distance back) and give special instructions to engineers of fast trains respecting the speed at which distant signals may be passed.

It is a matter of history that the fall of the Ashtabula bridge in 1876, and ten years later the terrible disaster at White River, Vt., and at the fatal Bussey bridge had a great influence in bringing about a general inspection and overhauling of bridges and bridge floors, and the result was a great improvement in the railway bridges of this country. It is to be hoped that this fearful example of the dangers of grade crossings may cause greater care everywhere in their protection.

As we stated at the outset only five railway accidents in the United States have ever resulted in a greater number of deaths. The principal facts concerning the seven worst accidents ever recorded on railways of the United States are summarized in the following table:

Date.	Place and railroad.	Kind.	No. killed.
May 6, 1853	Norwalk, Ct. (N. Y. & N. H.)	Drawbridge,	46
July 17, 1856	Camphill, Pa. (Phil. & Reading)	Rear collision,	66
July 15, 1864	Port Jervis, N. Y. (Erie)	Head collision,	60
Dec. 29, 1876	Ashtabula, O. (L. S. & M. S.)	Bridge,	92
Aug. 10, 1887	Chatsworth, Ill. (T., P. & W'n.)	Culvert,	73
Oct. 10, 1888	Mud Run, Pa. (Lehigh Valley)	Rear collision,	60 to 70
July 30, 1896	Atlantic City, N. J. (Pa. & P. & R.)	Grade crossing,	46

THE RELATION BETWEEN PUTRID GASES AND typhoid fever, from the standpoint that such gases are predisposing causes of the disease, has been investigated by Dr. Giuseppe Alessi. By subjecting rats, guinea pigs and rabbits to an atmosphere containing the exhalations from excrementitious matter and later inoculating them with cultures of typhoid bacillus, watching the effects and making post mortem examinations of such animals as died, together with cultures from their organs, the doctor concludes that putrid gases predispose these animals to the pathogenic action of typhoid germs. Further and exhaustive studies led to the belief that the predisposition is caused by a combination of the gases given off by putrefaction, and not by any one of them, the animals being subjected to ammonia, sulphuretted hydrogen, carbonic acid, and other less well known gases, and subsequently inoculated with the typhoid bacillus. Long-continued breathing of the combined gases of putrefaction seemed to diminish the predisposition under discussion, but not to terminate it, although the experiments were limited in point of time. While discrediting the old theory which made the gases of putrefaction directly responsible for typhoid fever the experiments strongly confirm modern hygiene in its teachings that sewer air and other bad air should not be breathed. We are indebted to Mr. H. Alfred Roechling, Assoc. M. Inst. C. E., 14 Market St., Leicester, England, for a copy of Dr. Alessi's paper, reprinted, we suppose, for private circulation. The paper was translated by Misses E. and C. Harvey and contributed by Mr. Roechling to The Sanitary Institute, of which Mr. E. White Wallis, Parkes Museum, Margaret St., London, is secretary.

LETTERS TO THE EDITOR.

Summer Uniforms for Railway Employees.

Sir: American railway officers are as a rule noted for their practical good sense; but I have noticed of late what seems to me a great oversight on their part. During the hot weather of the present summer, when heat and humidity were competing to see which should do the most to make humanity suffer, and when everyone felt as if Adam's original costume were clothing enough, I have observed the conductors on several of our important railways sweltering and suffering in the heavy blue "Prince Alberts," which they are obliged to wear. It certainly ought to be possible to devise a uniform for summer wear, which would be far more comfortable, and I am sure that passenger trainmen and other railway employees would greatly appreciate the change. No man can perform his duties as well when bodily discomfort is constantly distracting his attention; and I believe that railway managers would find that uniforms for their employees suited to hot weather would pay large returns in the way of a better-looking and more polite staff, more alert in the performance of their duties. S .M. K.

New York, July 29, 1896.

Which Side of an Oak Tie to Lay Down.

Sir: Referring to the query of R. W. W. in your issue of July 23, as to which side of an oak tie should be up when laid in a dirt roadbed, one side having full face and the opposite side having corners rounded off, I think the rounded side should generally be placed up. Such a tie is frequently made from a tree large enough to make two ties to an 8 ft. section of the trunk, or what is commonly called a "split tie." If laid with the rounded side up, the grain of the wood will have a tendency to shed the water, whereas if laid with the full face, or heart side, up, the grain will tend to carry the water to the center of the tie. There would probably be at least ½-in. of sap at the rounded corners, and if placed down it will commence to rot quicker than if turned up; for in the latter position it will stand a better chance to dry out after rains. The full face side down will also hold better in the tamping. The rounded side will not give as good bearing for the rail, but in a dirt track it is fair to asume that the traffic is not heavy, consequently there will be no serious cutting of the rail into the tie. Yours very truly, F. G. Jonah.

Marine, Ill., July 27, 1896.

A Region Where Times are Good.

Sir: In this Bayou Lafourche section of Louisiana everything is on a boom. Good crops and plenty of money makes business good anywhere. A new railway is being built from the Mississippi River down the banks of Bayou Lafourche which will ultimately reach Lockport, a distance of about 60 miles. An ice factory has been started in Napoleonville and there is some talk of putting in water-works. Mr. Leon Godchaux, the largest sugar producer in the United States, is putting in an immense sugar mill and remodeling his Elm Hall refinery, enlarging its capacity from 900 tons per day to 1,200 tons. This is done to enable him to handle the enormous crop of 90,000 tons which he confidently expects to cut from this enormous estate. It is expected to turn out this season no less than 12,000,000 lbs. of fine quality "white granulated" sugar. The railway system on this plantation, consisting of 10 miles of track, will be extended about 4 miles, to enable him to handle the crop more expeditiously. Another 12-ton Baldwin locomotive will be added to the rolling stock. The track is of first-class steel rails with frogs and switches of the latest design.

A week ago the sugar house on the Souvenir Plantation, owned by Mr. Godchaux, was destroyed by fire. The loss amounted to $75,000. Within 12 hours after the fire started the plans were made and an order placed for a new refinery to take the place of the one burned. The contract calls for a complete sugar house, to be ready for grinding by Oct. 15 of this year. The new house will be of the latest design and double the capacity of the old one. W. Irving Willis.

Napoleonville, La., July 26, 1896.

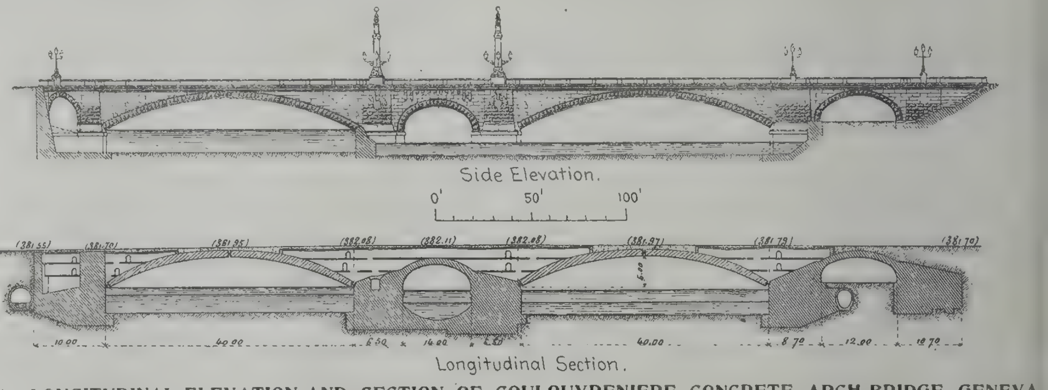


FIG. 1. - LONGITUDINAL ELEVATION AND SECTION OF COULOUVRENIERE CONCRETE ARCH BRIDGE, GENEVA, SWITZERLAND.

Bride's Sewer Flushing Device.

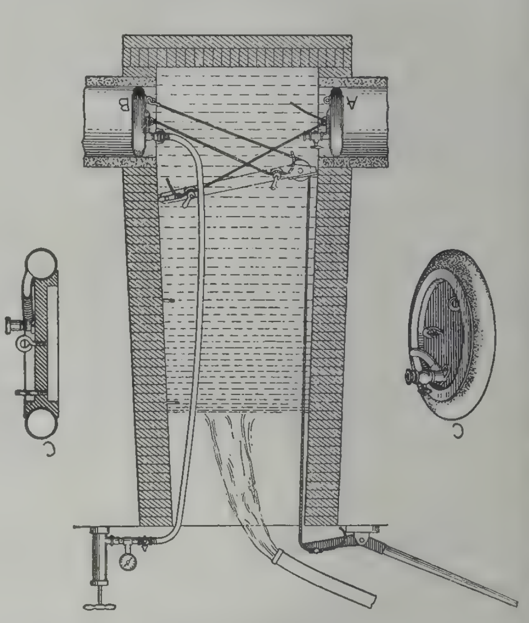
Sir: I enclose herewith a cut and description of a sewer flushing device which may be of interest to your readers. At the request of the inventor I gave it a trial on our sewers here and found it to work most satisfactorily.

In connection with the criticisms of flush tanks (see Eng. News, June 4, 1896), in the report of the annual convention of the American Water-Works Association, an inspection of this device is recommended.

Yours truly, Morris Hacker,
Civil Engineer Chevy Chase Land Co.

Chevy Chase, Md., June 22, 1896.

(The device in question is a stopper consisting of a circular block with a rubber ring around its rim. The ring is inflated after the stopper is inserted in the pipe, or pipes, leading from the manhole, thus making a water-tight seal. The manhole is then filled with water from a hose, or any other means provided, after which the stopper is suddenly withdrawn by means of the lever and accessories shown in the illustration. Mr. C. T. Bride, 129 B St., S. W., Washington, D. C., controls the device, which he states has been used by the sewer department of the District of Columbia.



A New Sewer Flushing Device.

It is, of course, no new thing to flush sewers by plugging the pipes leading from manholes. Where that system is in vogue this device may prove much more advantageous than some of those already in use, but automatic flush tanks will still be found advantageous and even necessary in many cities.—Ed.)

The Modified Darcy Formula and the New Westminster Steel Main Gagings.

Sir: So much attention is now being given to the very important practical question of how much water we may expect a pipe of given material, diameter and hydraulic gradient, and laid under ordinary practical conditions, to deliver, that such a communication as that contained in your issue of July 30, under the title of "Flowage Test of a 14-in. Riveted Steel Pipe," cannot fail to be interesting.

In this test the data were as follows: Observed discharge, 0.99 cu. ft. per sec.; fall per 1,000, 0.455; diameter, 1,167 ft.; character of pipe, riveted steel, rivets not countersunk. Applying the modification of Darcy's well-known formula for rough cast-iron pipes already communicated to your paper upon a previous occasion, we find an exact correspondence with observed results.

In order that your readers may check this assertion, if they see fit, I will give the generalized formula of Darcy, as follows:

$$Q = \sqrt{D^5 . h},$$

in which Q = cu. ft. per sec.; D = diameter in feet, and h = fall per thousand.

Inserting the given factors:

$$Q = \sqrt{1.167^5 \times 0.455} = 0.99 \text{ cu ft},$$

as observed,

From this it would appear that a new riveted steel pipe of the character described in the report is under the same conditions as regards discharge as a rough cast-iron one. After some years of service the above pipe will no doubt give a reduced delivery.

I have already taken occasion to call attention to the great simplicity and practical utility of the above generalized formula. It is adapted to the case of very rough cast-iron pipes, and will therefore in many cases give too small a discharge; in other words, it contains a factor of safety, as all practical engineering formulas should do. By a curious cancelling of factors, if we make Q = U. S. gallons per minute, and D = diameter in inches, then the above formula gives a discharge about 10% greater than for feet and seconds, and in many cases this would be nearer the truth than the original formula.

E. Sherman Gould,

Ortley Beach, N. J., July 30, 1896.

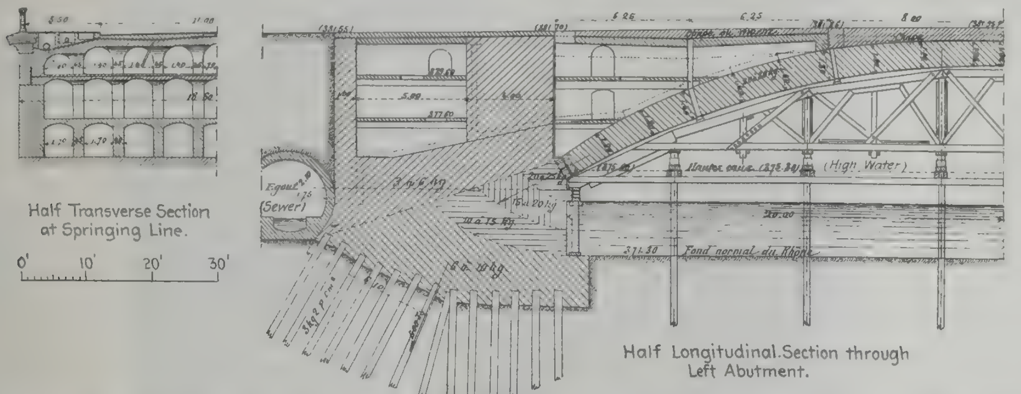

Half Transverse Section at Springing Line.
0' 10' 20' 30'
Egout (Sewer)
(High Water)
Fond normal du Rhône
Half Longitudinal.Section through Left Abutment.

FIG. 2.--SECTION SHOWING LEFT ABUTMENT, ARCH AND SPANDREL CONSTRUCTION, COULOUVRENIERE BRIDGE.

◆

Notes and Queries.

A. O. G. asks where iron sidewalks are manufactured and what are their merits and faults?

◆

THE COULOUVRENIERE CONCRETE ARCH BRIDGE, GENEVA, SWITZERLAND.

The success with which concrete, with or without a metal skeleton, lends itself to aesthetic treatment in the construction of street and park bridges has been mentioned often in Engineering News, and from time to time prominent American structures of this type have been described and illustrated in its columns. In Europe, however, the use of concrete for roadway bridges has been more extensive than in this country, and it was in Germany that the well-known concrete and iron constructions of Monier and Melan were first developed and exploited. But, besides these combination structures, concrete arches without metal skeletons have been built to a considerable extent in Europe, and European engineers are not infrequently found who prefer them to any of the patented constructions. As an example of this non-skeleton construction we illustrate herewith the Coulouvreniere Bridge, a concrete bridge of two 131.2-ft. spans, recently completed at Geneva, Switzerland. Besides its handsome appearance this bridge is notable for the boldness of its design, considering the material used and for numerous structural details which are not exemplified by such concrete arches as have been constructed in America up to the present time.

The Coulouvreniere Bridge crosses the River Rhone at Geneva, Switzerland, and was constructed to replace a bridge built in 1857, which in aesthetic qualities and strength had become undesirable. It was decided that the new bridge should be of concrete and should consist of two main arches separated by a central pier of considerable width, but the details of its construction and design were opened to competition. Designs were presented both for combination concrete and iron constructions and for articulated concrete construction, and the latter construction was adopted as preferable by the experts, who were Prof. Ritter, of the Zurich Polytechnic School, and Mr. Elstres, Engineer of the Jura-Simplon Ry. Co. The chief reason given by the experts for their choice was the lack of empirical evidence supporting the various theories as to the exact action of combination iron and concrete arches under stress; it was considered doubtful if the extension of the metal tension members under stress would not rupture the concrete in which they were imbedded, considering the length of the span.

The arch construction adopted can be hardly better described than by the term articulated, there being a steel joint at each springing line and at the crown, designed to fix definitely the curve of pressure and to reduce the danger of fissures from expansion or settlement under load. This design was submitted by M. Bois, one of the competitors, and has a counterpart in the Munderkingen Bridge in Wurtemberg. Fig. 1 shows a side elevation and longitudinal section of the structure. The span of each of the large arches is 40 m. (131.2 ft.) and the rise is 5.55 m. (18.2 ft.). The total length of the bridge is 152 m. (498.56 ft.), the width of roadway 11 m. (36 ft.), the width of sidewalks 3.5 m. (11.48 ft.) each, and the width over all 20 m. (65.6 ft.). The left-hand arch crosses the main channel of the river which always flows full since it is separated from the other branch of the river by a wing dam, but in high water both channels flow full. The center and right-hand arches cross this right-hand channel, in which the flow varies from almost nothing to 2,000 c. m. per second. The 12 m. (39.36 ft.) arch at the extreme right spans the quay on the right bank of the river.

With the exception of the left abutment, no great difficulties were encountered in any of the foundation work. This left abutment was on a bed of mud, and to render it safe against the weight a large number of piles had to be driven and capped with a thick mass of concrete. Fig. 2 shows the foundation as built and other features which will be noted further on. The character of the superstructure, of course, required unusual care to secure an unyielding foundation.

As has already been stated the main arches had spans of 40 m. (131.2 ft.) with three hinges or articulations each. Fig. 3 shows the character of the articulations and details of the abutment hinge. The crown hinge was exactly the same, but only 0.9 m. (2.95 ft.) deep. They were constructed entirely of steel and entirely buried in the concrete, except, of course, the bearing faces as shown. Each articulation or joint, running clear across the arch, required 60 frames of the character shown, or 30 concave and 30 convex bearings. Fig. 2 shows how each articulation is continued up through the spandrel filling.

To construct the arches centers were first built, as shown by Fig. 2. Upon these the concrete was laid in transverse, voussoir-like layers, Fig. 4, showing the method of work. Each voussoir was 1 m. (3.28 ft.) thick along the line of the intrados. Except that care was taken to even up the load on the centers by having voussoirs on the opposite haunches under construction simultaneously and to keep the centers carefully leveled, no exceptional precautions were taken. The composition of the concrete was 425 kg. (935 lbs.) of cement per 1 cu.m. (1.308 cu.yd.) of aggregate, which consisted of pebbles crushed to pass a hole of 3 cm. (1.18 in.) diameter. The concrete was mixed by machine. The placing of the concrete for the right-hand arch took 20 days and for the left-hand arch 10 days. The center for both arches was struck about 2½ months after their completion, the lowering being done gradually by letting the sand out of the boxes in which the posts rested. The settlement of the arches were as follows:

	Right Arch.	Left Arch.
Settlement upon striking center..	22 mm. (0.86 in.)	30 mm. (1.18 ins.)
Total settlement.	42 mm.(1.65 ins.)	38 mm. (1.49 ins.)

The character of the spandrel filling is shown clearly by Fig. 2, as is also the construction of the roadway and sidewalks. The sidewalk covers are plates of concrete with an embedded meshwork of iron. Various dimensions and details of construction not mentioned are shown by the illustrations. Exteriorly the bridge has the appearance of a stone structure of different kinds of stone, the piers being a yellow stone resting on granite, the spandrel walls white, the arch ring the natural concrete color, the cornice blue marble and the balustrade rose-colored granite. The construction was done by the city of Geneva, under the direction of its engineer, M. Butticaz.

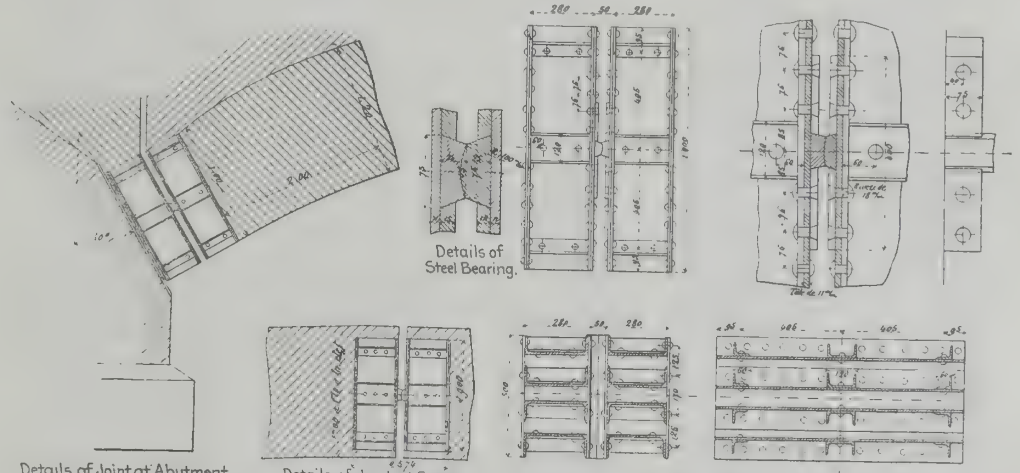

Details of Steel Bearing.
Details of Joint at Abutment.
Details of Joint at Crown.
Details of Hinges at Springing Line.

FIG. 3.—DETAILS OF ARCH HINGES, COULOUVRENIERE BRIDGE.

In its arch construction this bridge is a counterpart of the Munderkingen Bridge in Wurtemberg, which has a span of 50 m. (164 ft.) and a rise of 5 m. (16.4 ft.). Since the completion of the Coulouvreniere Bridge it has been subjected to some unusually heavy loads without exhibiting any deflection. The most notable of these loads were two locomotives weighing, together, 150 tons, which were taken across the structure one behind the other, and a test load of 500 kg. (1,100 lbs.) of gravel per square meter.

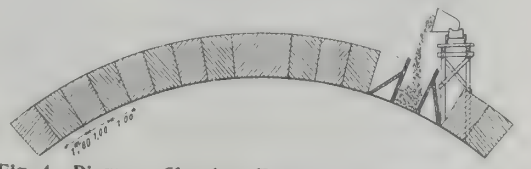


Fig. 4.—Diagram Showing Manner of Constructing Concrete Arch Ring, Coulouvreniere Bridge.

For the matter from which this description has been prepared we are indebted to our French contemporary, "Le Genie Civil."

PRELIMINARY REPORT OF THE COMMITTEE ON TESTS OF FIREPROOFING.

As most of our readers will remember, a series of tests of the resistance of structural materials to fire was arranged for several months ago, and the work was placed in the charge of an able committee consisting of Messrs. S. Albert Reed, representing the Tariff Association of New York; Geo. L. Heins, representing the Architectural League of New York, and Messrs. H. De B. Parsons and Thos. F. Rowland, Jr., representing the American Society of Mechanical Engineers.

This committee has just presented a preliminary report, showing the progress made to date in their work. The following is their report substantially in full:

Your committee, after having effected its own organization, determined to add to its numbers by the creation of an Advisory Board. This step was taken for the purpose of more widely increasing the interest taken in the experiments, and also to prevent, as far as possible, the impression that the work was of a sectional or local character. The names of the gentlemen who accepted invitations to serve on this Advisory Board, are as follows:

Edward Atkinson, President Boston Manufacturers' Mutual Fire Ins. Co.; Osborne Howes, Secretary Boston Board of Fire Underwriters; Charles A. Hexamer, Secretary Philadelphia Fire Underwriters' Association; H. H. Glidden, Manager Chicago Fire Underwriters' Association; W. Martin Aiken, Supervising Architect, U. S. Treasury Department, and Representative, Illinois Chapter, American Inst. of Architects; Stevenson Constable, Superintendent of Building Department, New York city; Geo. B. Post, New York Chapter, American Inst. of Architects; F. H. Kindl, Structural Engineer, Carnegie Steel Co.; John R. Freeman, Chief of Inspection Department Factory Mutual Ins. Co's; Henry Morton, President Stevens Institute of Technology; C. J. H. Woodbury, M. Am. Soc. C. E.: H. B. Dwight, Dwight Survey & Protection Bureau, New York; F. C. Moore, Delegate N. Y. Board of Fire Underwriters to Board of Examiners of Department of Buildings; Wm. A. Wahl, Secretary Franklin Institute, Philadelphia; John T. Williams.

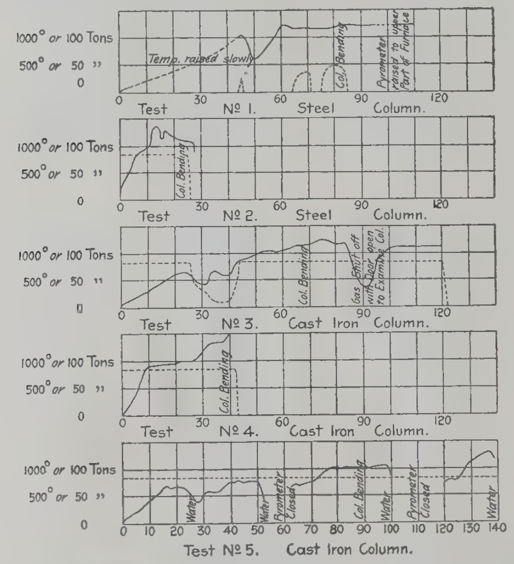


Fig. 2.--Results of Tests of Loaded Columns Exposed to Heat.

(Solid lines show temperature. Dotted lines show load on column.)

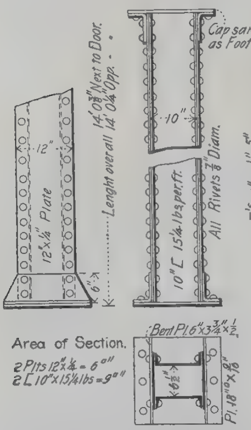


Fig. 3.—Details of Steel Column Tested in Test No. 1.

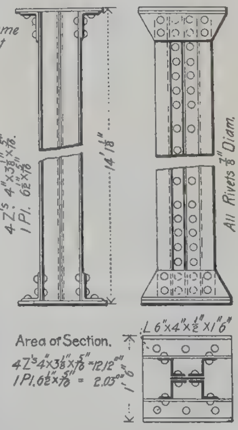


Fig. 4.—Details of Steel Column Tested in Test No. 2.

During the winter just past your committee erected a testing plant, as shown in the accompanying photograph (Fig. 1). The gas producer in the back ground is 9 ft. in diameter by 12 ft. in height, and is equipped with a hopper valve on top. Gas is generated by means of steam from the boiler as shown, and carried into the furnaces through pipes, as clearly indicated in Fig. 1. The foundation shown on the left is ready for the erection upon it of a furnace for testing beams and floors. It will be 27 ft. × 12 ft., but it can be arranged to take larger beams if so desired. The furnace shown on the right is for testing columns and is 14 ft. square, outside measurement.

The arched roof is made of fire brick and is independent of the side walls, being supported by outside corner posts. The walls are of common brick, but can easily be changed so that experiments can be made on other materials. One side wall and the end wall with the door, are 12½ ins. in thickness; the rear wall is 8½ ins. and the fourth wall is 4 ins. inside, 2 ins. air space and 8½ ins. outside, making a total thickness of 14½ ins. The floor is covered with fire brick, with openings left for the branch gas pipes and air spaces to support the combustion. These branch gas pipes are 4 ins. in diameter, capped with tuyeres reduced to 2 ins. In order to increase the temperature when desired, a barrel of naphtha is connected by means of a small pipe and blown into the gas pipe at the "Y" branch, by means of a steam jet.

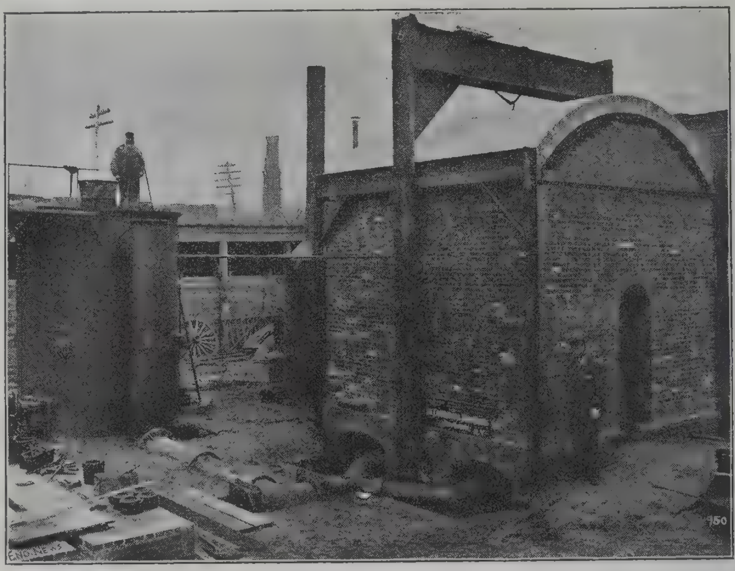


FIG. 1.—APPARATUS FOR TESTING THE EFFECT OF HEAT UPON STRUCTURAL MATERIALS.

The column is placed in compression by means of an hydraulic ram underneath, resting on three 24-in. I-beams, the same as those across the top of the furnace shown in the photograph. In order to keep the entire length of the column within the furnace, filler blocks of cast iron are placed between the ends of the column and these I-beams. The hydraulic ram is 12 ins. in diameter, and the water pressure can be carried to 2,500 lbs. per sq. in. The temperature is measured by means of a Uchling & Steinbart pyrometer (illustrated and described in Engineering News, Nov. 14, 1895).

The money to carry out this work has been advanced by various parties, and, together with the committee's disbursements, is shown in the accompanying treasurer's report.

(We omit the detailed report. It shows that $3,055 have been subscribed, chiefly by underwriters' associations, and $2,336.38 have been expended, of which about $2,000 was for constructing the apparatus shown in Fig. 1. The committee still owes $766.92, thus having spent to date about $30 more than the amount subscribed.—Ed.)

Your committee decided that it would be best to make the tests according to the following programme:

1. That a series of tests be made on columns of steel and of cast iron, without any fire protection whatever, these tests then to be taken as a basis of comparison with those that follow.

3. That a series of tests be made on unprotected beams and cast-iron columns, protected with different materials and in different ways.

3. That a series of tests be made on unprotected beams and girders.

4. That a series of tests be made on protected beams and girders.

It has also been proposed that each series be divided for test both with and without water.

Your committee has communicated with many manufacturers of fireproofing materials and has been informed that these manufacturers will submit their materials for purposes of tests.

Results of Tests of Unprotected Columns.

The result of this series of tests is shown in the accompanying diagram, Fig. 2, where the solid lines represent the temperature and the dotted lines the loads on the columns.

Test No. 1 was made on a steel column and the temperature was raised rapidly. Test No. 3 was made on a cast-iron column under similar conditions. Both columns began to fail as soon as they showed "red."

Test No. 2 was made on a steel column and the temperature was raised more slowly than in the other tests just described. Test No. 4 was made on a cast-iron column under similar conditions. Both these columns failed when they began to show "red," although the time was longer than in Tests Nos. 1 and 3.

Test No. 5 was made on a cast-iron column, and after heating a jet of water was thrown upon it through a ¾-in. nozzle. The column was first heated to 675° and then quenched with water without injury. The heat was then slowly raised again to 775° and the column again quenched with water. The heat was then raised slowly to a temperature of 1,075°, and the column, which then showed a "dull redness," was again quenched with water. The heat was then raised again to 1,300°, and the column, which now showed a "bright red," was again quenched with water. The column was beginning to yield by bending just before the last application of the water. The column was apparently unaffected by water, although it failed by bending under the load, the same as in Tests 3 and 4.

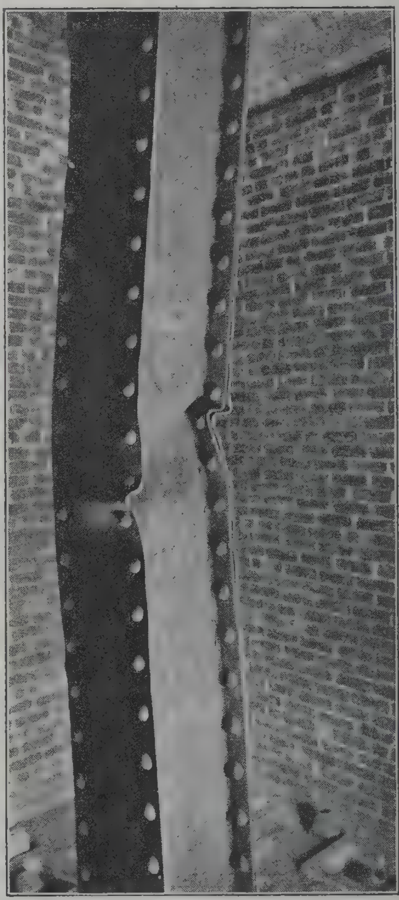


Fig. 5.—View of Column (Test No. 1) in the Furnace After Testing.

Detailed Log of Tests.

Column Test No. 1.—Fire Test without Water, Steel Column, May 19, 1896.

The walls of the furnace were of common brick, as already described, and the door was closed with a double thickness of sheet iron, which made the opening practically tight. The column was a Carnegie steel box channel, of the dimensions shown in Fig. 3 and was unprotected.

The gas producer was fired the day before, with valve closed against the furnace. The packing in the hydraulic cylinder leaked and a fitting of the pipe gave out as the test started. These causes delayed the use of the water pressure.

Log.

Time, h. m.	Pyrometer deg. F.	Hyd. pressure, tot'l l'd, tons.	Remarks.
10:35	.....	.....	Wood fire lit.
10:45	.....	.....	Gas turned into furnace.
11:02	.....	.....	Furnace door closed.
11:03	.....	.....	Naphtha valve slightly open.
11:13	.....	.....	Pyrometer put in furnace through lower hole, 2½ ft. abv. furnace door, with point 12 ins. from column.
11:19	1,025	.....	Pressure on column; light load.
11:20	1,050	.....	Pyrometer point 24 ins. from column.
11:25	600	.....	Raking gas producer; gas shut.
11:28	.....	.....	Gas turned on again.
11:33	1,025	.....	No naphtha.
11:36	1,225	.....	Half faucet of naphtha.
11:38	1,200	.....	
11:40	1,175	14.13	Water pressure on.
11:41	1,180	28.26	Quarter faucet of naphtha.
11:46	1,175	.....	Pressure off, water valve rep'k'd.
11:50	1,175	.....	Closed all air openings; water pressure on.
11:55	1,200	48.06	Column began to show "red."
11:56	1,210	.....	Column began to yield.
11:59	1,225	42.41	Hydraulic pressure falling fast.
12:10	1,230	.....	Pyrometer shut off; raised to upper hole, 8½ ft. above floor, and point 3 ft. from column.
12:16	1,230	.....	
12:25	1,250	.....	Gas shut off.

The column would have failed sooner if the working load of 80 tons could have been used. The result of the test is shown in the flashlight photograph (Fig. 5) taken of the column before it was disturbed. After the column was removed from the furnace Fig. 6 was taken. The brick walls of the furnace were cracked, the greatest damage taking place where one wall was bonded into the next and the cracks at these places extended through the bricks. Along the horizontal joints the walls cracked most on the bond courses. All the walls were hot, the 8-in. wall being too hot to hold the hand in contact with it.

Strength by Gordon's formula:

Breaking strength, per sq. in......45,630 lbs.
Area of cross-section ....15 sq. ins.
Breaking load......15 × 45,630 = 684,450 lbs. = 342 tons.

Actual greatest load, cold, 141.4 tons, with no change of form.

Column Test No. 2.—Fire Test without Water; Steel Column; Furnace Same as Test No. 1. May 27, 1896.

The column was a Carnegie steel Z-bar, as shown in Fig. 4, and was uncovered.

Log.

Time, h. m.	Pyrometer deg. F.	Hyd. pressure, tot'l l'd, tons.	Remarks.
2:23	80	.....	Pyrometer point 3 ft. from col.
2:24	200	84.8	Wood fire lit.
2:30	650	84.8	Gas turned on.
2:33	....	84.8	Door closed; full cock naphtha.
2:35	1,000	84.8	One-quarter cock of naphtha.
2:36	1,300	84.8	
2:37	1,350	84.8	
2:38	1,375	84.8	Naphtha closed.
2:39	1,300	84.8	
2:40	1,125	84.8	One-eighth cock of naphtha.
2:40½	1,300	84.8	
2:41	1,325	84.8	
2:42	1,250	84.8	
2:43	1,200	84.8	
2:44	1,175	84.8	Naph. cock closed to "dropping"
2:45	.....	84.8	Pyrometer moved to 2 ft. from column as flame touched point.
2:46	1,125	84.8	Column began to yield.
2:47	1,125	84.8	Column yielding fast.
2:49	1,100	84.8	Impossible maintain hyd. press.
2:51	1,100	84.8	Pump and gas stopped.
2:52	900	84.8	Pyrometer closed.

The result of this test is shown in the photograph, Fig. 7.

Strength by Gordon's formula:

Breaking strength, per sq. in......42,820 lbs.
Area of cross-section ....14.15 sq. ins.
Breaking load..14.15 × 42,820 = 605,900 lbs. = 303 tons.

Column Test No. 3.—Fire Test without Water; Cast-iron Column; Furnace same as Tests 1 and 2. June 30, '96.

The column was a cast iron, hollow, round column, with flanges faced on both ends, as shown in Fig. 8, and was uncovered. It was cast horizontally, with a dry sand core, by the Cornell Iron Works, New York.

Log.

Time, h. m.	Pyrometer deg. F.	Hyd. pressure, tot'l l'd, tons.	Remarks.
2.32	.....	14.1	Wood fire lit.
2:45	.....	84.8	Gas lit, door being closed.
2:50	.....	84.8	Pyrometer in place, 18 ins. from column.
2:51	575	84.8	
2:54	625	84.8	
2:57	625	84.8	Gas shut off to poke producer.
2:59	500	84.8	
3:00	475	56.5	Removed loose bricks; interfered with tuyeres.
3:04	425	28.2	
3:05	450	.....	Gas truned on; door closed.
3:06	650	15.5	
3:08	667	.....	Air openings closed.
3:12	600	11.3	Door down to arrange bricks.
3:13	650	.....	Door closed.
3:13½	750	.....	Naphtha valve opened one-half.
3:14	750	.....	
3:15	812	42.4	
3:17	900	84.8	
3:21	950	84.8	
3:23	1,000	84.8	
3:25	1,025	84.8	
3:28	1,050	84.8	
3:30	1,025	84.8	
3:32	1,025	84.8	
3:36	1,100	84.8	
3:37	1,125	84.8	Slight redness reported by some.
3:40	1,137	84.8	Column reported bent slightly.
3:43	1,175	84.8	
3:44	1,200	84.8	
3:47	1,250	84.8	
3:50	1,225	84.8	
3:52	1,175	84.8	
3:55	1,200	84.8	Gas shut off; door down; column decidedly red and bent.
4:04	387	84.8	Gas on and door closed.
4:08	925	84.8	No naphtha.
4:09	925	84.8	Naphtha turned on one-half cock
4:10	1,000	84.8	
4:15	1.112	84.8	
4:32	1,125	84.8	Gas shut off; stopped pumping.

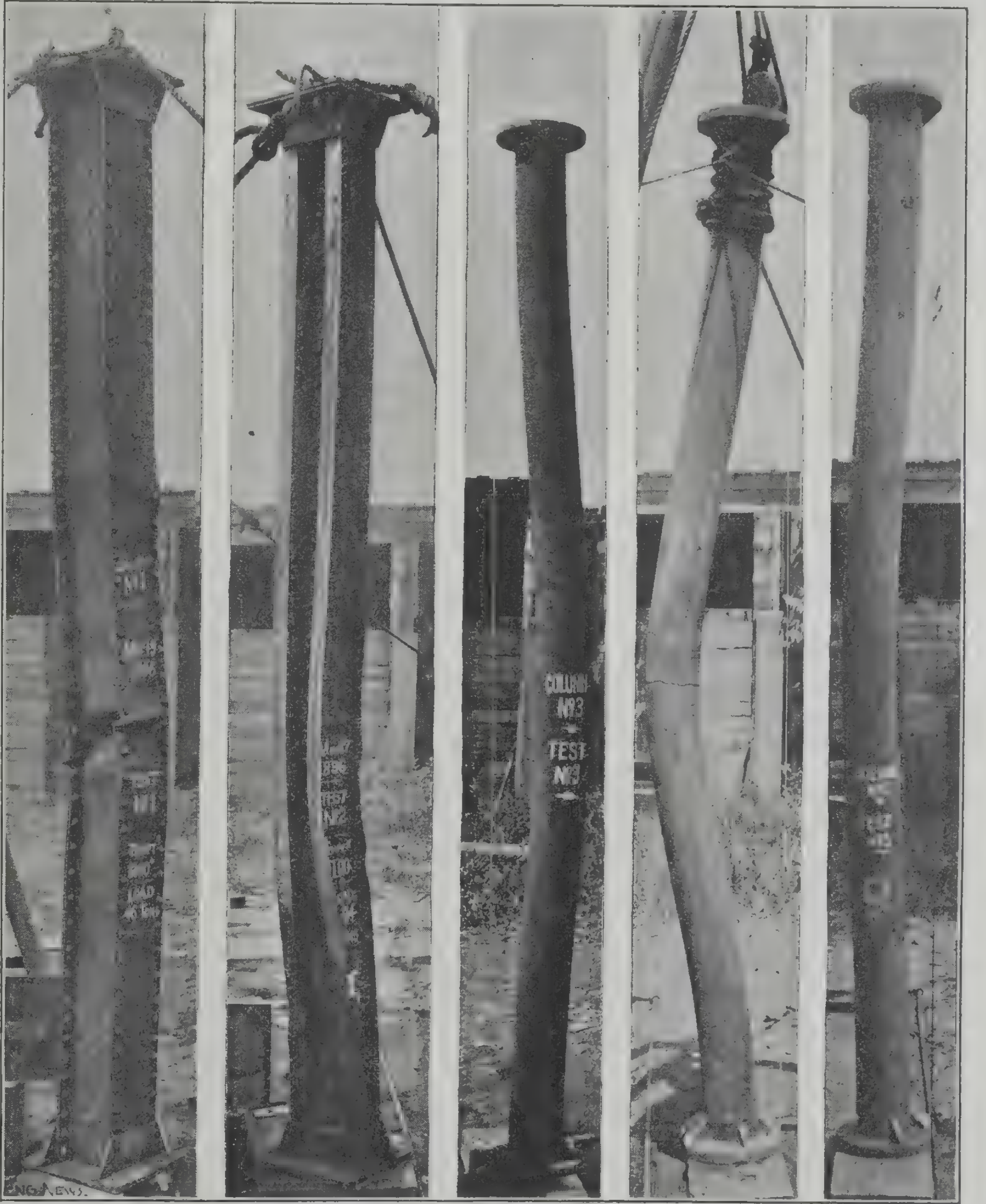


Fig 6.—Steel Column, Load, 46 tons, Temp., 1,200°.
Fig. 7.—Steel Column, Load, 84 tons, Temp,, 1,100°.
Fig. 8.—Cast-iron Column, Load, 84.8 tons, Temp., 1,100°.
Fig. 9.—Cast-iron Column, Load, 84.8 tons, Temp., 1,550°.
Fig. 10.—Cast-iron Column, Load, 84.8 tons. Temp., 1,300°.

FIGS. 6 TO 10.—VIEWS OF COLUMNS AFTER REMOVAL FROM THE FURNACE.

Strength by Gordon's formula was as follows:

Breaking strength ....902,000 lbs.
Safe load..... ....1-5 × 902,000 = 180,400 lbs. = 90.2 tons.

The result of test No. 3 is shown in the photograph, Fig. 8.

Column Test No. 4.—Fire Test without Water; Cast-iron Column; Furnace same as Tests 1, 2, and 3. July 6, 1896.

The column was a cast-iron, hollow, round column with flanges faced on both ends, and was uncovered. It was cast horizontally with a dry sand core, by the Cornell Iron Works, N. Y. The column had a length over all of 13 ft. ¼-in., thickness of flanges 1⅝ ins. flanges reinforced by four ribs, each ⅞-in. thick, reaching from outer end of flange to cylinder at an angle of about 45°.

Log.

Time, h. m.	Pyrometer deg. F.	Hyd. pressure, tot'l l'd, tons.	Remarks.
2:22	.....	.....	Wood fire lighted.
2:25	.....	84.8	Gas lighted.
2:28	.....	84.8	Pyrometer placed 18 ins. from column.
2:29	.....	84.8	Door closed.
2:30	675	84.8	
2:31	875	84.8	
2:33	900	84.8	
2:35	912	84.8	
2:40	950	84.8	
2:43	975	84.8	
2:44	1,000	84.8	
2:45	1,000	84.8	
2:49	1,000	84.8	Naphtha used, ¼ cock.
2:51	1,125	84.8	
2:52	1,100	84.8	More naphtha, ⅜ cock.
2:53	1,200	84.8	More gas.
2:54	1,300	96.1	
2:54½	1,325	84.8	
2:57	1,350	84.8	Column bending.
2:59	1,350	84.8	More naphtha, ½ cock.
3:01	1,375	84.8	Color reported.
3:03	1,500	84.8	
3:03½	1,525	84.8	Column yielding fast.
3:05	1,550	84.8	Column broke suddenly.

The result of the test is shown in the photograph, Fig. 9. The fracture occurred at about the center of the column where the deflection was the greatest. There was a crack about 5 ins. long, about 7 ins. above the fracture on the convex side of the column, showing that the column first pulled apart on the outside of the bend. No water was thrown on this column during the test.

Column Test No. 5.—Fire Test with Water; Cast-iron Column; Furnace same as Tests 1, 2, 3 and 4. July 10, 1896.

The column was a cast-iron, hollow, round column, with flanges faced on both ends, and was uncovered. It was cast horizontally with a dry sand core, by the Cornell

Iron Works, N. Y. The column was 8 ins. in diameter, outside and 1 in. thick, the end flanges were 1⅝ ins. thick, and were reinforced with four ribs, as in test No. 4. There was a slight defect in this casting, there being a porous portion a few inches long on one side about 3 ft. 6 ins. from the lower end.

Water was thrown upon the column through about 50 ft. of 2½-in rubber hose, and a ¾-in. nozzle. The pressure at the hydrant was 50 lbs.

Log.

Time, h. m.	Pyrometer deg. F.	Hyd. pressure, tot'l l'd, tons.	Remarks.
2:16	.....	84.8	Wood fire lighted.
2:28	.....	84.8	Gas lighted.
2:29	600	84.8	Door closed; pyrometer in place 18 ins. from column.
2:31	625	84.8	
2:32	675	84.8	
2:33	700	84.8	
2:36	675	84.8	Pyrometer moved back 5 ft. from column.
2:40	625	84.8	
2:41	675	84.8	
2:42	525	84.8	Water thrown on column 1 min.
2:43	450	84.8	Door open; fire out.
2:44	400	84.8	Door open; fire relighted.
2:46	425	84.8	Door closed.
2:47	540	84.8	
2:49	1,000	84.8	Heat raising too fast.
2:51	650	84.8	
2.52	675	84.8	
2:55	700	84.8	
2:58	750	84.8	Pyrometer 3 ft. from column.
2:59	800	84.8	
3:01	740	84.8	
3:02	750	84.8	Pyrometer 18 ins. from column.
3:05	785	84.8	Pyrometer moved back 5 ft.
3:06	775	84.8	
3:09	400	84.8	Water on column ½ minute; fire out; door down.
3:16	.....	.....	Gas relighted; door closed.
3:19	675	84.8	Pyrometer 18 ins. from column.
3:22	700	84.8	More air admitted.
3:24	725	84.8	
3:27	775	84.8	
3:28	800	84.8	
3:30	900	84.8	
3:35	1,025	84.8	
3:40	1,025	84.8	
3:41	1,050	84.8	
3:50	1,050	84.8	Column red.
3:55	1,075	84.8	Water on column ½ minute; fire out; door down; more water on column as it was still red.
4:13	.....	84.8	Gas relighted.
4:17	750	84.8	Pyrometer 18 ins. from column.
4:21	787	84.8	Naphtha ½ cock.
4:23	900	84.8	
4:24	1,025	84.8	
4:27	1,150	84.8	
4:29	1,200	84.8	
4:30	1,250	84.8	Column getting red.
4:31	1,275	84.8	Column bending.
4:32	1,280	84.8	
4:34	1,300	84.8	Pyrometer moved back; water on column 1 minute.
4:35	.....	84.8	Door down and water on column again 2 minutes.

The result of this test is shown in Fig. 10. The column was very red when the water was thrown on it the last time. The brick walls and arch roof cracked when water fell on them. The column was badly bent, but otherwise appeared uninjured.

The report is signed by the Committee on Fireproofing Tests, whose names we give at the head of the article, and is dated at 22 William St., New York, July 27, 1896.

* * *

THE BRIDGE BRAKE.

By Robert Grimshaw.

The deflection of bridges or similar structures depends, other things being equal, upon their span. But the increase of deflection and change of form due to a moving load becomes less important, in a statical sense, as the proportion of live to dead load diminishes with increase of span. It is, however, far otherwise when we consider the oscillations caused by a moving load having impulses with a regular period, as for instance those due to marching troops or trotting horses; as such oscillations, when their rate harmonizes with that of the structure, increase successively in amplitude.

It has been demonstrated* that the period of vertical oscillations of a prismatic girder may be calculated from the deflections arising not only from its nearly-uniformly distributed dead and live loads, but from isolated loads. This is also the case with lateral vibrations, except that with these those deflections (other than those caused by wind and so-called centrifugal force) must be calculated on the supposition that the load acts in the same direction as the impulse. For example: With a cylindrical girder having the same moment of inertia in every direction transverse to its length, the vibration-period is the same in every direction, no matter what the direction of the impulses; as only the masses and their elasticity come into play, gravity being of influence only as regards the intensity of the impulses.

Besides the so-called centrifugal force, wind may cause lateral as well as vertical undulations—which in the case of the chains of Telford's Menai suspension bridge, increased so greatly that part of the carriageway got loose and hung down like an apron, to the water, 100 ft. below. To prevent a repetition of this occurrence, the two chains, one above the other, on each side of the bridge, were connected by lattice-work.

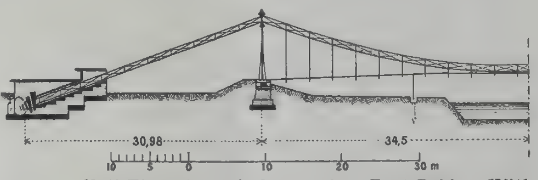


Fig. 1.—Half-Elevation of Suspension Foot-Bridge With Attachments for Preventing Oscillations.

The same manner of stiffening was applied on a railway bridge over the Danube Canal at Vienna, by Schnirch; but although it had served the desired purpose at the Menai bridge, it did not in the Vienna structure, which carried a railway track, and it was in consequence afterwards removed.

While short beams have such short vibration periods that impulsive moving loads can cause them no harm by successively-increasing vibration amplitude, girders of every kind, beyond a certain length, may be exposed (no matter how stiff they may be) to injurious vibrations by such influences as a body of marching men, keeping step; trotting horses, a locomotive having excessive counterbalance weights, etc.

The oscillation-period, in seconds, of a prismatic beam is stated by Koepcke (in the second paper quoted in the footnote) to be dependent on the deflection u_1 caused by a single load in the centre, and that u_2, caused by an equally-distributed load, and is equal to

$$t = \sqrt{0.0040252\ u_1 + 0.0031736\ u_2};$$

u_1 and u_2 being expressed in millimeters.

With an unloaded girder, only the deflection u_2, caused by the distributed dead load, comes into play; therefore the limit of resistance against vertical vibrations caused by a body of men keeping step at the rate of three paces per second, will be

$$u_2 = \frac{t^2}{0.003176} = \frac{0.3333^2}{0.003176} = 35 \text{ mm.}$$

say 1.38 ins., and if they march at only two paces per second, the deflection will be

$$u_2 = \frac{0.5^2}{0.003176} = 78.7 \text{ mm.,}$$

or say 3.1 ins.

Supposing the coefficient of elasticity of a prismatic girder to be 2,000,000 kilos. per sq. cm. (= say 28,446,000 lbs. per sq. in.); the ratio of height to span $\frac{h}{l} = \frac{1}{10}$, and the greatest stress in the center 800 kilos. per sq. cm. (=say 11,378 lbs. per sq. in.); the expression for the extension and compression of the fibers

$$\delta = \frac{24 \times u_2 h}{5\ l^2} = \frac{24 u_2}{50\ l} = \frac{800}{2,000,000} =$$

0.0004; and as for men at a quickstep, u_2 is 35 mm. = 1.38 ins., we have the span l, corresponding to this step, as

$$l = \frac{24 \times 35 \text{ mm.}}{5 \times 0.0004 \times 10 \times 1000} = 42 \text{ meters,}$$

or say 137.8 ft.

For men marching at two paces per second, the deflection of a beam undulating in half-second periods being 78.7 mm. = 3.1 ins., we have the minimum span of such a beam

$$l = \frac{24 \times 78.7}{5 \times 0.0004 \times 10 \times 1000} = 94.4 \text{ meters,}$$

or say 309.7 ft.*

As these quantities, 42 and 94.4 meters, or 137.8 and 309.7 ft. respectively, are small, the vibrations of common iron girders would occur oftener if the passive resistances of sliding or of rolling friction on the piers did not consume the "vis viva" of marching men, etc. This sliding or rolling is due to the lengthening of the lower flange of the girder under tension, which necessitates that one end or both shall slide on the bed-plates. In many cases such frictional resistance is sufficient to prevent increasing deflection under repeated impulses, regular in time and amount, such as those due to marching troops.

The absence of such friction on the bed-plates causes girders in the form of double arches symmetrical to a horizontal axis, such as those over the Rhine at Mayence (by Pauli), over the Elbe at Hamburg (by Lenz), or the Tamar at Saltash (by Brunel) to be more subject than straight girders to vertical vibrations.

As the vibration-period, and the danger, decreased with the diminution of the real or possible deflections by dead and live loads, so continuous girders are less subject to vibrations than are those covering only one span, or which, like those of the Gerbex type, are sectional; and still less so than all arch and suspension bridges.

The counteracting of the creation of oscillations or the shortening of their periods, may be effected.

(1) By strengthening the structure; or

(2) By the addition of special parts, acting like the finger of a violin-player in generating overtones; or

(3) By frictional devices.

The following examples are cited by Koepcke:

(1) The suspension foot-bridge shown in Fig. 1 was liable to strong oscillations by the passage of even a few men keeping step. This was stopped by a contrivance which was used in some other and similar instances for a similar reason; a friction brake.*

Although the chains of each pair on each side were bound together by lattice-work, this stiffening was not sufficient, as the span was 69 meters = 226.4 ft.; and the more so as the links of the chain had a cross-section of but 100 × 8 mm. = 3.937 × 0.315 ins., and as the wooden floor was light. The chain was easily deformed by unsymmetrical loads; and as the bridge had a width of only 2.3 meters = 7.55 ft., it rocked like a boat by reason of the deformations of the two sides being different.

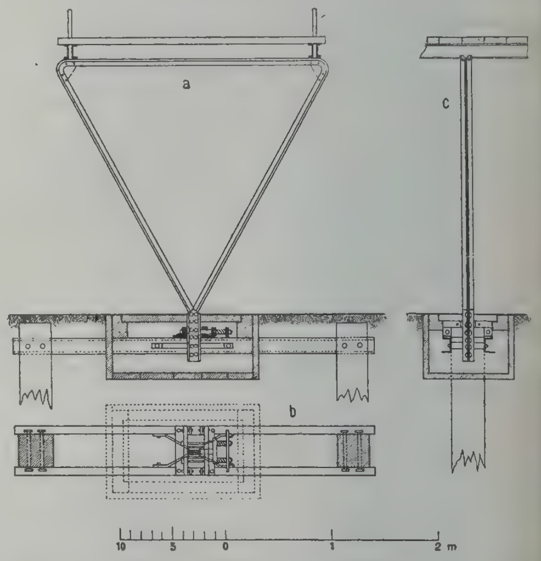


Fig. 2.—Details of "Brake" for Suspension Foot Bridge

In this case there were attached to the bridge, at the center and at a point 15 m. (49.2 ft.) therefrom, two devices shown in Fig. 2; each consisting of a triangular frame fastened under the footway, and having at its lower end a vertical continuation sliding in a clamp, which latter was placed below on the river-bank and acted on by springs, the tension of which was regulated by screws. The springs caused a frictional resistance of about 500 kilos. = 1,100 lbs., which was sufficient to resist the oscillations caused by troops passing over the bridge. The frames help, by their stiffness, to prevent rocking, and to keep the brake-poles vertical and their upper frames horizontal.

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*Koepcke: "Deutsche Bauzeitung," pp. 163 of 1885 and 549 of 1886.

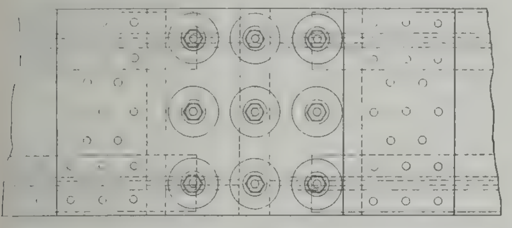
*When we notice that the deflection for 3 steps and 2 steps per second are 1.38 and 3.1 ins. respectively, and the spans corresponding to those rates of undulation are practically 138 and 310 ft. respectively, we have a ready rule (which I believe I am the first to point out) for getting the span from the deflection; the span in feet is 100 times the deflection in inches; and the span in meters is 12 times the deflection in centimeters.

*See "Deutsche Bauzeitung," as before cited.

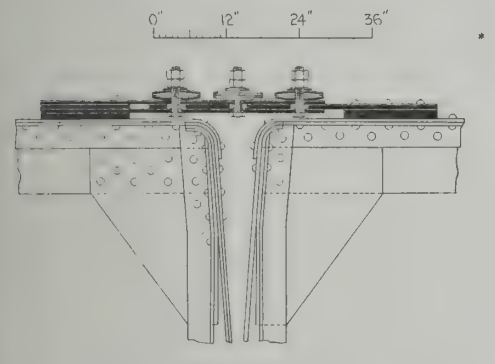
The supports on brakes may readily be raised in case of high water to prevent damage by floating ice, or drift—and as their resistance is but slight (say 500 kilos. = 1,100 lbs. each) the stresses in the main members of the bridge, and the motions due to temperature-changes and load-variations, are not materially affected.

This device proved efficient, and is still in place and effective.

In the case of the famous Loschwitz-Blasewitz rigid-suspension bridge over the Elbe, above Dresden, there are applied brakes at the center, to join the ends of the stiffening-girders. As the suspension girders require free movement about the hinges at the water, only a yielding connection, operating by friction, is here admissible. This connection is simply but perfectly effected by clamping an iron plate 20 mm. (0.787 in.) thick between two others, each 15 mm. (0.59 in.) thick, the compression being effected by nine screws each 35 mm. (1.15 in.) in diameter, held in constant tension by a pair of Belleville-steel spring washers. (See Fig. 3.) The clamped plate has slots cut lengthwise in it, long enough to permit the greatest changes of position caused by extremes of temperature and of load. The stresses in the screws being calculated at about 1,000 kilos. per sq. cm. (14,223 lbs. per sq. in.), and the coefficient of friction being 0.2, this would show a resistance of



Plan.



Longitudinal Section.

Fig. 3.—Plan and Sectional Elevation of "Brake" at Junction of Stiffening Girders of the Loschwitz-Blasewitz Suspension Bridge. Dresden.

$$\frac{2 \times 3.5^2 \times 3.14 \times 9 \times 1000 \times 0.2}{4} = 34,650$$

kilos., or say 76,403 lbs. As this resistance is applied at a point 2½ meters above the hinge, the moment of resistance is 2.5 × 34650 = 86.6 ton-meters, or say 281 English foot-tons on either side of the bridge; representing a very considerable capacity of resistance against oscillation from marching men, trotting horses, etc.

The sliding friction of about 35 meters = 34.45 long English tons, being but slight in comparison with the stresses on the hinges, which range between 579 and 826 metric tons (= say 570 and 814 gross tons); and being slight even compared with the strength of the compression-member of the stiffening-girder, which member has a cross-section of 1.5 × 87 × 4 ×10 ×1 = 210 sq. cm. = 32.55 sq. ins., it is therefore not harmful.

A similar contrivance has been applied in this same bridge to the studs of the tension-members of the side-girders, which move in holes in the pillars. Each stud being clamped by two screws, the sliding friction is, under the same assumption as before,

$$\frac{2 \times 2 \times 3.5^2 \times 3.14 \times 1000 \times 0.2}{4} = 7,693$$

kilos., or say 16,955 lbs.

Here the distance from the fulcrum or pillar-head being 25 meters = 82 ft., the moment of resistance is 25 × 7.693 = 192.3 ton-meters = say 362 foot-tons.

The bridge brake is applicable to almost every other form of bridge construction. In rope and chain suspension-bridges of the ordinary type, the oblique stays between the points of suspension and the roadway frames should not be bolted or riveted to the latter, but fastened by stirrups. In some cases the above-described method adopted at the Loschwitz bridge, will be feasible; either vertical or inclined supports being used.

Bracing such as that of the Lambeth bridge over the Thames at London, which acts by friction, as for instance in the center and at the pillars, will prevent or lessen oscillation without perceptibly affecting the necessary movability.

The bridge brake is also applicable to girder bridges. The ends of girders on the pillars may be connected by the same contrivance as is used at Loschwitz, in the center.

The device is especially suitable to cantilever girders, for making the connections between sections, and thus preventing both horizontal and vertical undulations.

STREET RAILWAY STATISTICS OF THE UNITED STATES.

We are indebted to our contemporary, "The Street Railway Journal," for the accompanying table showing the mileage, rolling stock and capitalization of the street railways of the United States. The figures in the table were compiled from returns from the various street railway companies collected by our contemporary for its financial supplement: "American Street Railway Investments," which was reviewed in our issue of July 30.

STATISTICS OF THE STREET RAILWAYS OF THE UNITED STATES.

STATES.	No. of Roads.	Horse.		Electric.			Cable.			Miscellaneous.			Total.		Capital Stock.		Funded Debt.		Capital Liabilities.	
		Miles.	Cars.	Miles.	Motor Cars.	Trail Cars.	Miles.	Grip Cars.	Trail Cars.	Miles.	Dummy Engines.	Coaches.	Miles.	Cars.	Total.	Per Mile Track.	Total.	Per Mile Track.	Total.	Per Mile Track.
New England.																				
Maine	13	17	34	98	165	64							115	263	1,977,875	17,200	2,253,000	19,600	4,230,875	36,800
New Hampshire	5	14	38	38	86	35							52	153	373,100	7,200	550,000	10,600	923,100	17,800
Vermont	5			29	37	9							29	46	472,000	16,300	401,000	13,800	873,000	30,100
Massachusetts	59	54	692	1,093	3,445	240				6	9		1,153	4,386	37,114,200	32,200	23,200,900	20,100	60,315,100	52,300
Rhode Island	8	3	2	137	379	212							140	593	8,320,200	59,400	8,357,200	59,700	16,677,400	119,100
Connecticut	23		21	334	702	200							334	923	9,646,740	28,900	6,676,000	20,000	16,322,740	48,900
TOTAL	113	88	787	1,729	4,808	760				6	9		1,823	6,364	57,904,115	31,800	41,438,100	22,700	99,342,215	54,500
Eastern States.																				
New York	109	295	2,058	1,382	4,559	688	55	821	201	172	483	1,571	1,904	10,381	174,374,161	91,600	173,593,596	91,200	347,967,757	182,800
New Jersey	36	40	200	543	1,202	135	2	2					585	1,539	35,035,250	59,900	33,627,000	57,700	68,662,250	117,600
Pennsylvania	110	10	174	1,451	3,715	239	27	156		3	10	4	1,491	4,298	134,862,445	90,500	73,067,688	49,000	207,930,133	139,500
Delaware	2			27	63								27	63	419,480	15,500	600,000	22,200	1,019,480	37,700
District of Columbia	10	53	289	59	100	171	28	142	175				140	877	14,910,590	106,500	4,360,000	31,100	19,270,500	137,600
Maryland	6		100	233	464	95	36	132	60				269	851	12,826,150	47,700	12,985,000	48,300	25,811,150	96,000
Virginia	17	10	27	163	247	39				4	1	4	177	318	5,600,250	31,600	4,800,000	27,100	10,400,250	58,700
West Virginia	4	6	7	26	32	6				9	4	20	41	69	1,240,000	30,200	600,000	14,600	1,840,000	44,800
TOTAL	294	414	2,855	3,884	10,382	1,373	148	1,253	436	188	498	1,599	4,634	18,396	379,268,236	81,800	303,633,284	65,500	682,901,520	147,300
Central States.																				
Michigan	31	3	5	438	1,004	222				9	4	5	450	1,240	9,137,900	20,300	7,244,500	16,100	16,382,400	36,400
Ohio	62	15	28	1,073	2,087	954	44	154	103	3	7	6	1,135	3,339	57,146,800	50,400	26,035,500	22,900	83,182,300	73,300
Indiana	26	25	40	305	479	228							330	747	10,276,550	31,100	8,651,000	26,200	18,927,550	[illegible]
Kentucky	10	45	139	167	291	220							212	650	7,465,900	35,200	6,585,000	31,100	14,050,900	[illegible]
Wisconsin	16	4	2	271	330	137							275	469	9,510,000	34,600	8,744,000	31,800	18,254,000	[illegible]
Illinois	48	74	427	877	1,787	2,662	82	677	329	27	78	305	1,060	6,265	78,450,305	74,000	64,102,650	60,500	[illegible]	[illegible]
Minnesota	11	7	11	278	667	318	7	40					292	1,036	19,714,000	67,500	14,123,090	48,400	33,837,000	[illegible]
Iowa	24	13	19	212	273	140	7	14	20	5	4	4	237	474	8,786,000	37,100	4,268,000	18,000	13,054,000	55,100
Missouri	31	24	62	484	963	696	101	326	490				609	2,537	29,375,300	48,200	29,161,000	47,900	58,536,300	[illegible]
TOTAL	259	210	733	4,105	7,881	5,577	241	1,211	942	44	93	320	4,600	16,757	229,862,755	49,900	168,914,650	36,700	398,777,405	[illegible]
Southern States.																				
North Carolina	8	2	3	39	62	9				2	2		43	76	611,000	14,200	710,000	16,500	1,321,000	30,700
South Carolina	6	36	63	10	6	4							46	73	462,000	10,000	193,000	4,200	655,000	14,200
Georgia	13	15	21	225	311	72				9	9	2	249	415	4,436,400	17,800	4,968,500	20,000	9,404,900	37,800
Florida	7	12	23	37	23	6							49	52	336,500	6,900	4,600	100	341,100	7,000
Alabama	15	15	23	76	99	53				103	23	88	194	286	5,617,800	29,000	2,475,000	12,800	8,092,800	41,800
Mississippi	5	12	23	4	4					4	4	24	20	55	195,000	9,800	16,500	900	211,500	10,700
Tennessee	19	16	21	208	302	92	1	2		9	7	3	234	427	5,773,500	24,700	3,887,600	16,600	9,661,100	41,300
Louisiana	11	22	51	156	427	4				6	7	49	184	541	11,619,700	63,200	9,029,400	49,100	20,649,100	112,300
Arkansas	9	34	78	38	61	35				5	2	2	77	178	1,530,375	19,900	773,700	10,000	2,304,075	29,900
TOTAL	93	164	309	793	1,295	275	1	2		138	54	168	1,096	2,103	30,582,275	27,900	22,058,300	20,100	52,640,575	48,000
Western States.																				
South Dakota	4	6	7	11	5	2							17	14	350,000	20,600	75,000	4,400	425,000	25,000
Nebraska	12	26	28	187	207	221							213	456	8,437,500	39,600	4,420,000	20,800	12,857,500	60,400
Kansas	12	22	30	103	118	77				11	5	13	136	243	3,665,000	27,000	2,635,000	19,400	6,300,000	46,400
Texas	32	73	149	254	304	49	4	1		11	4	15	342	522	6,335,500	18,500	5,280,600	15,400	11,616,100	33,900
Colorado	10	7	4	208	256	254	30	79	78	22	4	10	267	685	10,355,000	38,800	9,419,000	35,300	19,774,000	74,100
Montana	3		2	47	34	16	2	4	1				49	57	1,700,000	34,700	1,250,000	25,500	2,950,000	60,200
Idaho	1			4	2								4	2	54,000	13,500			54,000	13,500
Utah	4			92	105	17				8	2		100	124	1,456,000	14,600	1,000,000	10,000	2,456,000	24,600
Washington	22	4	6	210	155	27	18	45	15				232	248	9,802,000	42,300	6,074,457	26,200	15,876,457	68,500
Oregon	10	5	4	105	163	14	3	16		24	13	29	137	239	2,684,500	19,600	2,310,000	16,900	4,994,500	36,500
California	47	200	469	401	527	67	152	718	70	67	78	43	820	1,972	42,356,900	51,700	22,088,000	26,900	64,444,900	78,600
TOTAL	157	343	699	1,622	1,876	744	209	863	164	143	106	110	2,317	4,562	87,196,400	37,600	54,552,057	23,500	141,748,457	61,100
United States.	916	1,219	5,383	12,133	26,242	8,729	599	3,329	1,542	519	760	2,197	14,470	48,182	784,813,781	54,200	590,596,391	40,800	1,375,410,172	95,000
Canada.	30	13	37	450	714	436							462	1,187	17,517,300	37,900	5,665,000	12,300	23,182,300	50,200

The caution is given that the above figures are to some extent approximate, there being a certain percentage of companies which refuse to give information. Our contemporary estimates that figures for capital stock and funded debt are in error not more than 7% in any state, and in most of the states not more than 3 or 4%. Its statistics for mileage and cars do not differ from the correct figures more than 3 or 4% in any one state. While these statistics are published in the August number of our contemporary, it will be understood, of course, that the time necessary to collect and compile returns is such that the statistics actually represent the conditions of some months ago. Probably it would be not far from right to say that they represent the condition of street railway properties at the beginning of 1896.

It will be seen that about six-sevenths of the total mileage is equipped with electric traction. About 1,200 miles of horse-car roads and 600 miles each of dummy and cable roads make up the balance. The enormous capitalization of the roads in the Middle States, averaging $147,300 per mile, suggests the idea that capitalization is based on earning power rather than on the actual cost of the roads.

NOTES FROM THE ENGINEERING SCHOOLS.

The catalogue of Purdue University at Lafayette, Ind., shows a total of 635 students in attendance during the year just closed. The class just graduated numbered 108. The University's famous locomotive testing plant has made it widely known in railway circles, and if the Master Mechanics' Association had its scholarship endowment fund to dispose of over again there is no doubt that Purdue would be the institution selected.

The commencement announcement of La Fayette College, Easton, Pa., shows a graduating class numbering 50 members, of whom 20 received degrees in technical courses; 8 as civil engineers, 2 as mining engineers, 6 as electrical engineers and 4 received the degree of B. S. in chemistry.

University of Virginia, Charlottesville, Va.—The technical department of this institution is small, and out of 518 students attending the university the past year, only 14 were studying engineering. The university has a picturesque and healthful location among the foot-hills of the Blue Ridge mountains in the central northern part of the state. On Oct. 27, 1895, a fire destroyed the central building, known as the Rotunda. By this fire a large portion of the library was lost, but it is being rapidly restored, by contributions from individuals and other institutions of learning. The Virginia legislature has recently passed a bill through which it is expected that $200,000 will be realized for restoring the burned building.

Summer courses in law, chemistry and engineering are given, lasting eight weeks. The tuition fees are $50, $50 and $45, respectively.

The Leland Stanford Junior University, at Palo Alto, Cal., had, during the past year, 163 students in civil engineering, 125 in mechanical engineering and 85 in electrical engineering; the total number of students in the university being 1,069, 378 of whom were women. The total number of professors and instructors is 106. A summer school offers instruction in nearly all departments; the tuition is from $5 to $35. Tuition in the university proper is free.

The University of Minnesota,at Minneapolis, had an attendance during the past year in all departments of 2,467. The engineering department includes courses in civil, electrical, mechanical and mining engineering, also in metallurgy and chemistry. The requirements for admission are the same in all these courses, and include in mathematics only geometry and higher algebra. Shop work is required in none but the mechanical course; here it extends to the senior year, a total of 836 hours being required, which is an average of eight hours per week throughout the three years. The catalogue for 1897 contains 280 pages; a glance at the addresses of the students shows that a very large number are from Minneapolis.

Worcester Polytechnic Institute, Worcester, Mass. —President T. C. Mendenhall requests us to state that, by recent enactment of the state legislature, 20 new free scholarships become available to the next entering class. This makes 40 free scholarships in all available, being one for every senatorial district in the state, in addition to the 25 or 30 free scholarships to which students from Worcester county only are eligible.

University of Arizona, Tucson, Arizona.—This institution was opened in 1891; it has one main building, 105 × 200 ft., two stories high, a mining annex, 80 × 60 ft., and a number of small dormitories. It is situated about a mile from Tucson, on a 40-acre tract of land surrounded by attractive mountain scenery. Owing to the dryness of the climate and freedom from sudden changes this section has become quite a noted health resort. Tucson is 500 miles east of Los Angeles, at an elevation above sea level of 2,400 ft.

In engineering, the courses offered are civil, mechanical, electrical, mining and metallurgy, all leading to the degree of B. S. The whole number of students attending the university during the past year was 99.

Case School of Applied Science, Cleveland, O.—This school was founded in 1877 by Leonard Case and during the ten years in which Prof. Cady Staley has been its president the attendance has increased from 44 to 229. The mathematics required for admission are geometry and elementary algebra. Shop work, including joinery, pattern making and iron work, is required of all students in mechanical, electrical and mining engineering.

During six weeks of the summer vacation the laboratories will be open and instruction will be given in mathematics, chemistry and shop work. The catalogue contains a list of all the graduates which shows the majority to be holding excellent positions. Accompanying the catalogue is a separate pamphlet containing the president's annual report. It sets forth the progress of the school and devotes considerable space to rules for the government of athletics.

Agricultural and Mechanical College of Texas, College Station, Tex.—The twentieth annual catalogue contains 108 pages and 33 full page illustrations relative to the university and its special features. Arithmetic, English and History, constitute the reuqirements to enter the freshman class. These are four courses: Agriculture, horticulture, mechanical and civil engineering. The total number of students in attendance during the past year was 354.

IRON MINING on the Gobebic range has nearly ceased. The Tilden mine closed on July 31. It is stated that only 1,000 men are now working on the range where 8,000 are employed in busy times.

TRANSMISSION OF ELECTRICITY FROM NIAGARA FALLS TO BUFFALO.

For months past the press has contained numerous articles relative to the possibilities of the electricity generated at Niagara Falls. In fancy it has been transmitted to Chicago and New York, to there carry on all the various operations to which electricity can be applied. During this time, however, right of way has been secured for a transmission line between Niagara Falls and Buffalo. The construction of this line is alone estimated to cost $500,000. The poles will be of cedar and from 35 to 50 ft. long. The conductors will be of bare copper wire of 350,000 circular mills. We print a short description of the system.

The first step towards the actual transmission of the power of Niagara Falls over any considerable distance has been made, and Buffalo will be the first city to benefit by it. By Nov. 4 next, the cars of the Buffalo Ry. Co. will be driven by the electricity generated at the power house by the side of the great cataract, and the transmission of its power over a long distance will have become an accomplished fact.

Contrary to expectations, the system of transmission employed is not the two-phase, but the three-phase system, developed by the engineers of the General Electric Co., the advantage in favor of the latter lying in the fact that the transmission can be effected over three wires, whereas, in the two-phase, four wires must be used to convey the same amount of power. Thus the cost of the fourth wire is saved by the use of the three-phase system.

The contracts were made between the Cataract Construction Co., supplying the electricity, and the General Electric Co.; and between the latter company and the Buffalo Power & Conduit Co. controlling the supply and distribution of the Niagara power in Buffalo, and the Buffalo Ry. Co. The contracts provide for all the apparatus and machinery necessary for the transformation of, transmission, conversion and delivery of 1,000 HP. to the overhead wires of the Buffalo St. Ry. system.

The contract with the Cataract Construction Co. covers three of the air blast type transformers. These will be the largest transformers ever constructed, and will step-up the Niagara 2,200-volt two-phase current to either 11,000 or 22,000 volts three-phase. Any two of the transformers together will deliver 2,500 HP.; the third is a spare one. It is the intention of the Cataract Construction Co. to commence transmission operations at 11,000 volts, and later to increase the capacity of their transmission system by increasing the potential to 22,000 volts. The transformers will be designed and insulated to withstand the latter pressure. A complete system of air blast apparatus is also to be provided for cooling these transformers, as well as a marble switchboard with all necessary instruments for controlling their operation.

The pole line will be erected by the White-Crosby Co., and will have capacity sufficient to transmit 40,000 HP. This line will run from the transformer house at Niagara Falls along the two-mile line road near the track of the New York Central and Erie railways, will cross the creek at Division street, and from Tonawanda to the Buffalo city line will follow the canal banks.

For transforming the power down and converting it into that suitable for street railway purposes, the Power & Conduit Co. has purchased four static transformers of about 360 HP. each, and two 500 HP. rotary converters. The transformers will reduce from the line potential of either 11,000 or 22,000 volts to 400 volts, at which voltage the three-phase current will be turned into the rotary converters, and then converted into direct railway current of 550 volts. These transformers and converters will be set up in the Niagara street power station. The latter will be compound wound, and will operate in multiple with the steam-driven generators supplying the balance of the power necessary for the operation of the railway system. They will be of iron-clad type with steel frames, with collector rings for the three-phase current at one end, and a commutator for the direct current at the other. They will have six poles and will run at 500 revs. per minute, and are similar to that placed in the Niagara power house to furnish current to the Buffalo & Niagara Falls R. R.

Work will be begun at once and current will be transmitted from Niagara to Buffalo before winter sets in. It cannot be doubted that this is but the first step to a much larger use in Buffalo of the power of Niagara Falls, and that having once begun to deliver power into that city, the Niagara Power Co. will find a large demand for its output.

THE NEW U. S. LOCK AT SAULT STE. MARIE was informally opened for the first time at 10 a. m., Aug. 3. The first vessels to enter were the government boats "Hancock," "Andy Johnson," and "Antelope." The intermediate and upper lock gates only were used. Press dispatches state that the chamber was filled in about 13 minutes, not all the valves being opened at first, and it was emptied in 8 minutes. The gate machinery worked well, the lower gates closing in 3 minutes.

RENEWALS OF TIMBER RAILWAY BRIDGES WITH PERMANENT STRUCTURES.

In the report of the characteristics of the Lake Erie & Western R. R., made by Mr. W. F. Goltra, C. E. (Chief Clerk to the Chief Engineer), and representing the condition of the road on Jan. 1, 1896,* there is an interesting statement regarding the gradual substitution of wooden structures with permanent work composed of iron, steel or stone and filling with earth, for wooden structures.

On Jan. 1, 1887, there were 66,243 lin. ft. of bridges, all of which were wooden structures, with the exception of 523 ft. The permanent work then consisted of two iron girders, a few stone arches and stone boxes, 34 cast-iron pipes and 146 terra-cotta pipes. Since the present management took charge, on Feb. 1, 1887, permanent improvements have been made, gradually reducing the length of wooden structures from 65,720 to 31,037 ft., and permanent work has been substituted to the extent of 34,683.7 ft.; including 9,510.3 ft. of iron, steel or stone structures, and 25,173.4 ft. of solid earth embankment, thus shortening the aggregate length of bridges to the latter extent. Most of the costly structures have been built, and the average rate of $18.96 per ft. is higher than it will be for future permanent work, the cost of which is estimated at $15 per ft.

A few of the wooden structures were built in recent years and will not need renewal before six or seven years. It is estimated that the work of executing the permanent improvements will be completed by January, 1903, but as the annual appropriation for this work is dependent on the financial condition of the company, and also on the number of structures that require renewal, the estimated progress may vary somewhat. The estimated cost of completing the permanent structures is $420,000,000. Some wooden structures, to the extent of about 3,000 ft., may be renewed with wood owing to certain conditions that will not admit the economical substitution of permanent works, and the renewal of these is not included in the estimate. The length of bridging is being rapidly shortened by filling with earth, making solid embankments, and it is estimated that of the original 66,243 ft. of bridging on Jan. 1, 1887, about 45,000 ft. will be replaced with solid embankment, reducing the total length of bridging to 21,243 ft. by January, 1903.

Where iron pipe culverts, stone arches and boxes can be used, and the depth does not exceed 15 ft., the cost of permanent work is but little more than that of renewing wooden trestles, and seldom exceeds twice the cost, including the cost of filling openings with earth. For larger openings, where plate girders and masonry are necessary, the cost is little more than twice and seldom exceeds three times the cost of renewing wooden structures. The average life of wooden structures on this road is nine years. The cost of wooden trestles, not exceeding 15 ft. in height, is $7 per ft.; and that of wooden truss bridges is $28 per ft. Taking all the wooden structures into consideration, the average cost to renew them would have averaged about $9.90 per ft., while the permanent improvements will cost, when completed, an average of about $17.20 per ft.

Mr. Goltra says that if we view the question of cost from a financial standpoint only, and assume the interest at 5% on the investment for permanent improvements, the life of wooden structures at nine years, and average cost of same at $9.90 per ft., it is easy to calculate that it would be profitable to spend $3 for permanent work rather than to spend $1 for renewal of wooden structures, and as the ratio of cost for renewal of wooden structures and permanent work will only be about as one to two, the saving by making permanent work is apparent. But aside from this, what is saved by the reduction of openings in the track, thereby eliminating danger by fires, wrecks and accidents, is incalculable. The conclusion is, that if there is money available to make a roadway of permanent character at the earliest possible moment, it is certainly an element of economy in the operation of a railway to carry out such work as rapidly as possible.

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*The first "characteristic" report made by Mr. Goltra was reviewed at some length in our issue of April 25, 1895.

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THE NEW YORK RAPID TRANSIT COMMISSION on Aug. 6 decided to reject the application of the Manhattan Ry. Co., on the ground that it has no legal authority to grant permission for the construction of the surface railway lines which the Manhattan desires to build. It also adopted the following resolution::

> Resolved, That the Chief Engineer be, and he hereby is, directed to submit to this board at as early a date as possible routes and a general plan of rapid transit which shall conform to the following conditions:
>
> 1.—Total cost after abundant allowance for contingencies, not to exceed $30,000,000.
>
> 2.—Route to proceed from the southern terminus at or near the Postoffice and under the City Hall Park and Park row to Elm St. and Fourth Ave. to or near the Grand Central Station, and there to divide into the east and west side routes. The west side route to proceed under 42d St. to Broadway and the Boulevard to a point above 125th St. The east side route to proceed under Park Ave. and over private property to the Harlem River and across and beyond the Harlem River to as distant a point as the proposed limit of cost will permit.
>
> 3.—The railroad to have four tracks to the junction of the east and west side routes and above that point two tracks on each route, except that a third track for express service shall be added on both routes when conveniently and economically possible.
>
> 4.—The road to be in a tunnel, except on the east side, north of 98th St., and on the west side at Manhattan valley, 125th St.
>
> 5.—Plans to be so drawn as to permit further extensions in the future from the south and north termini and permitting the two and three-track portions to be widened into a four-track system without unnecessary expense or interruption of traffic.
>
> Resolved further That the Chief Engineer be authorized to call upon counsel of the Commission for such advice as he may deem necessary in the prosecution of the work hereby directed.

◆

THE TRACK DEPRESSION ON ATLANTIC AVE., in Brooklyn, N. Y., may be extended to the East River. We noted two weeks ago the estimate of cost submitted to the Commission in charge of the scheme, by the Long Island R. R. Co. Mr. Chas. M. Jacobs, Consulting Engineer to the railway company, has submitted the following additional estimate of the cost of depressing the tracks from Flatbush Ave. to South Ferry:

> To the Hon. Eugene G. Blackford, President Atlantic Ave. Commission, Montague St., Brooklyn, N. Y.
>
> Sir: In accordance with your request that I should consider the probable cost of extending the proposed depressed tracks of the Long Island Railroad westward from the present terminus at Flatbush Ave. to near the foot of Atlantic Ave. and South Ferry I beg to submit the following facts and estimate of cost:
>
> The length of the extension now suggested will be about 8,130 ft.
>
> This portion of the work will be more difficult of construction than that eastward of Flatbush Ave., and consequently more costly.
>
> The old Atlantic Ave. tunnel, from what I am able to ascertain, is of insufficient width to accommodate modern railroad cars on double-track service, is further constructed at such grades as to be of little service other than as a deduction for quantity of excavation already executed. This item is allowed. I am of opinion that if this plan were adopted it would be necessary to put in a station near Hoyt or Smith St. and have included this in my estimate. The question of a station for terminus at the foot of Atlantic Ave. I find is a large one, and it is impossible to estimate the cost of this work until the location of the terminus can be decided upon.
>
> My estimate of the cost of a two-track road for this extension, exclusive of diversion of sewers, water mains, etc., and of paving the surface of streets, and exclusive of relaying trolley car tracks, etc., is $1,188,058.
>
> Yours truly, Charles M. Jacobs,
> Consulting Engineer.

◆

COMPRESSED AIR MOTOR CARS are to be put in service on the Eckington & Soldiers' Home street railway in Washington, D. C. The cars are to be built by H. K. Porter & Co., of Pittsburg, Pa.

◆

THE LOUISVILLE WATER PURIFICATION EXPERiments were completed on July 31, but the report on the same is yet to be prepared. These experiments were begun about Oct. 1, 1895, and are the most extensive and careful tests of the kind ever made in this country. Four different processes have been tried, each being operated, as we understand it, at the rate of at least 250,000 gallons a day. The processes have all been patented ones, and the plant for each system has been operated by representatives of the company controlling it, the water being delivered to the filters without charge to the companies. The details of the tests have been under the general supervision of Mr. Chas. Hermany, M. Am. Soc. C. E., Chief Engineer of the Louisville waterworks, with Mr. Geo. W. Fuller as chemist and bacteriologist in charge. Mr. Fuller has had a large force of assistants, as his work has involved the collection and examination of a large number of samples. The Western Filter Co. had both gravity and pressure mechanical filters, each of 250,000 gallons daily capacity; it was represented by Mr. Chas. T. Whittier. The O. H. Jewell Filter Co., of Chicago, and the Cumberland Manufacturing Co., of Boston, the latter making the Warren filter, each had a gravity filter of 250,000 gallons capacity; the Jewell filter was in charge of Mr. Ira H. Jewell, and the Warren of Mr. Geo. Albert Soper. All of the plants named above were installed in 1895, we believe. The fourth process was started in March, 1896, by the John T. Harris Magneto-Electric Purifying Co., of New York, and was in charge of Mr. Harris. This process, so far as can be learned, relies first upon the partial electrolytic decomposition of the water, said to have an effect somewhat akin to the use of a coagulant, with a subsequent removel of suspended matter by some mechanical means, sedimentation or rapid filtration. Mr. Chas. R. Lang is President of the Louisville Water Co., the stock of which is practically all owned by the city.

◆

A NEW SCHEDULE OF WATER RATES at Keokuk, Ia., is to be established on the basis of the cost of building a plant equal to the existing one in efficiency and extent, if present plans are carried out. The works were built by the Keokuk Water-Works Co. in 1877-8, under a 20-years' franchise. Mr. Jacob A. Harman, of Peoria, Ill., has been engaged by the city to make the necessary estimates.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a derailment of a freight train at Leighton, Ia., on the Keokuk & Des Moines branch of the Chicago, Rock Island & Pacific R. R. The train was an extra eastbound, and the derailment is said to have been due to the breaking of an axle on the fifth car from the engine. The number of men killed is variously reported at from three to seven.

◆

A FREIGHT TRAIN COLLISION on the Louisville & Nashville R. R. at Mountain Creek, 68 miles south of Birmingham, Ala., on Aug. 1, is said to have been due to the engineer of one of the trains going to sleep in his cab, and running past the point where his orders required him to stop to await the passage of the other train. Two men were killed.

◆

A BURNING TRESTLE on the Oxford & Clarksville R. R., 10 miles from Durham, N. C., caused a train wreck on Aug. 2. The engineer and fireman were injured but the other trainmen and the passengers escaped.

◆

AN ELECTRIC CAR RAN AWAY on a steep grade of the Columbia & Donegal Electric Ry., near Columbia, Pa., on Aug. 9, and 6 persons were killed and 62 injured. The car was heavily crowded, and for some reason the motorman lost control of it while descending a heavy grade. The car at once attained terrific speed and jumped the track at a sharp curve at the foot of the hill and ran across the turnpike for a hundred yards, it then struck a train of cars and turned on its side in a deep ditch.

◆

A BRIDGE WAS BLOWN DOWN near Thomaston, Ga., on Aug. 3. According to press dispatches, it was an "improved lattice suspension bridge 250 ft. long and built at a cost of $700."

◆

A HEAVY RAINSTORM visited Richmond, Ind., on Aug. 8. A correspondent informs us that the rain began falling at midnight, Aug. 6, and continued for ten hours, the total precipitation being 5.9 ins., of which 3.9 ins. fell between 4 a. m. and 10 a. m. Many bridges were swept away and part of the east abutment of the National bridge over the Whitewater River, built in 1834, and forming part of the old National turnpike, was destroyed.

THE RESPONSIBILITY FOR THE ATLANTIC CITY accident will probably have to be settled in the courts, unless the two railways concerned can reach an agreement as to the proportion of damage that will be borne by each. Nearly all the deaths and injuries were to passengers on the Pennsylvania train; but the accident was caused by the engineer of the Reading locomotive.

◆

A SWING-SPAN BRIDGE WAS WRECKED at Milwaukee, Wis., on Aug. 3, by being run into by the whaleback passenger steamer "Christopher Columbus." The bridge is located at Buffalo St. It was being opened to permit the passage of the steamer, but the difficulty of manoeuvring the boat in the narrow channel was such that the vessel struck one end of the span when it had been swung about three-quarters open. The span was pushed off the turntable, and according to newspaper reports, narrowly escaped going over the side of the pier and into the river. The "Milwaukee Wisconsin" argues as the lesson of the accident, that swinging bridges are out of date as draw-spans over narrow channels.

◆

A PECULIAR ACCIDENT occurred at the Brooklyn Navy Yard on Aug. 8. The caisson closing the entrance to dry dock No. 2 gave way when the dock was empty, and the rush of water into the empty dock tore a half-dozen vessels loose from their moorings and did much damage to several of them. According to newspaper reports, some repairs were in progress on the interior of the caisson, and to facilitate the work a large proportion of the rock ballast with which the caisson is loaded had been removed, With the incoming tide, the buoyant effect of the water on the outside of the caisson became so great as to lift it from its groove, and the water, which was 26 ft. on the outside, of course immediately filled the dock.

◆

THE SOUTHAMPTON-NEW YORK TRANSATLANTIC record was broken by the "St. Louis," of the American line, which reached Sandy Hook light-ship at 11.26 a. m., Aug. 7, having made the passage from The Needles in 6 days, 2 hours and 24 minutes. The ship sailed 3,055 knots and made an average speed of 20.867 knots. The daily runs were, 477 knots, 519 knots, 530 knots, 520 knots, 510 knots and 499 knots. The captain is said to have stated that there was a fog on two days lasting 16½ hours and another when near New York of 5 hours, had it not been for which he would have made still better time. In the light of the above record of daily runs it can be appreciated how much (or little) a transatlantic greyhound slows down for fog.

◆

A NEW TRANSATLANTIC FREIGHT STEAMER is to be built by the Hamburg-American Steamship Co.,and will be called the "Pennsylvania." According to newspaper reports, it will have a length of 568 ft., beam of 62 ft. and 42 ft. depth. Its displacement will be about 20,000 tons. It will be propelled by quadruple expansion engines of 7,000 HP., and will carry 13,000 to 14,000 tons of freight, 228 cabin passengers and 1,500 steerage passengers. It is claimed that she will be the largest freight steamer afloat.

◆

ONE OF THE NEW LAKE FREIGHT STEAMERS, which has just been put in service is "The Senator," built by the Detroit Dry Dock Co., for the Wolverine Steamship Co. The vessel is 424 ft. long over all, 45 ft. 6 ins. beam, and 28 ft. deep. Her tonnage is 4,048 gross and 3,178 net. She is driven by triple-expansion engines with cylinders 22, 35, and 58 ins. and 44 ins. stroke. Forced draft is used and a speed of 14 miles an hour was made on the first trip.

◆

EIGHT GAS-LIGHTED BUOYS are to be placed in the St. Lawrence River, between Ogdensburg, N. Y., and Cape Vincent. Each holds 176 cu. ft. and burns for several months without refilling. The buoys were furnished by the Safety Car Heating & Lighting Co., of New York city.

◆

PROPOSALS FOR EXTENDING THE HYDE PARK water supply tunnel at Chicago, are wanted until Aug. 18. The extension will be 7 ft. in diameter and 5,300 ft. long. Mr. Joseph Downey is Commissioner of Public Works.

◆

BIDS FOR SORTING THE RUBBISH of the city of New York, other than garbage, ashes and street sweepings, are to be received by the Department of Street Cleaning, of which Col. Geo. E. Waring, Jr., M. Inst. C. E., is Commissioner, until Aug. 26. The material will be sorted at the yards of the department, as brought there by the department. The contract will run for a year and the contractor will pay for the privilege weekly in advance.

◆

A SHORE DRIVE FOR BROOKLYN is to be constructed soon, after plans by Olmsted, Olmsted & Eliot, Landscape Architects and Engineers. It is said that the drive will be three miles in length, extending from Bay Ridge to a point near the U. S. Military Reservation at Fort Hamilton. Mr. Elijah R. Kennedy is president and Mr. Geo. Ingram is secretary of the Shore Road Commission, whose office is at the City Hall, Brooklyn, N. Y.

LOCKS AND DAMS ON THE GREAT KANAWHA RIVER, W. VA.

The Great Kanawha of West Virginia is one among the many navigable rivers of the United States which is being improved by the government under appropriations made in the River and Harbor bill, and expended under the U. S. War Department and its corps of engineers. The figures and statements hereafter given will show that the money on this particular stream especially, has been wisely expended, and the results attained are entirely satisfactory.

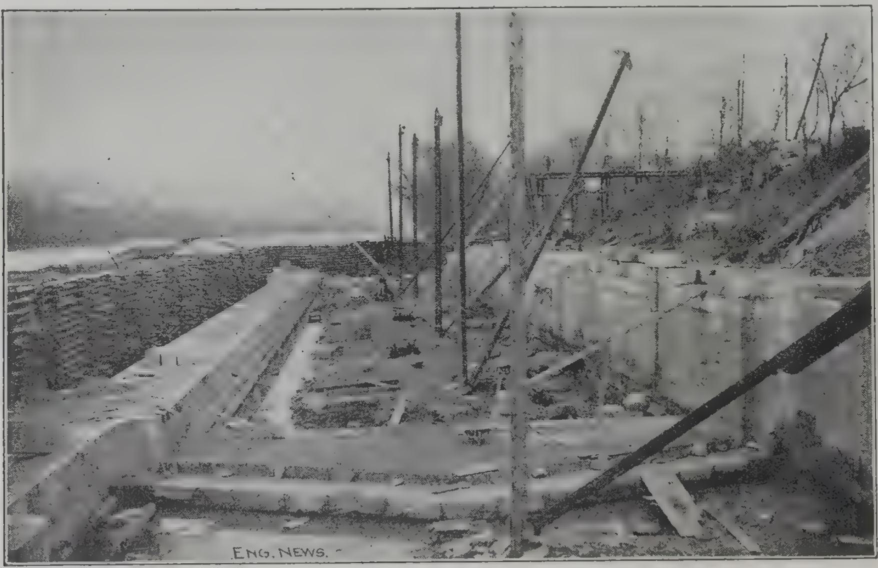

FIG. 1.—LAYING THE MASONRY FOR LOCK NO. 9, GREAT KANAWHA RIVER. Zimmerman, Truax & Sheridan, Contractors.

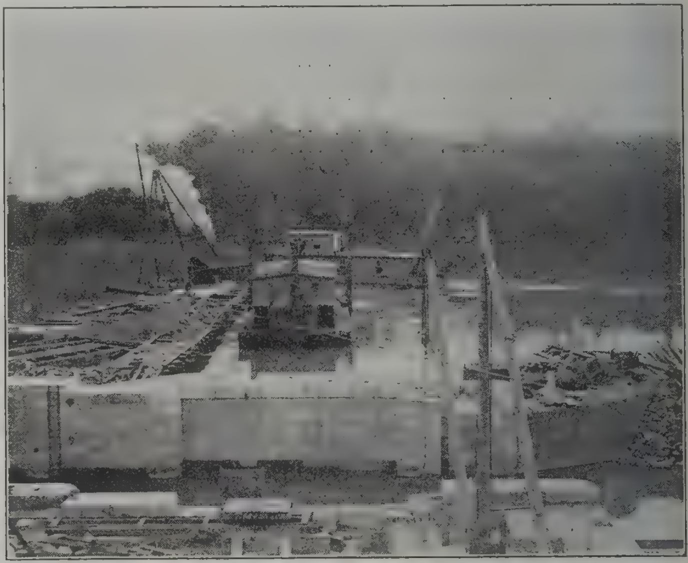

Fig. 3.—Lock Nearly Completed. Coffer Dam for First Section of Dam Begun.

This stream is a continuation of New River, which takes its rise in Watonga Co., N. C., and is joined by the Gauley, of West Virginia, near Kanawha Falls; the distance from there to its mouth, where it empties into the Ohio River, 260 miles above Cincinnati, is about 100 miles. The river flows through a fertile and picturesque region filled with coal, salt and timber.

Originally the stream could not be depended on for navigation purposes, as at some seasons of the year the water was extremely low and many snags and loose rocks were found in the channel.

Something was done by state aid to remedy the trouble, but the results were very intermittent and unsatisfactory, as little could be accomplished except in high water.

Finally, suitable appropriations were obtained and the government undertook, by means of a complete system of large locks and dams, to obtain a constant navigable depth of at least 6 ft. throughout the whole length of the river. This necessitated the building of ten locks and dams, and locations were selected at suitable points that would give the desired result. Dams Nos. 2, 3, 4, 5, 6, 7 and 8 are already completed and in successful operation, and Nos. 9, 10 and 11, to complete the system, are well advanced, as shown by the illustrations.

In January and February, 1893, the Engineering News contained advertisements for the work, and on Feb. 16 of that year the bids for lock and dam No. 9 were opened at Charleston, W. Va. Zimmerman, Truax & Sheridan, contractors, of Duluth, Minn., were the lowest bidders, and a month later the contract for dam No. 10, situated 6½ miles further down the river, was awarded to the same firm, and about the same time No. 11 was also placed under contract with Mr. Thos. Mumford.

The photographs herewith published were taken at lock 9, and gives a good idea of the progress of the work at each place, all being at practically the same stage of advancement.

Fig. 1 shows the manner of conveying and laying stone, prior to the removal of the coffer dam around the lock walls, by means of a tramway on the tipple shown on the land wall side of the cut. The stone and material, from the railway siding and stone cutting yard on top of the bank, are conveyed and then lowered by a derrick onto tram-cars which run on a track to the point of the wall where the material is needed. Fig. 2 shows the wall after the removal of the coffer dam, and the manner of setting stone with derrick boat. The material in this case is lowered onto barges instead of tram-cars and then floated to the point needed. Fig. 3 shows the lower end of the lock walls, part of the protection crib, and the commencement of the coffer for the first section of the dam, with dredges at work. This section is 270 ft. long, 97 ft. wide. The total length of dam when completed is about 500 ft. Fig. 4 shows the completed coffer with channeler drill cutting trenches in the bed rock for anchor bolts, to be set about 9 ft. deep in concrete.

All the locks below Charleston are uniform in size, being 411 ft. in total length of masonry, 342 ft. long between quoins and 55 ft. wide in the chamber between walls. The walls at Lock No. 9 are 19 ft. above top of miter sill and 25 ft. above bed rock. Those at No. 10 are but 21 ft., as the bed rock lies higher.

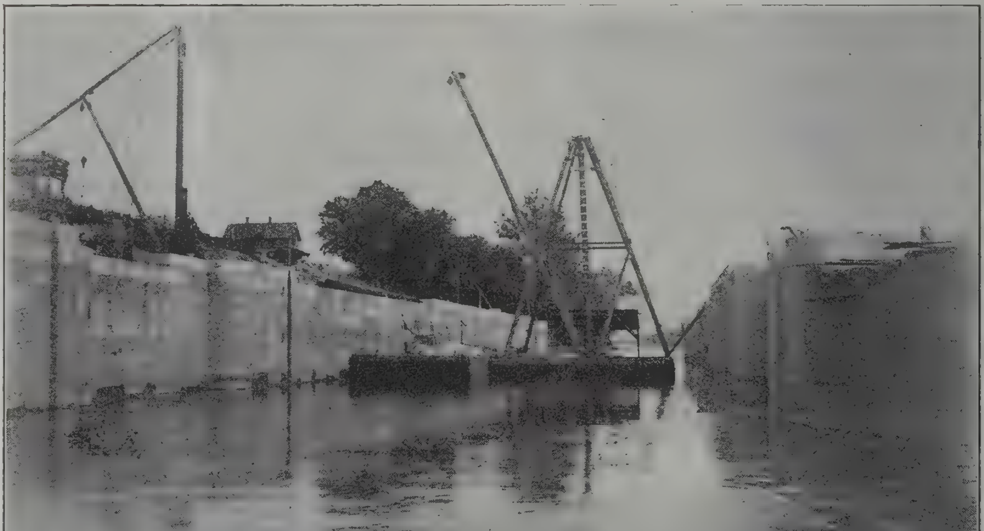

FIG. 2.—LAYING STONE FROM BARGES TO COMPLETE LOCK

The approximate quantities for Lock and Dam 9, with contract price received, are given as follows:

Kind of work Lock and dam 9:	Approximate quantities.	Bid.	Amount.
Grubbing and clearing	complete	$500.00	$500
Crib logs in cofferdam	140,000 ft.	.17	23,800
Sheathing	93,000 ft. B.M.	25.00	2,325
Cofferdam filling	21,500 cu. yds.	.65	13,975
Excavation	44,000 " "	.80	35,200
Excavation, rock	800 " "	2.00	1,600
Embankment	10,500 " "	.55	5,775
Puddling	1,300 " "	2.00	2,600
Concrete	2,500 " "	6.75	16,875
Backing masonry	5,950 " "	9.00	53,550
Rock-face masonry	2,970 " "	11.00	32,670
Pointed-faced masonry	2,200 " "	13.00	28,600
Cut-stone masonry	450 " "	18.00	8,100
Sills	520 " "	17.00	8,840
Quoins	76 " "	24.00	1,824
Coping	870 " "	18.00	15,660
Stone filling	4,200 cu. yds.	2.00	8,400
Riprap, hand-placed	3,000 " "	3.00	9,000
Paving	1,100 " "	5.00	5,500
Timber, perm. const'n.	165,000 ft. B.M.	40.00	6,600
Bolt holes in masonry	6,500 lin. ft.	.30	1,950
Total			$283,344

The quantities at No. 10 are somewhat smaller, the prices received averaging 7½% higher, and the total building price was $232,44[illegible]. At No. 11, owing to increased depth of foundations, the quantities are considerably larger, the total price amounting to a little over one-half million dollars.

As regards the class of work, the courses of masonry ranged from 1 ft. 6 ins. to 2 ft. 2 ins. in thickness, and the stones averaged about 1 cu. yd. Some of the larger ones, however, slightly exceeded 2 cu. yds. in contents. The inside faces of the lock chamber were vertical and built of "point face" and cut stone. The outside of the river wall was "rock face," with a batter of 3½ ins. to the foot from foundation to the top of the coping. The wall facing the land was made of selected backing, with each course set in from 5 to 7 ins., according to the height of the course. Immediately back of this wall was a rock drain, 3 by 8 ft., extending the whole length of the wall and intended to carry off the surface seepage and the water of some springs. The outlet was in the lower wing wall. The bed rock, especially at Lock No. 9, was very hard and uneven in places, and the projections were all carefully removed and the foundation stone well fitted to the level surface, so as to prevent water coming through under the wall. Sheet piling and clay puddle were required to cut off water from springs in the bank and the quicksand that came with the water.

Work was commenced at each place at about the same time, in July, 1893, and has been continued without stoppage to the present, except when interfered with by floods, or bad or frosty weather. No masonry is set after frost appears and the open season generally commences about June 1 and ends the latter part of November. No fatalities have occurred and but few minor accidents since the work was started.

Owing to the liability of sudden and violent rises in the river, the coffer dams used are made unusually strong; that at No. 9, enclosing the lock walls, is 542 ft. long up and down stream with shore ends 114 ft. each, or 770 ft. in total length, and 21 ft. high above bed rock. It is made of rough green timber about 7 ins. in diameter made into cribs heavily drift-bolted, 16 ft. wide and 21 ft. long. It was sunk in sections to bed rock, the trenches having been excavated by dredging, and the cribs then filled with heavy dredged material, sheathed with boards and banked with clay and gravel to a natural slope. The banking and filling are then riprapped on top with rough stone to protect them from the wash. Built in this manner they have never given trouble although subjected to the most extreme tests. In the fall of 1893 the dam was flooded and pumped out five times, and on one occasion, in 1894, there was a rise of 19 ft. in as many hours, causing heavy currents but resulting in no injury whatever to the coffer dam.

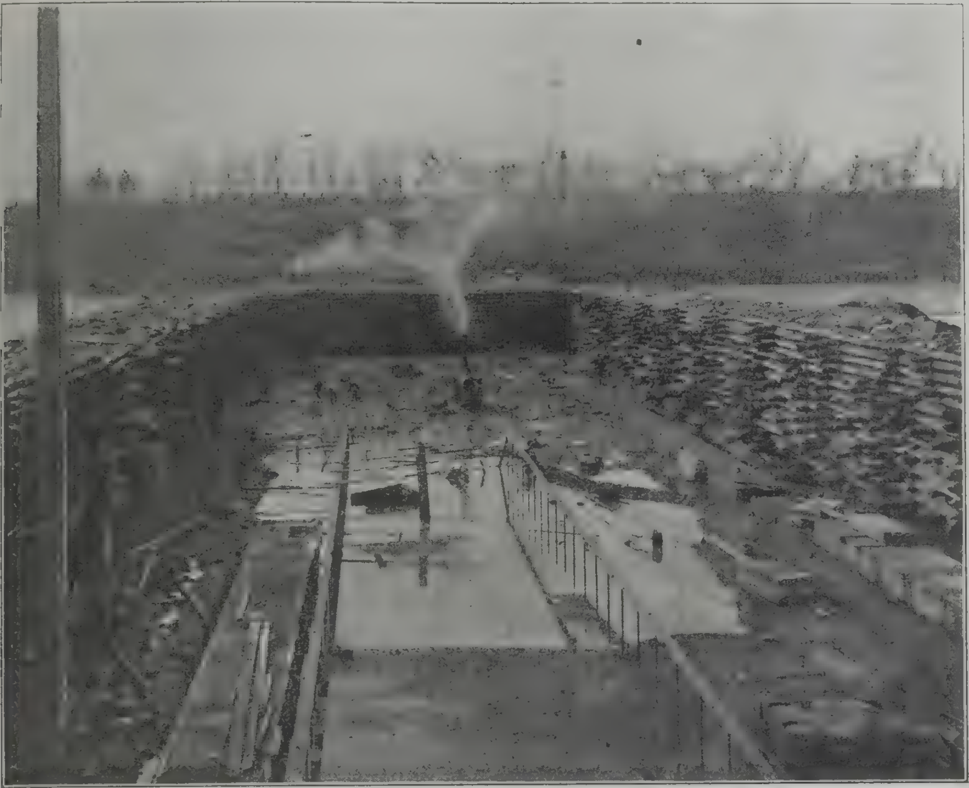

FIG. 4.—COFFER DAM COMPLETED AND PUMPED DRY, AND WORK IN PROGRESS ON DAM FOUNDATIONS.

The plant used by Zimmerman, Truax & Sheridan consists of:

1 Bucyrus 2-yd. dipper dredge, having steam speed hoists, independent swinging engines and steel boom; 1 Marion, O., 1½-yd. dipper dredge; 1 Wardwell channelling drill; 1 Sergeant-Ingersoll steam drill; 1 Lidgerwood carrier, 200 ft. span, used at quarry to convey and load stone on railway cars for transportation; 3 steam derricks or crane boats with 70-ft. booms; 2 large dump scows; 2 pumps, boilers and engines, with Baldwin's Centrifugal pumps; 8 working barges; 2 blacksmith and machine shops; 2 commissary stores; side tracks; cement houses, etc.; 25 derricks, either steam or doubledrum boom-hoisting horse power. In connection with this plant over five miles of ⅞-in. galvanized iron guy line and steel hoisting line were used. The wire rope was purchased principally from Jno. A. Roebling & Sons, and derrick fittings, engines and horse powers from the American Hoist & Derrick Co., St. Paul, Minn.

At No. 11 the lock is on the opposite side of the river from those at 9 and 10, and the material is carried across the stream from the railway siding by a Lidgerwood cableway having 2½-in. main cable, the distance between towers being 1,505 ft. The lowest part of the cable, without load, is 94 ft. above low water and it carries a maximum load of 4 tons and has worked very satisfactorily.

The stone used is a native sandstone, obtained chiefly at Lottes, W. Va., near the river, 20 miles above Lock 9. Stone for the other locks previously built has also been obtained at that point or elsewhere near the river, and has generally been satisfactory to the engineers as to strength and wearing qualities, but some difficulty has lately been found in fully satisfying the authorities. This is caused largely by the requirements for coping stone, which are of large size, as between the gate recesses on both walls for a distance of about 600 ft. all headers are used, none less than 2 ft. 6 ins. wide, 1 ft. 6 ins. thick, 6 ft. long on lock wall, and 6 ft. 11 ins. on river wall. These must be perfect in weight and texture and without flaw or defect.

The inspection and management of all the work has been under the immediate supervision of Mr. A. M. Scott, M. Am. Soc. C. E., Resident Engineer, Charleston, W. Va. There has been a rigid enforcement of specifications and close attention to minor details The chief inspectors in immediate charge of construction at the different points are Thos. E. Jeffries, C. E., and J. R. Myers, for Lock 11. A. M. Campbell, C. E., and Saml. Campbell, for Lock 10, and R. M. Stephens and Walton Venable for Lock 9.

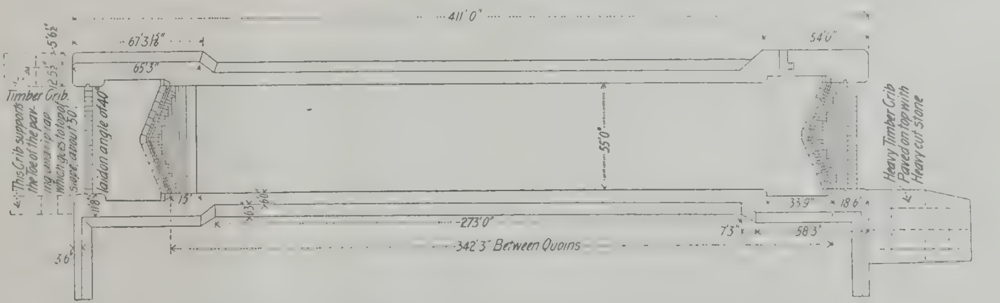

FIG. 5.—PLAN OF LOCKS NOS. 9 AND 10, GREAT KANAWHA RIVER.

The cement used is the Ulster Co. brand, or Hoffman brand of Rosendale, mixed 2 parts of sand to 1 of cement, except in foundations where it is used 1 to 1. Coping and cut stone were cut to ⅜-in. joints; other face stone to ½-in., and backing-bed and outside vertical joints to 1 in. The average amount of cement used was about one barrel or 300 lbs. to 2¾ yds. of masonry, and all the work has been first class in every particular.

The dam used, except at Nos. 2 and 3, which are fixed or stationary, is the Chanoine wicket type, operated by trestle service bridges. The sills of the navigation pass are from 12½ to 13 ft., and the sills of the weir from 5 to 9 ft. below upper pool levels. They have worked satisfactorily and with comparatively small expense. These dams can be lowered when the stage of water in the river will suffice over the shoals, this making an open river when the water is high enough.

The obstruction on account of ice averages but 9 days per year; while in some of the recent floods it was found impossible to ship full loaded coal barges drawing 6 ft., more than 100 days in the year. On the completion of the contracts herein mentioned this delay will be entirely obviated and a constant gage of at least 6 ft. will be maintained and with it a proportionate increase in the river traffic which for 1894 is itemized as follows:

Articles.	Quantity.	Tonnage.
Coal	25,821,000 bush.	1,032,840
Timber	19,648,000 ft. B.M.	32,920
Staves, oak	501,000	1,500
Tanbark	880 cords	880
Hoop poles	115,000	230
Railroad ties, oak	580,860	87,130
Shingles	2,067,000	310
Brick	888,000	2,220
Salt	3,180 bbls.	440
Merchandise and produce on steamboats		64,000
Total, 1894		1,222,530
Total tonnage.		
1890 (report of Chief of Engineers, p. 2,246)		1,127,232
1891 (" " " " " 2,425)		1,225,355
1892 (" " " " " 2,062)		1,360,750
1893 (" " " " " 2,593)		1,116,537

There has been an increase, since 1877, of 20,637,000 bushels of coal alone.

The total expense to the government for the completed work, including superintendence and operating expenses, will approximate $4,000,000, and the expense of operating and keeping each lock and dam in repair will approximate $2,700 per year.

For information contained herein we are indebted to the reports of the engineers having this work in charge, and to the contractors for the material from which our illustrations are prepared.

REDUCTION OF THE WEIGHT OF RECIPROCATING PARTS IN LOCOMOTIVES.*

(With inset.)

It is not the intention of your committee to discuss extensively the necessity for reducing the weights of reciprocating parts. While locomotives were yet light in weight, and low boiler pressures and moderate speeds were the rule, the effects of improper counter-balancing were not serious, and consequently the matter received but scant consideration.

The great increase in the size and weights, and also in the boiler pressures of locomotives which had been made during the past ten years, to meet the demand for greater hauling capacity and higher speeds, has made it necessary to largely increase the size and strength of most of the parts. The increase in mass and strength has, perhaps, made the locomotives more capable of absorbing without injury to themselves, the greater portion of the disturbances caused by the reciprocating parts, but the numerous reports of damaged tracks, bent rails and broken bridges that have been caused by badly balanced engines, the now common practice of high maximum speeds and the introduction of the compound locomotive, with its large reciprocating weights, have all served to attract attention to this subject.

The result has been that probably during the past few years more thought and study has been given to this subject of counter-balancing than in all the previous history of the locomotive. That the matter has received careful attention is evidenced by the able reports that have been made to this Association and the valuable papers that have been read before the railway clubs and other societies, as well as the numerous articles that have appeared in the technical papers, so that the whole question is to-day better and more generally understood than ever before, and there is no point that has been more clearly brought out than that of the great desirability of reducing the weight of the reciprocating parts to the lowest possible limit consistent with necessary strength.

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*Report of a committee of the American Railway Master Mechanics' Association, presented at the Saratoga convention.

In seeking to accomplish this there are but two conditions that can properly be considered—material and design—and we shall consider them as applied to the parts under discussion.

Pistons.

The use of cast iron for pistons has been almost universal in this country, principally because they can be easily and cheaply made of this material, and also because of the low cost of maintenance and renewal. Cast iron is not only relatively a weak metal, but the stresses due to uneven contraction in cooling necessarily compels designers to make cast-iron pistons stronger than would theoretically be needed to resist only the external forces; also, in spite of the many advantages cast iron has over other iron and steel for piston material, the allowable stress cannot be great. A comparison of the relative strength and cost of mild or soft steel and cast iron would seem to indicate that the substitution of steel, either cast or in plate form, forged or pressed, or perhaps a combination of both, would offer the most practical solution of the problem of how to effect a saving in weight here without unduly increasing cost; and your committee find that much progress has been made in the use of this metal for pistons, and in most cases a large reduction in weight has been the result.

In design, the single plate form seems thus far to have been the most in favor, and undoubtedly this type permits of the greatest possible reduction in weight consistent with a proper degree of strength. For very large pistons for the low-pressure cylinder of compound engines, it is certainly to be preferred to any type that has yet been brought out. Three forms of this kind of piston are made, viz., with central plate, a very good example of which is shown in Fig. 1; the side plate as per Fig. 2, and the inclined, or Z form, as per Fig. 3.

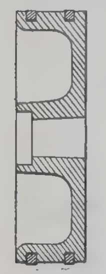


Fig. 2.—Side Plate Piston for Locomotives.

A modification of the side plate is heavily dished and provided with a cast-iron rim, as shown in Fig. 19.

Although the single plate solid-cast or forged steel piston probably presents the best form for combining strength and lightness, the wear between piston and cylinder, due to the greater coefficient of friction, presents an objection to its use which it has been sought to overcome in various ways; and further, when the cylinder has been worn to such an extent that reboring is necessary, and the piston is consequently too small, your committee could not learn that any satisfactory method had yet been devised for enlarging it, consequently the whole piston must be thrown away. Several plans have been tried for providing the rims of steel pistons with a bearing surface of metal having better wearing qualities and that would be less liable to damage the cylinder than steel. In some instances the surface of the rim has been tinned all over to a depth of 1-16 or ⅛ in., but the tin does not hold well. In the piston shown in Fig. 4 the Richmond Locomotive Works has tried grooving the rim as shown, and then filling the grooves with tin, but this was not a success. Brass or bronze has been cast in the grooves, putting in a section, allowing it to cool, and then burning or casting on another section, thus providing for shrinkage. This plan has proved more successful, but owing to its necessary limitations, large wearing surfaces cannot be obtained; and the wear is consequently rapid, and repairs must be frequently made. In the piston designed by Mr. F. J. Cole, for the Baltimore & Ohio Railroad, and shown in Fig. 3, the two packing rings are made quite wide, but while they would possibly better meet the requirements for wear, such wide packing rings are usually considered objectionable.

Fig. 5 shows a Z plate piston made by the Rogers Locomotive Company, in which the wear seems to be very well provided for. It is designed for compound locomotives with 19-in. or 20-in. diameter horse-power, and 29-in., 30-in. and 31-in. diameter low-pressure cylinders. These all have a cast-iron "carrying-ring," AA, as shown on their face. The piston is turned to shape to receive this ring, and the latter bored to fit, sawed through at one place, sprung on and secured from turning by ½-in. copper rivets. The grooves for packing rings are then trued up to size, the edges of the carrying ring A furnish in part the bearing for the inner edge of the packing rings. As A is slightly larger in diameter than the flange of the piston, at the outer side of the packing rings, the cast steel part will not touch the cylinder until A is worn down about 1-16 in.; A can then be turned with its worn face to the top by removing the copper rivets and putting in new ones, their holes being drilled by templates to match again when A is turned 180°.

Weight of 20-in. diameter piston, with rod, Fig. 5, 358 lbs.; 31-in. diameter, complete with rod, 535 lbs.

Figs. 6 and 7 illustrate a very handsome, strong and light design for cast steel single plate pistons, and which is used in Class "K" two-cylinder compound built by the Chicago, Burlington & Quincy Railroad. Eccentric spring packing rings of cast iron are lined solid on the bottom, 12 ins. of the circle in high pressure cylinder, and 18 ins. in the low pressure cylinder. The low pressure piston rod is extended through and supported by the front cylinder head. To reduce as much as possible the weight of this extension it is made of steel pipe, which is internally threaded and screwed on to a short extension of the rod. These pistons were designed for 180 lbs. steam pressure, and weigh as follows:

Weight 20-in. cast steel piston (Fig. 6)	221 lbs.
" piston rod	94 "
" 3-in. nut	5 "
Total	320 lbs.

Weight 29-in. cast steel piston (Fig. 7)	395 lbs.
" solid rod	94 "
" hollow extension rod	46 "
" 3-in. nut	5 "
Total	540 lbs.

The Pennsylvania Railroad has designed and is using a piston which is shown by Fig. 19, and which is a combination of a single plate, dished in shape, cast or forged steel, and a cast-iron rim secured to the plate by countersunk head screws. The rim is made much the widest at the bottom, where it bears on the cylinder. This design combines the lightness and strength of the Z-plate, with the additional advantages of a good wearing surface and ease of renewal.

One objection to this design is that if great care is not exercised in fitting up the pistons, there may be leakage around the bolts. The rings must be nicely fitted and drilled to jigs, holes tapped and bolts well threaded and made steam tight. After bolts are screwed up, they should be tightly riveted up, care being taken that they are not loosened in the operation. These pistons have been in service about two years with good results.

The designs in single-plate pistons, which have been mentioned and illustrated, have been made principally for high speed and high pressures, and are given as good examples of what can be done where it is very desirable to reduce the weight to the lowest possible limit consistent with strength, the question of cost being secondary. With this type of piston, in order that the clearance spaces may not be too great, it is necessary that the shape of the cylinder heads should be made to conform to that of the piston, and it is recommended that the surfaces of pistons and cylinder heads should be turned all over, although this is not absolutely necessary, providing the work of casting and fitting up the parts is well done.

There are many who favor the bull-ring type of piston, because they believe that this form, while presenting good wearing surfaces to the cylinders, also enables the wearing parts to be easily and cheaply renewed, and repairs can be quickly made. Also this type enables the Dunbar or other sectional packing rings to be used; further, with this form of piston, as with solid piston, it is not necessary to cast irregular-shaped and excessively heavy cylinder heads, and the clearance spaces are more easily regulated. By the use of steel this type of piston can be much lightened. Fig. 8 shows a design of steel piston of the bull-ring type, which has been successfully used in engines built by the Schenectady Locomotive Works. Referring to the design, Mr. A. J. Pitkin, the superintendent, says "We make extensive use of the I-section form of piston (Fig. 9) where roads desire solid heads. When the separate bull-ring and follower type of piston is desired, we are using the design shown (Fig. 8), making the spider and follower of steel, and we have found this makes a very strong and light piston, and one which gives good satisfaction in service."

The weight of piston and rod in Fig. 8 is 318 lbs., including rod and nut; weight of piston and rod, Fig. 9, 299 lbs.

Fig. 10 shows a 20-in. solid or box piston, blue print of which was furnished your committee by the Norfolk & Western Railroad. This is made of malleable iron, and is very interesting as showing the possibilities of the application of malleable iron in the construction of light pistons. The report of Mr. G. R. Henderson, mechanical engineer of this road, to Mr. R. H. Soule, superintendent of motive power, copy of which was sent with blue print, gives results of a test made of this piston in comparison with a solid-cast iron piston. Report states that pressure was first applied to center of malleable portion to try strength of brass retaining ring, and at seventy-eight tons on wheel press the outer cast iron wearing ring broke, the malleable iron center being only slightly damaged at edges. The piston was then put on wheel drop, supported on a cast-iron ring around the outer edge, given fifty blows with 140-lb. drop falling 12 ft. This merely curled up the edges somewhat, and it was then taken to a casting breaker and given one drop of 5 ft., one of 8 ft., one of 12 ft., and two of 18 ft., when it broke badly. The solid cast-iron piston cracked at ten blows of a 140-lb. drop, and went all to pieces on the fourteenth blow, showing that the malleable piston was much the stronger. In service the pressure tending to force off the outer ring would only be the steam pressure multiplied by the area, about 15,000 lbs., which gives a factor of safety for that portion of about 10. The cast-iron piston weighed 257½ lbs., while the composite weighed but 187½ lbs., a gain of 70 lbs. Mr. Henderson thinks that this type, having shown such remarkable results, can be still further reduced in thickness, thus further reducing the weight, and he expects to make other experiments with this end in view.

Fig. 11 shows another type of malleable iron piston, blueprint of which was received by your committee from the South Carolina & Georgia Railroad. Two of these pistons were placed in a 17 × 24-in. passenger engine about four months ago, and have given good results; have been removed on two occasions for examination and found in good condition, and contained no condensed water. The weight of piston, with rod, is 175 lbs. as against 265 lbs. weight of old rod and piston of the bull-ring and follower type. This is a difference of 90 lbs. for each piston, a saving that would seem to argue well for the further use of this material for pistons.

Piston Rods.

Piston rods have always had a circular section, and no other section can be had as good for the same purpose. Iron has been very largely replaced by steel. The only way that the weight of this part can be reduced is to make the rod hollow, plugging the ends to prevent steam from coming through. A design for hollow rod is shown in Fig. 12, and is submitted by the Schenectady Locomotive Works, which states that it has not yet used this design. Its latest practice is to make the ends or fits larger than the body of the rod, which enables it to make the rod lighter than if the crosshead fit was made in the usual way, and also diminishes the risk of breakage. This practice, in connection with the hollow rod, would give the lightest possible form. We find that it is now the almost universal practice to secure the piston to the rod by a single nut, instead of keys or pins, as was formerly done. This is no doubt largely due to the increase in steam pressures which has been made during the past few years, and which has rendered desirable a safer and more reliable form of construction.

Mr. E. M. Herr, assistant superintendent of motive power, Chicago & Northwestern Railway, sends drawing of piston rod used on that road, and which has crosshead fit 3½ ins. diameter, while body of rod is 3¼ ins. diameter, and says: "This is not only done to lighten the rod, but to make it stronger where the strength is needed." He also says: "I am of the opinion that with the proper material we can use hollow rods to good advantage, and I am now looking this matter up with a view of trying a set experimentally."

Crossheads.

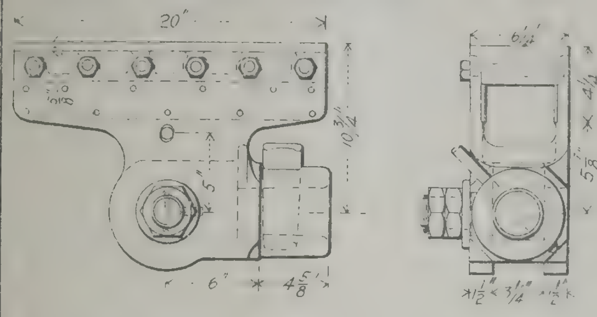
The substitution of steel for cast or wrought iron would seem to offer the most promising method of reducing the weight of crossheads, and your committee finds that in several recent designs for high-speed locomotives, as well as heavy freight locomotives, this metal has been employed with good results. Fig. 13 shows a design of crosshead of the four-bar guide type, which is probably as light as it can be made. This crosshead weighs 158 lbs. and has been successfully used in passenger engines built by the Schenectady Locomotive Works, and which have 19-in. cylinders, boiler pressure 190 lbs.

It consists of one steel casting, and the wings and wrist pin are hollow. The wearing surfaces are faced with cast iron gibs, with bosses fitted accurately by templates to the body of the crosshead, and held by brass rivets. The very light and strong crosshead shown in Fig. 14 is used by the Pennsylvania Railroad in their Class "L" high-speed locomotives; cylinders 18½ ins. diameter, boiler pressure 185 lbs. It weighs 146 lbs., and is used in connection with a single cast-iron box or enclosed guide. The wearing surfaces of the crosshead are lined with tin about ⅛-in. thick. As these surfaces are very large and well protected from dust and cinders, the wear is slight. The pin can be removed when necessary for trueing up or to disconnect for any purpose. This also permits of the use of the connecting rods with solid front ends, or without straps and bolts, thus further reducing the reciprocating weights.

Fig. 15 shows a cast steel crosshead weighing 150 lbs., used by the Norfolk & Western Railroad in its Class "D" engines, cylinders 19 ins. diameter, steam pressure 150 lbs. It is for four-bar guides, and the wearing surfaces are faced with white metal. The wings are cored out to lighten them. This crosshead, though light, seems to be of ample strength for the work required, and could perhaps be made still lighter.

For freight engines a very good design of the Laird type is shown in Fig. 16. It is made by the Rogers Locomotive Company. It weighs 198 lbs., and is designed for 20-in. cylinders and boiler pressure of 175 lbs. The body is a steel casting with a cast-iron block for wearing surfaces on guides. Referring to this type of crosshead, the superintendent, Mr. Wells, says:

"We do not advocate the Laird type for engines that make anything like high speeds, for the reason that the center of gravity of the crosshead is too far above the



Side Elevation. End Elevation

Fig. 16. Crosshead for Laird Guide, Weight, 198 lbs., Rogers Locomotive Works.

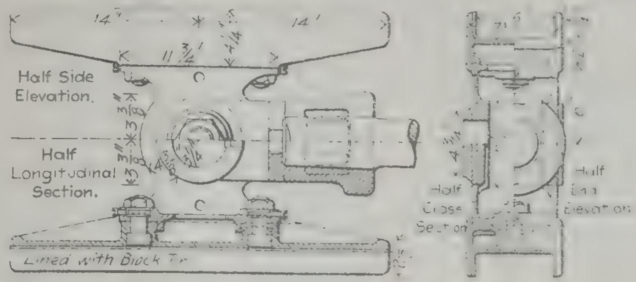


Fig. 17. Cast-Steel Crosshead, Weight, 296 lbs., Penna. R. R.

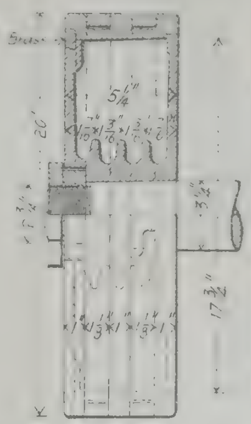


Fig. 10. Malleable Iron Box Piston, Diameter, 20 ins., Weight, 187½ lbs., Norfolk & Western R. R.

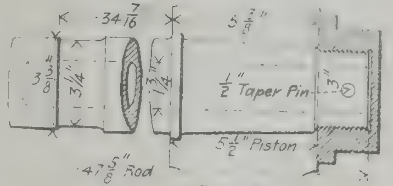
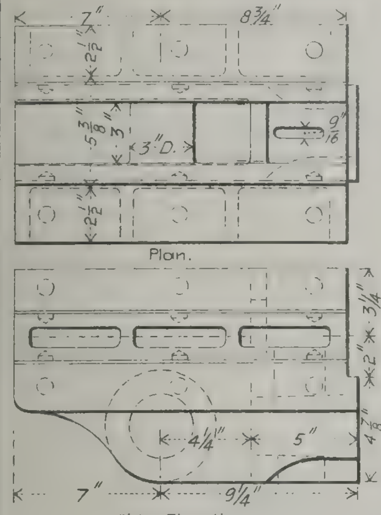
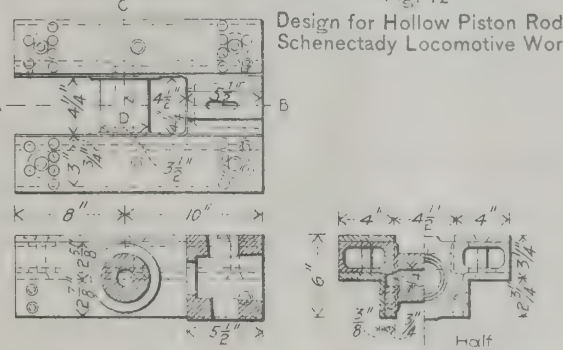


Fig. 12 Design for Hollow Piston Rod, Schenectady Locomotive Works



Side Elevation.

Fig. 15. Cast-Steel Crosshead for Four Bar Guides, Weight, 150 lbs., Norfolk & Western R. R.



Section A–B. Half Sec. C–D. End Elevation.

Fig. 13. Four Bar Guide Crosshead, Weight, 158 lbs., Schenectady Locomotive Works.

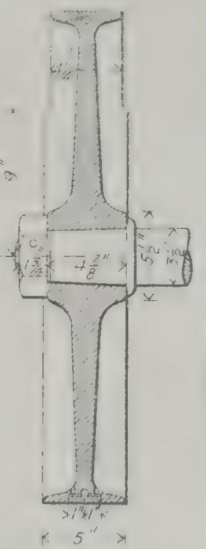


Fig. 1. 30 in. Cast-Steel Piston, Weight, 288 lbs., for Webb Compound, London & Northwestern Ry.

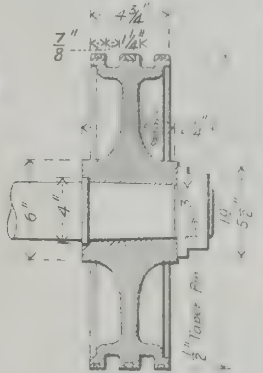
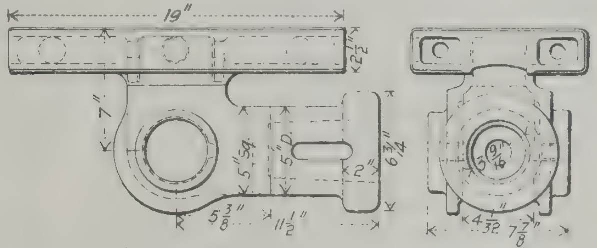
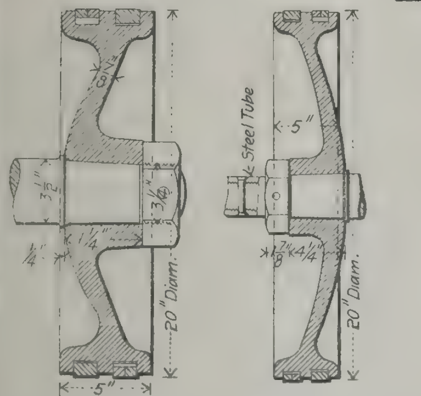


Fig. 9. Center Plate Piston, Weight, 299 lbs., Schenectady Locomotive Works.



Side Elevation. End Elevation.

Fig. 14. Crosshead for Single Bar Guide, Penna. R. R.



Figs. 6 and 7. Cast-Steel Single-Plate Pistons, for 2 Cylinder Compound Locomotive, C. B. & Q. R. R.

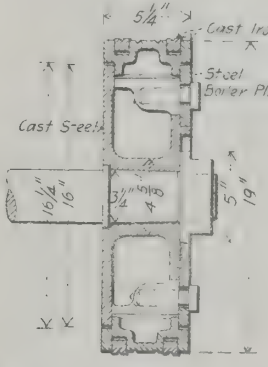


Fig. 8. Bull Ring Piston, Weight, 318 lbs., Schenectady Locomotive Works.

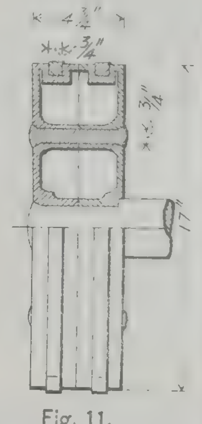
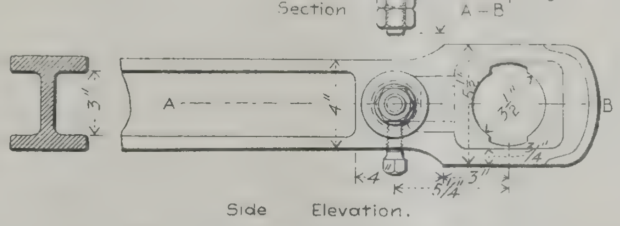


Fig. 11. Malleable Iron Box Piston, Diameter, 17 ins., Weight, 175 lbs., So. Car. & Ga. R. R.



Side Elevation.

Fig. 18. Main Rod of I Section, Penna. R. R.

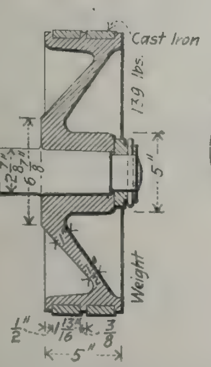


Fig. 3. Z-Plate Cast-Steel Piston, Diameter, 18 ins., Weight, 139 lbs., B. & O. R. R.

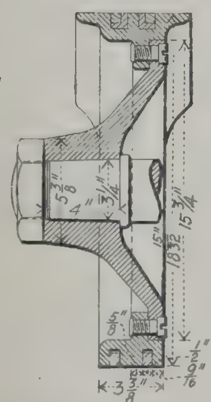


Fig. 19. Combination Steel and Cast-Iron Piston, Penna. R. R.

RECENT DESIGNS OF LIGHT-WEIGHT RECIPROCATING PARTS FOR LOCOMOTIVES.

(Accompanying a Report of a Committee of the American Railway Master Mechanics' Association.)

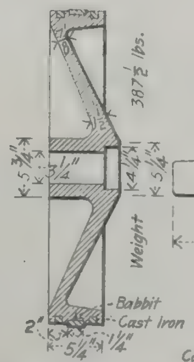


Fig. 4. Z-Plate Cast-Steel Piston, Diameter 31 ins., Weight. 387½ lbs., Richmond Locomotive Works.

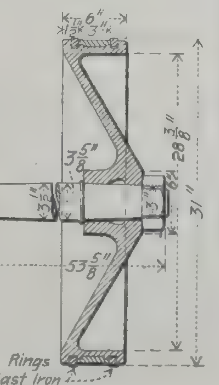


Fig. 5. Z-Plate Cast-Steel Piston, with Cast-Iron Carrying Ring, Rogers Locomotive Works.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

center of the rod (it is out of balance), but for slow or moderate speeds it seems to give good results in practice.'

The crosshead shown in Fig. 17 is used by the Pennsylvania Railroad in their new type of mogul heavy locomotive for fast freight. The compound locomotives of this type carry 205 lbs. pressure, and the simple 180 lbs. The cylinders of the former are 20 ins. and 30 ins. diameter, and of the latter 19 ins. diameter. The crosshead is all cast steel and weighs 296 lbs. The bearing surfaces are all lined with block tin. The shoes are drilled with jigs, and other shoes can be quickly substituted when necessary to retire them.

This crosshead is a very good example of what can be done by the substitution of steel for iron, the comparison of the design with the Class "R," having same type crosshead, but made of wrought and cast iron, and which is given in Table I., gives a reduction in weight of 108 lbs., with a difference of 14,141 lbs. total piston pressure in favor of the Class "R."

Main Rods.

In main rods, as now used on locomotives for very high speeds, and which are subject to the stresses due to the up-and-down motion at 400 or more revolutions per minute, it has been found necessary to place the metal where it would be most effective. This is undoubtedly the I section, with broad top and bottom, and substituting steel for iron, the allowable stresses are somewhat greater, and the web and flanges can be made thin, which has the effect of considerably reducing the weight. Your committee believe that main rods of steel and of properly designed I section, and of solid front ends, will provide about as much reduction in reciprocating weight as can be had from this source.

An excellent example of this type of main rod is shown by Fig. 18, and which is used in the Class "L" locomotive of the Pennsylvania Railroad.

The drawings accompanying the report, and which illustrate the Pennsylvania Railroad practice, have been furnished your committee by Mr. F. D. Casanave, general superintendent of motive power, who also sends in addition the accompanying table, which gives a comparison of the weight of reciprocating parts for the Class "P" 18½-in. cylinders, 160 lbs. pressure, and the Class "L" 18½-in. cylinders, 185 lbs. pressure, parts of which are shown in Figs. 14, 18 and 19. Also a comparison between their Class "R" consolidation freight engine, 20-in. cylinder, 140 lbs. pressure; and the mogul freight engine, 19-in. cylinder, 205 lbs. pressure, Figs. 17, 18 and 19. It will be seen that, notwithstanding there is a very decided increase in piston pressure of the Class "L" over the Class "P," and in the mogul over the Class "I," in both cases there is a large reduction in the reciprocating weight.

Comparison of Weights of Reciprocating Parts, P. R. R. Locomotives.

Class of engine.	"P."	"L."	"R."	Mogul.
Main rod, front end....	144½	121	171	104½
Crosshead, complete.. .	174	146	277	269
Piston and rod, complete.	310	269½	368	324
Total reciprocating wt.	628½	536½	816	697½
Total piston pressure..	43,008	49,729	43,982	58,123
Piston pressure per lb. of reciprocating wt.....	68.4	92.7	53.9	83.3

Your committee has endeavored to give some of the lines that can be safely followed in reducing the weight of reciprocating parts, and it may be said that in all the designs, drawings of which are shown, the expense of production, and possibly of repairs, are considerably greater than with the heavier designs made largely for cast and wrought iron, but it must be borne in mind that these designs were adopted principally because of their low first cost and cheapness of maintenance, and the question of weight was considered of secondary importance, and your committee has not been able to learn of any method of design or construction that has yet been brought out by means of which the weight of reciprocating parts can be very materially reduced without entailing considerable increased cost over former methods of construction.

H. D. Gordon, C. F. Thomas, C. G. Turner, T. A. Lawes, John A. Hill, Committee.

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THE LINK MOVEMENT ENGINE.

The accompanying diagrams illustrate a curious mechanical movement adopted in a steam engine, which was recently described in "The Engineer" (London). The engine is patented by Mr. G. Chapman and was constructed by Messrs. John Milne & Son, of Edinburgh. The object of the inventor is to dispense with connecting rods, and thus to produce a very compact engine. The engine has two cylinders placed at right angles with each other, each cylinder in the actual engine being inclined 45° from the vertical, instead of one being vertical and the other horizontal, as in the diagrams. "The Engineer" describes the engine as follows:

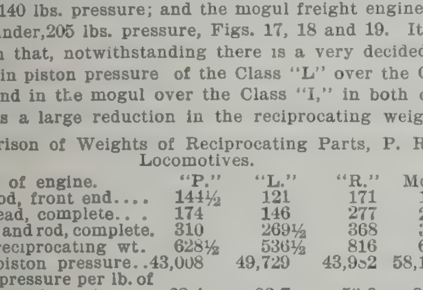

Fig. 1 and Fig. 2.--Diagrams of the Motions of Chapman's Link Movement Engine.
Built by John Milne & Son, Edinburgh.

> Roughly speaking, the two pistons move diagonally, and cross and recross midway at every stroke, a link, half the length of each, connecting them; a pin at each end of the link passing through the crossheads forms the respective cranks, and circular motions cause the rotation of the shafts, the pressure on the slippers being reduced to a minimum.
>
> It is a known geometrical fact that any point in the circumference of a circle revolving on the inside of another of double the diameter will describe a straight line. Mr. Chapman's engine utilizes this principle in a way that will be readily understood by the aid of the two small diagrams annexed. Fig. 1 shows the pistons at the ends of their strokes, and Fig. 2 shows one at half stroke. The crank length is from A to B, or half the diameter of the virtual circle within which the crank pins revolve. Any of our readers accustomed to geometrical work will see that this is an extremely pretty parallel motion without further description. The details of the engine have been very neatly worked out. It is not possible to dispense with guides, because the pressure on the piston varies. But Messrs. Milne say that a new engine which they have tested gave about 78% of its indicated power on the brake at 180 revs. per minute. This, for a small engine, with cylinders only 5 in. diameter by 10 in. stroke, is very good work.
>
> The cranks are side by side, the flying crank C, Fig. 2, acting like an ordinary drag link. This seems to us to be a very meritorious attempt to solve a difficult problem.

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THE ADVANTAGES OF RIBBED GLASS AND OF WIRE GLASS.

Some very interesting experiments were carried out some time ago for the Boston Manufacturers' Mutual Fire Insurance Co., which showed that ribbed glass gave far better illumination in a room than ordinary smooth glass. The tests were made by Prof. Chas. L. Norton, of the Massachusetts Institute of Technology, and the following was his report:

> The glass experimented upon was furnished by the Boston Plate and Window Glass Co. It included ribbed or fluted glass of four grades. No. 1 was 3-16-in. thick and had four ribs to the inch; No. 2 was ⅛-in. thick and had 11 ribs to the inch; No. 3 was ⅛-in. thick and had 21 ribs to the inch, and was of a strong greenish tint; No. 4 was same as No. 3, but was nearly colorless; No. 5 was ⅛-in. thick rough plate; No. 6 was ⅛-in. thick white cathedral; No. 7 was ⅛-in. thick white endoyance; No. 8 was single-thick ground glass; No. 9 was yellow tinted plain glass.
>
> Photometric comparisons of the intensity of the light from two windows similarly situated, one glazed with plain glass and the other with ribbed glass, show a difference of from 50 to 200% in favor of ribbed glass. The ribbed glass, No. 4, the best of those tested, transmitted, with ribs horizontal, in a direction perpendicular to its plane, 2.9 as much as plain glass, and in a direction 30° to the right and left, 2.5 times as much as plain glass, and in a direction 60° to the right or left, 1.9 times as much light as plain glass.
>
> It may be well at this point to describe briefly the distribution of light in a room when illuminated through ordinary window glass. In both fair and cloudy weather the general resultant direction of the light entering through a window is downward, ordinarily at an angle of 40° or 50°. The brightest portion of the room is therefore the floor in front of the window. As a floor is not, as a rule, a good reflecting surface, a large amount of light is absorbed there and lost. Such light as is reflected goes upward and backward toward the ceiling. Such light as falls on the wall spaces between the windows must therefore be mainly light which is diffusely reflected from the floor and objects upon it. Early in the morning and toward evening the angle of the incident light with the horizontal is less, and the light therefore penetrates further into the room, but the wall spaces between windows gain but little by this greater obliquity.
>
> If panes of ribbed glass be substituted for the plain glass the bright spot on the floor in front of the window disappears, and the entire floor, walls, and ceiling appear of sensibly the same brilliancy. The action of the ribbed glass appears to be prismatic, the greater part of the light falling on the ribbed glass at any point being refracted and spread out into a fan-shaped beam lying in a plane nearly perpendicular to the plane of the glass and to the direction of the ribs. This being recognized as the probable action, photometric measurements of the intensity were made at a distance of 8 ft. back of the glass in a horizontal plane, at five angles in this plane.
>
> Two panes of glass whose relative merits were to be compared, were set one above the other in a large window having a southern exposure. On the inside, with the panes for centers, were built two rooms, semicircular in plan, and each about 3 ft. high and 8 ft. radius. Outside the rooms was a photometer room entirely enclosing both. The panes were 18 ins. square. At corresponding points in the two rooms holes were cut in the side walls and disks of semi-transparent membrane, ground glass or paper were placed over the holes. One hole was directly opposite the pane and the others were at 30 and 60° to the right and left. The holes in the lower room were directly under those in the upper room, and by means of a system of mirrors any two corresponding disks could be viewed side by side. If one disk was brighter than the other, the corresponding pane was obscured by a shutter sliding across it until the disks appeared equally bright. The amount of light falling upon the two disks now being the same, the amount transmitted per unit of area of the glass is inversely as the area exposed.
>
> It must be distinctly understood that I do not mean that this gives the amount of light actually passing through the glass, but simply the amount which passes through in such a manner as to be available at the disks. Thus, if half of the ribbed glass pane has to be obscured in order to equally illuminate two corresponding disks, the ribbed glass is transmitting to the disk twice as much light per square inch as is the plain glass, and hence of two equal windows the ribbed glass window would give to objects situated in the general direction now occupied by the disk twice as much light as the plain glass window.
>
> None of the other samples gave such efficiency as did the ribbed glasses, the fine-ribbed, No. 4, being the best. It was found that the effect of having the ribs horizontal was to give an increase of light at the middle hole, and a less increase at the sides. Whereas the vertical ribs gave a greater increase at the sides and a less increase at the middle. The horizontal ribs tend to throw the light which would otherwise fall to the floor straight ahead far into the room, while the vertical ribs spread out the light on both sides. It is, however, useless to discuss the measurements of the distribution with horizontal ribs, as the brilliancy of the glass itself is then so great as to be unbearable, rendering its use in this position out of the question, for most purposes.
>
> The diffusion of heat was much the same as the diffusion of light. There was no spot where the heat rays from outside streamed directly in when ribbed glass was used, and objects near the window were cooler than when plain glass was used by from 4 to 15° F. However, the ribbed glass itself is hotter than the plain glass and the temperature of the air in the two cases was not sensibly different.

The company has also just published views showing the results of tests on the fire-resisting qualities of wire glass. The tests were made by the Secretary and Inspector of the Philadelphia Fire Underwriters' Association, April 30, 1896.

A brick test house was built 3 × 4 ft. inside and 9 ft. high. Iron grate bars were placed at the bottom of the house and openings left on the side walls near the ground for purposes of draft. This structure was piled for two-thirds of its height with wood treated with a liberal allowance of oil and resin. The skylight was glazed on one side with ¼-in. wired glass, on the other with ¼-in. rough glass without wire. In five minutes after the fire had been lighted the latter had broken and fallen in. The fire was maintained for forty minutes, and at the end water from a hose was played on the glass.

The wired glass in the side of the building, not being well attached by iron clamps was bent out of shape without giving way or yielding. The plate in the door was unimpaired, being set in a wooden frame fully encased in tin.

The results of this test are corroborated by a fire in the works of a stamping company at Newark, N. J., practically destroying the works. The buildings had several wire glass windows in place of iron shutters, and these withstood the heat successfully without rupture.

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THE DETROIT MUNICIPAL STREET ELECTRIC LIGHTING PLANT.

The municipal electric lighting plant at Detroit has now been in operation for nearly a year. The Public Lighting Commission has just issued its first annual report, covering the construction of the plant and its operation up to June 30, 1896. The specifications for the plant and the bids for its construction were published in our issue of March 1, 1894, and the Peck boilers were illustrated and described in Engineering News for June 20, 1895. The following information is abstracted from the report:

Prior to the establishment of the municipal service, the city was lighted by contract; Detroit being one of the first cities of the country to be lighted by electricity. The contract was held by the Brush Electric Light Co., from 1884 to 1890, inclusive, and from 1891 to 1895 the Detroit Electric Light & Power Co. supplied light, but the city plant was put in partial operation in April, 1895. The number of lamps furnished each year, the total amount paid the companies for street lighting, and the cost per lamp, from 1884 to 1894, inclusive, was as follows:

Year.	Total No.	Paid to companies.	Av. per lamp.
1884	24	$3,650	$152
1885	300	71,982	240
1886	382	91,571	240
1887	565	115,490	204
1888	608	117,370	193
1889	702	128,063	182
1890	719	137,937	192
1891	1,031	133,717	130
1892	1,168	152,283	130
1893	1,279	164,831	129
1894	1,279	169,360	132

The agitation for municipal ownership began with the first annual message of Mr. H. S. Pingree, Mayor, in 1890. The subject was urged in succeeding messages for 1891, 1892 and 1893, and in March of the latter year authority was secured by the city to establish a public lighting plant. In April the people voted in favor of such a course, 15,282 to 1,245. Early in the year bids were invited for lighting the city for varying periods, from one to ten years. Only one company bid, the one then lighting the city, its figures ranging from $154 per lamp per year for a one-year contract to $102 for ten years. The city had no power to contract for more than three years; the offer for such a period was $124 a year.

The plant was constructed by a commission of six members, appointed by the Mayor and confirmed by the Council. Mr. Alex. Dow, M. Am. Inst. Elec. E., was chief engineer or city electrician, from June 14, 1893, to July 1, 1896, when he resigned and was succeeded by Mr. Walter D. Steele, who had been assistant city electrician since June 3, 1895. Mr. Jesse M. Smith, M. Am. Inst. Elec. E., and Prof. H. S. Carhart, Assoc. M. Am. Inst. Elec. E., were consulting engineers. Mr. Will F. Conant was secretary of the public lighting commission up to July 1, 1896, when he was appointed secretary and general manager.

The central station is located on the river front, where 64,175 sq. ft. of land has been devoted to the purpose. Next to the street, the station consists of a brick office building three stories high, 136 ft. front, 35 ft. deep at one end and 14 ft. deep at the other. The first floor is divided into shops and storerooms; the second is used for offices by the commission, and the third for bulky stores. A 16-ft. alley separates the office building from the power house. The latter includes a 50 × 150-ft. engine and dynamo building, 48 × 150-ft. boiler house, the two being joined by a building 17½ ft. wide, containing accommodations for the engineer, bath rooms, lockers and other rooms. A dock and railway siding give facilities for receiving supplies. The site cost $63,125, and the building, $72,248.

The steam plant includes seven Peck double deck, tubular boilers, fully described in our issue of June 20, 1895, and five triple expansion condensing engines, built by S. F. Hodge & Co. The engines have been found to give the best economy when indicating from 250 to 340 HP. each.

The electric generating plant includes 18 50-K-W. dynamos for series arc lighting, furnished by the Western Electric Co. and three 55-K-W. alternating current dynamos of the two-phase type, furnished by the Westinghouse Electric & Manufacturing Co. for the 2,500 incandescent lights required in 14 public buildings.

The distribution is divided into two sections, the first being an underground system within a one-half mile radius of the city hall and the second overhead construction. The main lines of the underground system are vitrified clay tile laid in concrete, with laterals of 2½-in. wrought iron dipped in graphite paint. The tile conduits have from 4 to 24 ducts and aggregate 181,794 ft. of single duct, costing an average of 23¾ cts., complete, including 88 manholes connected with the public sewers. The total mileage of main line, or tile conduit, is 34.43, and of lateral, or iron, 6.3 miles, the latter costing 34¾ cts. per ft., including 149 manholes. Of the 40.73 miles of underground conduits only 12.7 miles are yet occupied with public lighting wires, the balance being available for extensions, or for rental. At present 2,503 incandescent and 184 arc lamps are supplied through the underground system and 1,309 on the overhead system, the arc lamps being of 2,000 c. p. The underground cables are rubber insulated, with tape and lead covering the rubber. The arc circuit cables have 7-32 ins. of rubber around a No. 4 copper conductor. The feeder cables for the incandescent system are the same as those just described and the mains have 9-64 ins. of rubber around a No. 8 copper conductor. These cables were furnished by the Safety Insulated Wire & Cable Co., of New York. The underground work cost $87,602; the pole and wire system, $107,780; and the 135 lamp towers $85,099.

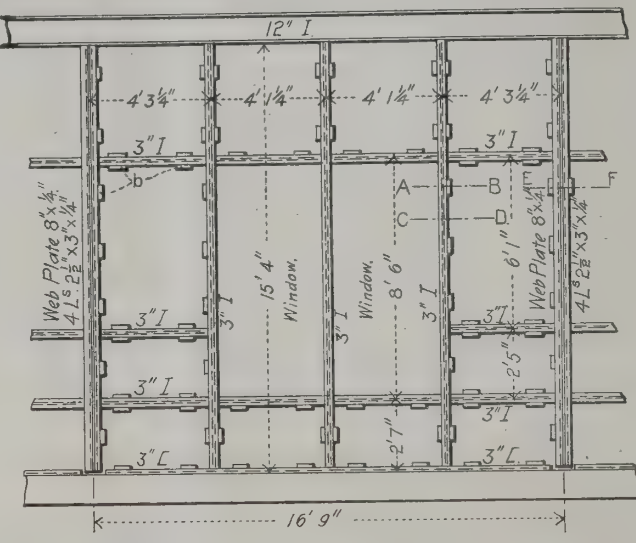

Fig. 1.—Iron Frame at Barclay Street Ferry House Ready to Receive Filling of Rock Plaster

The poles for the 1,309 arc lamp on the overhead system, so far as set by the commission, range from 40 to 70 ft. in height; up to 55 ft. they are cedar and the 220 above that height are of Norway pine. There are 329 miles of wire. The number of poles set by the commission is 4,378, public lighting wires being placed on 1,435 police and fire department poles, up to the end of 1895, and the wires of these departments being placed on 797 lighting poles. An interchange of the use of poles has also been effected with some of the private companies which use the streets.

About half of the lamps are supported by one-light cranes; 500 are supported on 135 towers, 45 of which have three lights, 87 have four, one has 5 and two have 6. Of the 135 towers 23 are within the half-mile radius and most of the remainder are in the outer districts where the buildings are small and scattered and the foliage is not dense. Eight of the towers are 100 ft. high; two are 175 ft., and the balance are 150 ft. high. The hours for lighting are from one-half hour after sunset to one-half hour before sunrise every night in the year. The police department reports all lamps not burning, as it did when the city was lighted by contract.

The report contains two tables, one relating to lamps out during nine months of contract operation, of 1,279 lamps, and the other to city operation of 1,483 lamps. According to these figures the percentage of hours out under contract ranged by months from 0.834% in January to 3.867% in December, and under city operation from 0.42% in June, 1896, to 0.201% in October, 1895.

Since Oct. 1, 1895, the entire city has been lighted by the public plant, the number of lamps on Oct. 1 having been 1,470, and on June 30, 1,492, the average number of lamps in service being 1,483.

The cost of running the plant during the nine months named was $82,803. This was divided as follows:

Coal at $2.19 per ton	$12,208
Labor and management	55,822
Carbons	5,820
Oil and rags	1,150
Teaming	1,970
Globes and nets	476
General supplies	4,472
Printing and stationery	237
Freight and transportation	126
Incandescent lamps	328
Surgeon and hospital	194
Total	$82,803

Deducting $6,606 for the cost of operating the incandescent lamps, leaves $76,197, or $68.52 per lamp per year, for the average number of arc lamps lighted during the period. To this the report adds $16.18 per lamp for interest on bonds, making $84.70 per lamp per year, against $133.80, which the city was paying before its plant went into operation. It should be remembered, however, that the city had an offer of $102 per year for a ten-year contract in 1893, or $124 for a three-year contract. While the city did not then have authority to enter into a contract for more than three years, neither did it at that time have power to build a municipal plant. Possibly authority to make a ten-year contract could have been secured from the legislature, had that been deemed advisable, fully as easily as power to establish a municipal plant. But even taking $102 as the cost per lamp and allowing 2½% for a sinking fund, the municipal plant would give cheaper service, according to the figures in the report, than would have been obtained under a ten-year contract.

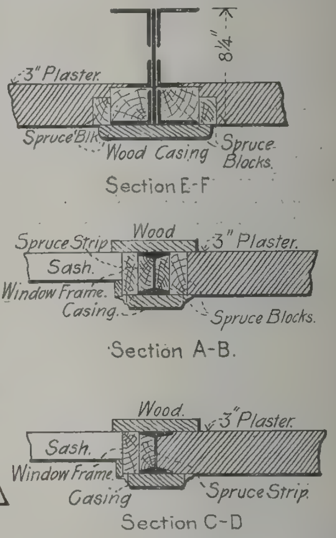

Fig. 2.—Sections Through Wall of Barclay Street Ferry House After Plaster Panels are Built in

The city now has the advantage, also, of quite an extensive underground conduit system, which of course increases capital charges, especially just at present, when less than a third of it is in use, but which later on may perhaps be a source of considerable revenue.

The total cost of the lighting plant up to July 1, 1896, was $641,247, less $11,106 of credit for labor and material, or a net amount of $630,142. This includes no allowance for interest during construction. About $600,000 of the cost was realized from the sale of bonds.

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A NEW METHOD OF FIREPROOFING.

The Barclay St. ferry house, owned by the Hoboken Ferry Co., of New York city, which has just been open to the public, presents quite a new departure in fireproof construction. The aim has been to make a wall or partition which would not furnish combustible material for a fire and yet would be suitable for a structure built on a dock and subject to the vibration caused by the impact of heavily loaded ferry boats. Only those partitions which enclose portions of the building which are to be heated in winter are constructed in the manner described.

The design is by Mr. Alexander Stevens, 99 Cedar St., New York city. The steel frame work was made as rigid as possible; no bolts were used, but every connection was well riveted. The studding consists of 3-in. I-beams, weighing 5½ lbs. per ft. These vertical studs are connected at intervals by similar horizontal beams; these latter are of the same size and weight as the vertical ones and have their flanges lying in the same planes. This made a rectangular opening with a groove extending around the inside of its perimeter, formed by the flanges of the beams, the bed of the groove being the webs, Figs. 1 and 2.

After the iron frame was in position, nailing blocks, b, b, b, Fig. 1, were fastened between the flanges of the I-beams by screws through the webs. These blocks were cut of sufficient width

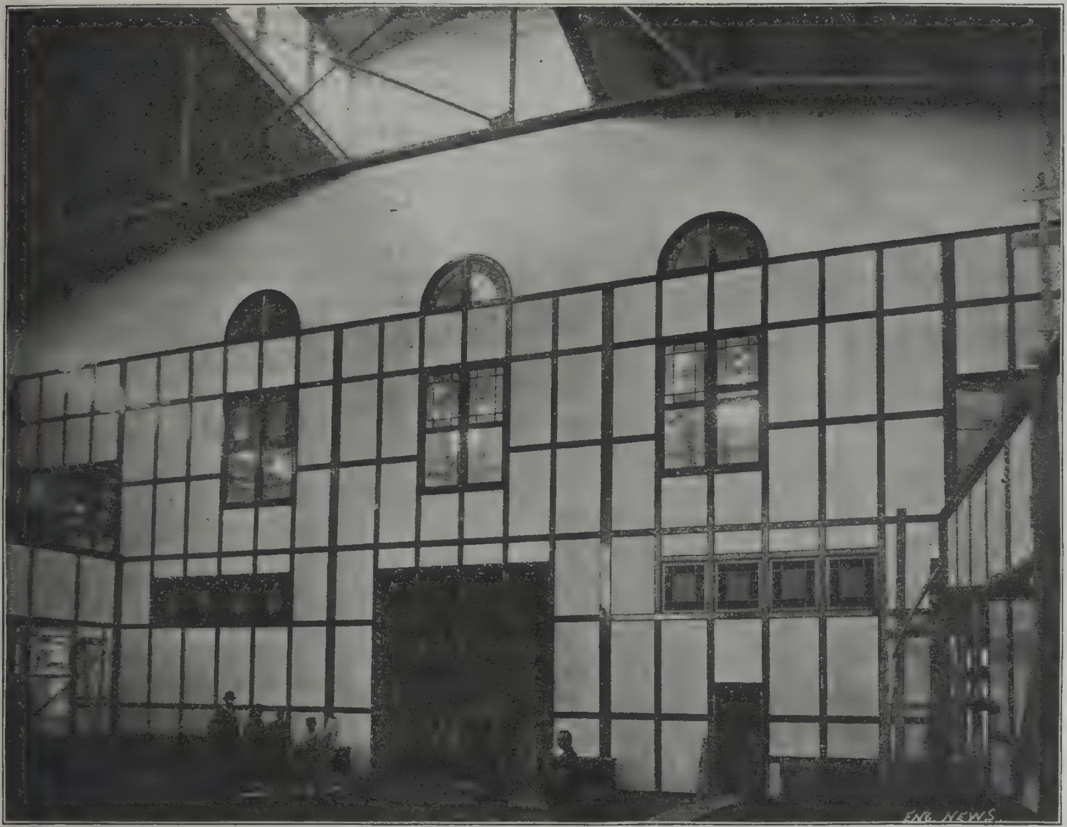

FIG. 4.—FINISHED WALL AT BARCLAY STREET FERRY HOUSE.

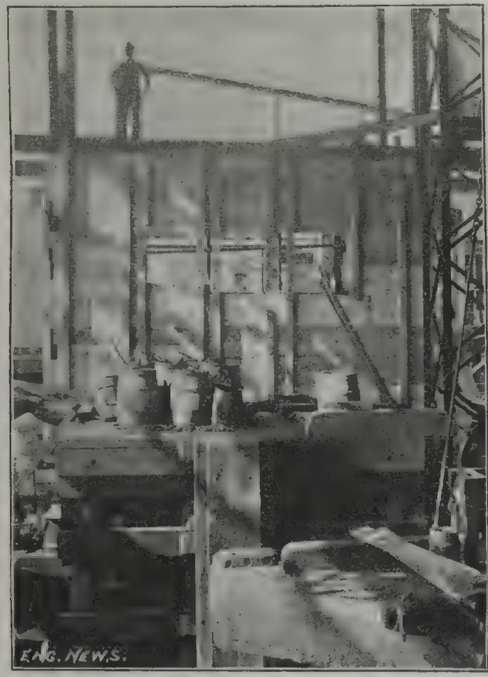

Fig. 3.—Molds in Position for Grouting in Plaster.

to come flush with the flanges on either side. The frame was now ready for the fireproofing. This is a hard plaster, made by the Rock Plaster Co., of Hoboken, N. J., and consisting primarily of lime, plaster of paris and sand, with an admixture of hair. The net work of iron I-beams, Fig. 1, composing the frame work for the walls and partitions was boarded up on both sides with 2-in. spruce lumber. These boards were held in position by verticals through which iron bolts were passed about every 4 ft. An opening from 3 to 6 ins. in width was left on one side of the wall just below the flange of each horizontal beam. Into these openings, plaster was poured as a grout and settled down into the mold formed by the plank siding and the beam flanges. The work of filling the molds was done by ordinary laborers. The photograph (Fig. 3) shows one of these molds in position, the openings for pouring in the plaster being on the opposite side. To fill the top portion of the rectangular space the plaster was mixed with sufficient water to make a stiff mortar and was crowded into place with a trowel. A mason had to be employed for this part of the work, experiments with common laborers failing to give good results. The molding boards were removed in a few hours. After their removal the surface of the plaster was flush with the surfaces of the flanges of the I-beams, which showed as a series of broad rectangular lines in the mortar wall with here and there the nailing blocks. On the inside of the building, where a smooth finish was desired, the work was finished off with a coat of "Rock White." Finishing strips of mahogany lumber were then put on over the lines of the beams, Fig. 4. On the outside the finishing coat was made of plaster itself, troweled hard, and about ¾-in. thick. The outside was then washed over two or three times with a solution of sulphate of zinc in order to convert any free lime near the surface into sulphate of lime and so make the wall more impervious to the weather. Though very hard, the plaster is somewhat affected when entirely exposed to the weather. The action of the weather on such a wall is very much like the rusting of iron; a scale forms which flakes off, but the portion underneath is not affected. For this reason, if it is kept properly painted, it should last as long as the piles supporting the building. The plaster is much harder than ordinary lime plaster, but it is claimed to be more elastic and less easily fractured by the motion which it is impossible to avoid in a ferry house built on piles. Some of the plaster at the Barclay St. ferry house has been in place for a number of months and is now about as hard as it ever will become. It shows no tendency to crack and appears to fulfill all of the requirements. The cost of the plaster, including the finishing coat on both sides, was 46 cts. per sq. ft.

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LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Validity of Law Compelling Corporation to Assign Reasons for Discharge of Employee.

The public, whether as many or one, whether as a multitude or a sovereignty, has no interest to be protected or promoted by a correspondence between discharged agents or employees and their late employers, designed, not for public, but for private information as to the reasons for discharges, and as to the import and authorship of all complaints or communications which produced or suggested them. A statute which undertakes to make it the duty of incorporated railway, express, and telegraph companies to engage in correspondence of this sort with their discharged agents and employees, and which subjects them in each case to a heavy forfeiture, under the name of damages, for failing or refusing to do so, is violative of the general private right of silence enjoyed by all persons, natural or artificial, from time immemorial, and is utterly void and of no effect. Liberty of speech and of writing is secured by the constitution, and incident thereto is the correlative liberty of silence not less important nor less sacred. Statements or communications, oral or written, wanted for private information, cannot be coerced by mere legislative mandate at the will of one of the parties and against the will of the other. Compulsory private discovery, even from corporations, enforced, not by suit or action, but by statutory terror, is not allowable where rights are under the guardianship of due process of law. It follows from the foregoing that the act of October 21, 1891, entitled "An act to require certain corporations to give to their discharged employees or agents the causes of their removal or discharge, when discharged or removed," is unconstitutional, and that an action founded thereon for the recovery of $5,000 as penalty or arbitrary damages fixed by the statutes for non-compliance with its mandate cannot be supported.—Wallace v. Georgia, C. & N. Ry. Co. (Supr. Ct. of Ga.), 22 S. E. Rep. 579

Condemnation Proceedings.

The only right of a city to condemn certain property being based on the necessity of acquiring it in order to carry out its contract to provide a railway company with terminal facilities, the fulfillment of that contract operated to extinguish any easement which the city might have acquired in the property along the right of way. Such power being primarily lodged in the state, and which may from time to time be granted to other corporate bodies, as to cities, for municipal purposes and to railway companies engaged in the public service as common carriers, and others, but always for some public use. Of this public use the state is usually the recognized judge, and her action in declaring a public use is seldom questioned by the courts. Incident to this power, however, always accompanying it, and as a constant and wholesome restraint upon it, are these two questions of fact: First, whether the property sought to be taken is really and in fact necessary for the public use; and, second, the question of just compensation, these two questions always being subject to the determination of a jury, and to be approved by the court.—Dennis Long & Co. v. City of Louisville (Ct. of App. of Ky.), 32 S. W. Rep. 272.

Liability for Defect in Street.

When a street railway company obtains a franchise from the city, agreeing to keep its tracks at proper grade, and an accident happens through its failure to do so, for which the city is liable in damages, the company is liable over to the city.—City of Fort Worth v. Allen. (Ct. of Civ. App. of Tex.) 31 S. W. Rep. 235.

Ancient Maps and Deeds.

In a suit for the recovery of real estate, a map purporting to describe, among others, the tracts in dispute, was offered in evidence. The map was not dated or signed by the surveyor who made it, but from field notes and other evidences it was shown to have been made in 1818, by a well-known and skillful surveyor, long since dead. Other surveyors testified that they had used and tested the map in their own surveys, and that it was the earliest known survey of the district it purported to describe. It also appeared that it related to an actual transaction, having been made to show the abutting owners along a proposed new road. The court held that it was admissible as an ancient map.—Whitman v. Shaw (Sup. Jud. Ct. Mass.) 44 Northeastern Rep., 333.

Special Assessments and Railroad Right of Way.

The right of way owned by a railroad may be assessed for improvements of a street on which it abuts; and in an action brought under a statute in which the contractor seeks to recover such assessment a personal judgment may be rendered against a company.—P., C., C. & St. L. Ry. Co. v. Hays (App. Ct. Ind.) 44 Northeastern Rep., 375.

Agreement of Abutting Owner to Pay His Share.

An abutting owner who agrees with one having a contract with the city to improve a street to pay his share of the cost of improving the street is personally liable for such amount, if the improvement is completed in accordance with the contract.—Burton v. Laing (Ct. Civ. App. Tex.) 36 Southwestern Rep., 298.

Stream Used as Sewer.

Where a municipality adopts and uses a stream as an open sewer, and fails to keep its channel open and to remove accumulations which obstruct the flow of water and throw it out of its banks up on the adjoining land. the land owner has the right of action for such injury, although the stream had been used as a sewer for 30 years.—Blizzard v. Danville (Sup. Ct. Penna.) 34 Atl. Rep., 846.

When Violence is Not an Excuse for Failing to Run Street Cars.

A street car company cannot excuse a failure to run its cars on the ground that it has been prevented by violence from doing so, where it does not appear that the civil authorities have failed to protect it fully in its efforts to operate its road. The fact that such company cannot get employees to accept its terms gives it no right to stop running its cars.—Loader v. Atlantic Ave. Ry. Co. (Supr. Ct. of Kings County, N. Y.) 35 N. Y. S. Rep., 999.

Conclusiveness of Estimates by Engineer.

A provision in a contract for railroad construction work that the payments therefor shall be made according to the estimates of the engineer of the railroad company, and that the final estimate of the engineer as to the quantity of the work, etc., shall be conclusive between the parties, without further recourse to appeal, does not prevent the estimates from being attacked for mistake or fraud, but merely makes them prima facie correct, as parties cannot agree in advance to oust the jurisdiction of the courts. Such fraud or mistake need also only be shown by a preponderance of the evidence.—Baltimore & O. & C. Ry. Co. v. Scholes (App. Ct. of Ind.) 43 N. E. Rep., 156.

As to the Number of Street Cars that Must be Run.

The number of cars to be run by a street car company is a matter within the discretion of the board of directors, subject to the power of the courts to compel them by mandamus to increase the number, whenever public convenience may require it.—Loeder v. Brooklyn Heights Ry. Co., 35 N. Y. S. Rep., 996.

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AND

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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

The publication of the results of the Louisville water purification experiments, which terminated on July 1, as noted in another column, will be awaited with the greatest interest by a large number of engineers and sanitarians. Seldom have there been scientific experiments of so long duration conducted in a manner which promises such valuable results. The Lawrence experiments on slow sand filtration, as a means of removing bacteria from water and reducing its contents in organic matter, are of course unexcelled, but they have been conducted with small filters and have no relation to mechanical filtration and but little bearing on the problem confronting those who have to deal with the silt-bearing waters of the South and West. The Louisville experiments have been carried out in a thoroughly practical manner and with plants in every way comparable in size and modes of operation with those in actual service. The unit tank for a mechanical filtering plant very commonly has a daily capacity of 250,000 gallons, which was the size of those used in the experiments, so that larger plants would be a mere multiplication of tanks, with practically no changes in modes of operation. Further than this, the experiments have been planned and carried out under the direction of Mr. Chas. Hermony, M. Am. Soc. C. E., for many years chief engineer of the Louisville water-works, with Mr. Geo. W. Fuller, formerly of the Lawrence Experiment Station, as chemist and bacteriologist in charge, and with an ample staff of able assistants. The competing companies have had able men in charge of their plants, so that everything has been favorable to the securing of valuable results.

Expensive as these experiments doubtless have been for both the city of Louisville and the competing companies, it seems certain that the money has been well spent. The city might have wasted large sums year after year, on an improperly designed plant, had it gone ahead without the experiments, and the impartial data secured regarding their processes cannot but be of value to the companies.

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Lack of space and time prevented us from commenting last week upon the very interesting tests of the resistance of loaded metal columns to heat which were recorded in our last issue. We advise any of our readers who may not already have done so to bestow careful study on these tests, as they appear to us about the most valuable that have ever been put on record. It will be noticed that the tests were made on full-size columns; that loads were applied well up to what would be used in actual practice, and that the columns were subjected to temperatures which must have equaled those which are reached in any but very severe conflagrations.

Turning now to the results of the tests, the surprising thing to us is that the columns stood up under their load so remarkably well. The committee which made the test is non-committal as to what it thinks or does not think as to the lessons to be drawn from the tests; but it will be noted that the load which they applied to the columns equaled the full capacity of their hydraulic press. We imagine that if they were rebuilding their testing plant they would instal a larger press.

A great deal has been said and written about the necessity for thoroughly protecting iron work by fireproofing, and we would by no means lessen the force of this; but every engineer who realizes the fragile nature of most fireproofing materials will be very glad, we are sure, to learn that a bare steel or cast-iron column can stand unharmed in a temperature of 1,000 to 1,200°, even though it is under a very considerable load, and further, that a good deal of abuse in the way of hose streams turned on when it is at a red heat is required to do it serious harm.

But in this connection many of our readers may recall a photograph published in our issue of July 2, showing the ruins of a steel frame factory building of the Washburn & Moen Co. at Worcester, Mass., which was burned on April 5. Here was a building with almost no wood in its construction, and with very little inflammable material inside it. A tank of fish oil used for tempering springs was set on fire and the flames swept through the building almost instantly. In a very few minutes the structure collapsed a total wreck, almost every column being bent and twisted. We understand that the experience with this building is leading many engineers to advise against the steel frame for factory buildings, and go back to wood frames as after all the safest.

Now, the question comes, why did the columns in this Worcester building fail so suddenly and entirely, whereas those in the recent tests stood up so surprisingly well? We have considered this matter with some care and are able to find but one explanation: It will be noticed that the columns tested by the committee, which we showed last week, were all what may be called "hollow" columns. The columns in the Washburn & Moen shop, on the other hand, were made up of light steel plates (or channels) with light angles riveted to their edges. Thus the column depended for stiffness entirely upon light projecting flanges, which in a rush of flame are sure to be heated quickly, and are moreover likely to be heated unevenly on the two sides. May it not be that this class of column is more susceptible to the influence of heat than columns of hollow section? If this is actually the case, the fact would have an important bearing on the design of factory building. It is to be hoped that the able committee on tests of fireproofing may carry out tests on columns of this class and may also test the effect of heating columns on one side.

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The verdict of the coroner's jury on the Atlantic City accident is an excellent illustration of the difficulty of getting from a set of men who know nothing of a certain technical subject an opinion upon that subject that shall be of any value. While the jury recognized, as they could hardly fail to do, that Farr, the engineer of the Reading express, was negligent in failing to check the speed of his train in time, with the signals against him, they also held the towerman, Hauser, deserving of censure for giving the safety signal to the West Jersey train instead of to the express. Further, three of the six jurors, in an independent verdict, declared that the engineer of the excursion train erred in not exercising greater care in crossing ahead of the fast express.

The idea which governed the jurymen appeared to be that it was the business of every employee to take measures to prevent collisions at this crossing. It is fortunate, indeed, that such ideas have been abandoned in the operation of all railway lines of importance. The old idea was to make everybody alert to prevent accidents, in disregard of the well-known fact that what is everybody's business is nobody's business. The modern system is to give each employee certain fixed duties for which he, and he alone, is absolutely responsible, and in addition to make the matter of safety depend as little as possible on human memory and judgment, and as much as possible on mechanical safeguards.

As a matter of fact, neither the engineer of the West Jersey train nor the towerman deserve a single particle of blame in connection with this terrible wreck. The former obeyed the signals held up before him implicitly. It was no part of his duties to know anything about the trains on another railway which crossed his. Nor was it his duty to keep his train out of their way. It was of course his duty when the emergency came and he saw the Reading train coming down on the crossing at a speed too great to be checked to do anything possible to avert the catastrophe; but nothing was possible even to the wisest judgment or the coolest head in the few seconds before the crash came.

As for the towerman, if it was an error of judgment for him to give the slow excursion train the right of way over the crossing ahead of the express, it was an error of the most trifling character, and one which should have resulted in nothing more serious than a minute's delay to the express. The fact should be emphasized that the safety of the traveling public is not dependent upon the judgment of the towerman. If it were, then the howl of the newspapers about putting the lives of thousands of passengers at the mercy of a forty-dollar-a-month youth would be justified.

The great, prominent fact which the coroner's jury should have emphasized in its verdict, but did not, was that Farr, the engineer of the Reading express, used his judgment instead of obeying his orders, and made a fatal error of judgment when he approached the distant signal at so high a speed that he was not "prepared to stop at the home signal," as the rules required. The towerman obeyed orders; it was his duty to give the right of way to whichever train he deemed best. The engineer of the excursion train obeyed orders, for he had a clear signal for the crossing; but the engineer of the fast express did not obey orders, and on him the first responsibility for the catastrophe lies.

◆

We trust the Atlantic City accident will be studied diligently by those who have had the hardihood to claim that the running of very fast trains is attended by no more danger than the running of ordinary trains. While a few railway officers have made themselves prominent by defending this idea, it has been ably pointed out by others that the long distance required to stop a train running at a speed of 60 to 90 miles an hour, constitutes an element of danger that can never be wholly eliminated. The Atlantic City accident fully proves the correctness of this position. We do not imagine, of course, that train speeds are to be decreased, or that fewer very fast trains will be run in future; but their dangers will, we hope, be more fully recognized, and every means will be taken to instill into the minds of engineers that fixed signals must be approached with caution.

As we said last week, the Atlantic City accident will doubtless have an influence in checking the tendency to omit derailing switches at such especially dangerous points as grade crossings and drawbridges; but it ought also to show the necessity of still more strict training of enginemen to unvarying obedience to fixed signals. We cannot place a derail in front of every fixed signal, and at most places we must rely on the engineer's implicit obedience to the warning signal held up before his eyes.

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The New York Rapid Transit Commission has done wisely, we believe, in taking up anew the problem entrusted to it, and attempting to solve it on a more economical basis than was proposed in the original plan. Briefly, what is proposed is a four-track tunnel beneath the street surface from the City Hall to the Grand Central Station, with two-track extensions north, on the west side via Broadway and the Boulevard, and on the east side via Park Ave., adding a third track for express service where it is most needed. The limit of cost is set at $30,000,000; and there is every reason to believe that for this sum a system could be built which would serve the present need for rapid transit and which could easily be extended and enlarged later to suit the traffic requirements. We have always held that it was wise to save the five or ten million dollars which will be represented by the difference in the cost of building the road on Broadway or on Elm St., and that the road will draw practically as heavy a traffic on the one line as on the other. Should the road actually be constructed on Elm St., the Broadway shopkeepers and lot-owners who were chiefly instrumental in refusing it right of way on that street may eventually regret their action.

EXPORTING AMERICAN MANUFACTURES.

We do not recall a time when so much general interest has been felt by manufacturers everywhere in this country in the cultivation of an export trade as appears to be evident at present. At least three organizations, all of them of very recent formation, are now actively engaged in aiding manufacturers in the development of their foreign trade, viz., the Exporters' Association of America, with offices at Morris Building, New York city; the National Association of Manufacturers, with headquarters at 1757 North 4th St. Philadelphia, and the Philadelphia Museums, which occupy the old offices of the Pennsylvania R. R. Co., at 233 South 4th St., Philadelphia.

Each of these organizations appears to be carrying on a vigorous work and to be receiving the hearty support of the manufacturers, which it is designed to serve. The first named organization was briefly described on p. 33 of our issue of July 16. It is a purely voluntary association of manufacturers, and its chief functions appear to be to facilitate the export of goods by manufacturers who are not versed in the customs of foreign trade. To this end, the officers furnish to members reports of the financial standing of foreign customers and attend to consular and custom house work in connection with foreign shipments. Weekly reports of exports of goods in which each manufacturer is interested, are furnished to the members. The dues are $100 per year. Mr. Andrew H. Power is the Secretary.

The National Association of Manufacturers is a considerably more ambitious organization, which does not confine its activities entirely to foreign trade. It is interesting itself, for example, in the movement for a uniform freight classification and also the establishment of a Government Department of Commerce and Manufactures, a topic which we discussed editorially in our issue of April 23, 1896. But cultivation of foreign trade is, after all, its chief purpose; and in many respects it appears to cover a field very similar to that of the organization described above. In the last circular issued by this Association we find the following interesting statement:

> Suspicions of political purposes have done great injury to the association and have naturally retarded its progress: for there have been those outside of its membership who have not hesitated to raise the cry of politics upon every opportunity. The business motives and business methods of the association, however, have impressed themselves upon business men, and it is now pretty generally understood that the National Association of Manufacturers is essentially and wholly a business affair. The elimination of all elements of politics has given the association a membership of a representative character which would not be obtainable under the narrowing influence of partisanship.

Turning to the work of the Association, we learn that it has established a "Bureau of Publicity," at 1751 North 4th St., Philadelphia, where five persons are constantly employed. It took a prominent place in the agitation at the last session of Congress for bills relating to the restoration of treaties of commercial reciprocity, and the statement is made that "there is every prospect of favorable action during the next session." It organized a tour to South America by a party of leading manufacturers, which was noted in our issue of May 14. The party sailed on July 1, and will be absent until Sept. 1. It has also sent a committee of three to visit and report upon trade conditions in Mexico, a special Commissioner is now in Denmark, and another (Hon. Robert P. Porter) returned from Japan June 6 and will present a report to the Association on the industrial present and future of that country and its possibility of competition with American manufacturers. Preliminary steps have been taken toward the establishment of agencies for the exhibit of American manufactured goods abroad. A concession has been obtained from Venezuela for the establishment of warehouses at Caracas for the exhibit of American products, and similar concessions are proposed with other South American countries. The committee having this branch of work in charge includes Mr. John H. Converse, of the Baldwin Locomotive Works, Philadelphia, and Mr. Jas. M. Dodge, of the Link Belt Machinery Co.

The Philadelphia Museums is a concern on a quite different basis from the other two organizations described above. It appears to be aiming to aid the manufacturer in the purchase of his raw material, and the carrying on of his business quite as much as in the extension of his selling trade to foreign countries. It is practically a Philadelphia institution. The city councils chartered it June 15, 1894, and have thus far appropriated $120,000 for its expenses, of which $65,000 was appropriated this year. At present the museums are located in the building formerly used by the Pennsylvania R. R. Co. for its general offices, where floor space to the amount of 200,000 sq. ft. is available. A five years' lease of this property has been taken; but at the end of that time it is hoped that the institution will be housed in its own building. The city has already appropriated a building site of eight acres for the Museums (to which eight acres more are to be added), and appropriated this year $15,000 toward putting the site in condition for building upon.

The trustees of the museums are elected by the city councils and approved by the Mayor, and 14 already elected are to serve for life, the list including such names as Chas. H. Cramp, Thos. Dolan, Francis L. Potts, Wm. L. Singerly, Charlemagne Power, Jr., Frank Thomson and John Wanamaker. The Governor of Pennsylvania, the Mayor of Philadelphia and the President of each branch of the City Councils, are also members ex officio. There is also a "National Advisory Board" made up of "official delegates" appointed by various governments of foreign countries and the principal commercial organizations, such as Boards of Trade, Chambers of Commerce, Manufacturers' Associations, etc., of principal cities in the United States. This Advisory Board held its first annual meeting on June 24 and elected Henry W. Peabody, of Boston, President, and W. H. Parsons, of New York, Vice-President.

Turning now to the work which this institution is doing and proposes to do: It began its work by securing as the nucleus of its collection exhibits made by various foreign countries at the Columbian Exposition. These have been added to by gifts and purchases from abroad, and have been carefully arranged and classified. In 14 rooms on the first and second floors of its present quarters, the world's supply of raw materials are grouped. Thus all the cabinet woods are in one room, another has all the dyeing materials. In another series of rooms the classification is changed to a geographical one, and one set of rooms is devoted to Mexican products, another to Central American, etc. Still another series of rooms are devoted to exhibits of foreign manufactured articles, the idea being to show the American manufacturer with what goods he will compete in entering a foreign market. The collection in the museums now comprises over 60,000 objects, to which additions are constantly being made.

Finally there is a bureau of information containing files of over 500 trade journals, statistical publications, etc. The services which the museums will give to manufacturers are summarized as follows:

> The manufacturer who wishes to introduce his goods into new markets abroad will be shown samples of whatever is now salable in those markets. Full details as to the competition he may have to meet will be furnished him as follows:
>
> 1. Character and variety of goods demanded in various export markets.
> 2. The country from which imported, together with the names and addresses of foreign manufacturers, where possible.
> 3. The quantity imported annually into each particular city.
> 4. The manufacturers' price at the factory.
> 5. The retail prices in each city where sold.
> 6. Transportation charges from Europe to the various foreign ports compared with rates from the United States.
> 7. Import duties.
> 8 Character of packing.
> 9. The names and addresses of importers.
>
> This bureau will also collect detailed information concerning all public improvements in progress or contemplated in Spanish America, South Africa and other new export fields, which may be of interest to the commercial classes of the United States. The information and data of this bureau will be collected through American Consuls, foreign government officials, foreign merchants and the traveling representatives of the museum.
>
> The services of the museums, including this information, are free to all who come for it. The expense of copying, compiling and postage is asked of each manufacturer to whom the monthly reports are sent regularly. This has been estimated at $50 per year.

The Museums will not become a factor in the actual sale or introduction of American goods abroad, as this is left to such institutions as export commission houses, nor will it do the work of a commercial agency in reporting on the credit of foreign buyers. It will not advertise American goods, and American manufactures will not be displayed in the Museum. Prof. W. P. Wilson is the Director of the Museums, and Messrs. Gustave Niederlein and Wm. Harper are Chiefs of the Scientific Department and of the Bureau of Information, respectively.

We have described quite fully these several enterprises for the benefit of those of our readers who may be interested in the work that they have undertaken. Let us next inquire what significance lies in this general awakening of American manufacturers to the profit of cultivating an export trade. It was common enough a half-dozen years ago to hear manufacturers say that the home market was all they cared for. But the last three years have seen such an excess of productive capacity over current demand in the home market, that prices have been reduced to points never before reached. Manufacturers who ten years ago were selling all they could produce at good profits, are nowadays finding competition so sharp that prices are reduced to the lowest living figure, and in addition more money has to be spent in selling goods in order to hold customers and keep active competitors from securing them. It is entirely natural under these circumstances that the same men who a dozen years ago were chiefly concerned lest foreign competition should reduce their profits in the home market, are now in many cases fully convinced of their ability to hold this market against the competition of English or German or French manufacturers, and not only that, but to beat them in either price or quality in the markets of Asia, Africa and South America.

We are accustomed to hear so much of British competition, German competition, Belgian competition, Japanese competition, etc., with the products of American factories, that it is not strange that many people have obtained an idea that foreign manufacturing industries exceed those of this country in magnitude. But the fact is that the United States is by far the greatest manufacturing nation of the world. According to Mulhall the following was the total value of all the manufactured goods produced by the principal nations of the world in 1888:

United States	£1,443,000,000
Great Britain and Ireland	820 000,000
Germany	583,000,000
France	485,000,000
Russia	363,000,000
Austria	253,000,000
Italy	121,000,000
Belgium	102,000,000

It will be seen that according to these figures, in 1888 the manufactures of this country equaled in value the combined output of all the factories of Great Britain and Germany, which are, after the United States, the greatest manufacturing nations. In 1890, according to the United States census, the total value of the manufactured goods produced by the United States exceeded the above enormous total by nearly 30 per cent., the figure for the total being $9,056,765,000.

Now let us see how much of this total was exported. According to the last report of the U. S. Bureau of Statistics, the total value of all exports in the year ending June 30, 1895, was $807,638,000, of which about one-sixth was manufactured articles. Thus in round numbers the total value of our manufactured goods exported in that year was $135,000,000. What the exact total value of the output of our manufactories was during that year, there is no means of ascertaining; but we know that for two or three years after the census of 1890 was taken, the expansion of manufacturing industry in this country went on apace. Remembering that in the decade of 1880-1890, the product of United States manufactories doubled in value, it seems reasonable to believe that the fall in prices and the shrinkage in production that the past three years have seen, have not wholly offset the growth from 1890 to 1893, and that an assumption of $10,000,000,000 as the total value of U. S. manufactures in the year ending June 30, 1895, cannot be far from the truth.

Now comparing this vast sum with the value of our manufactured articles exported, we find that, in round numbers, for every dollar that the American manufacturer received from goods sold abroad, he received $75 for goods sold at home. It is evident from this that our export trade in manufactured articles is as yet a mere trifle compared with the volume of goods required to supply home consumption.

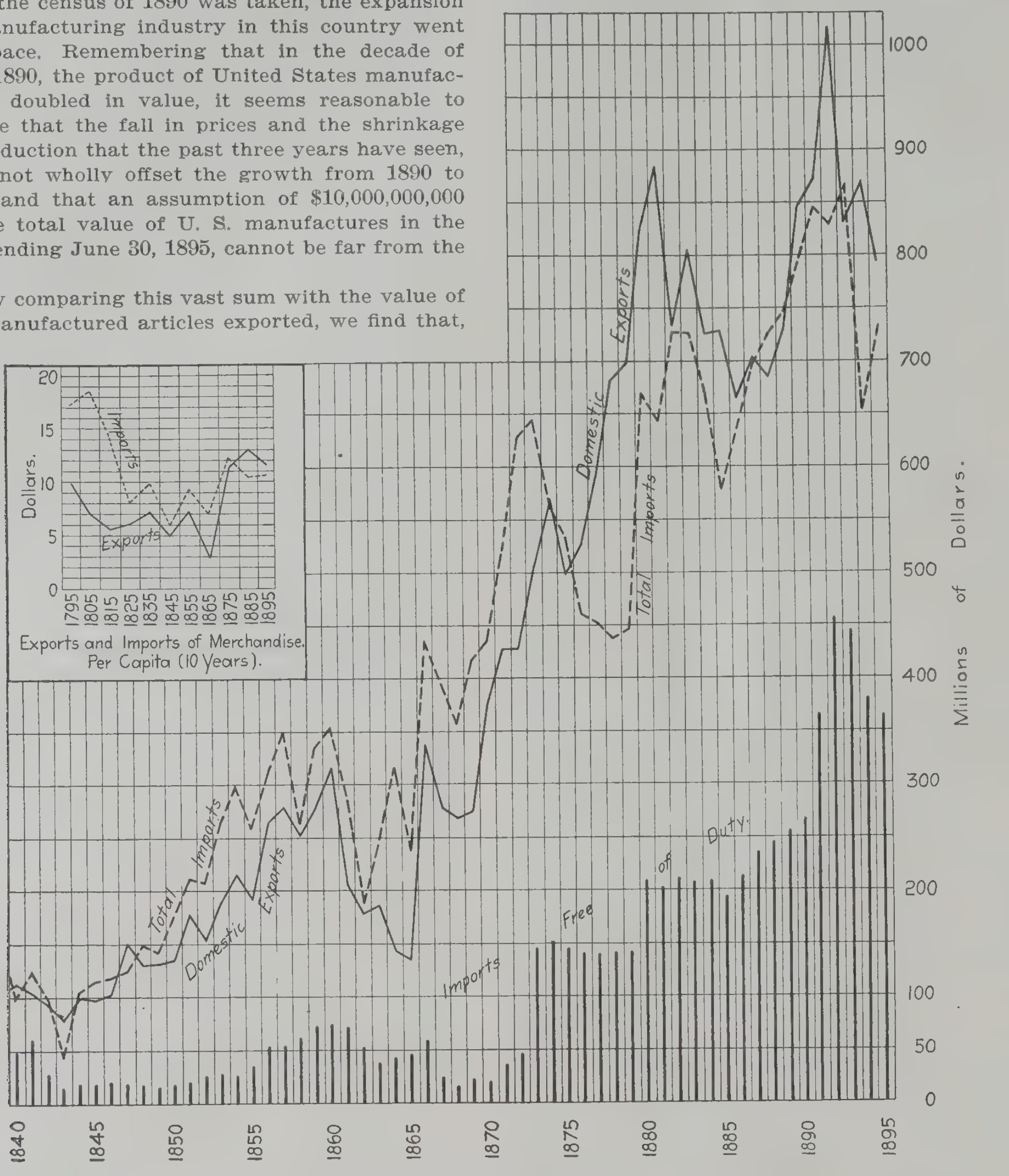

FIG. 1.—FOREIGN COMMERCE OF THE UNITED STATES, 1840 TO 1895.

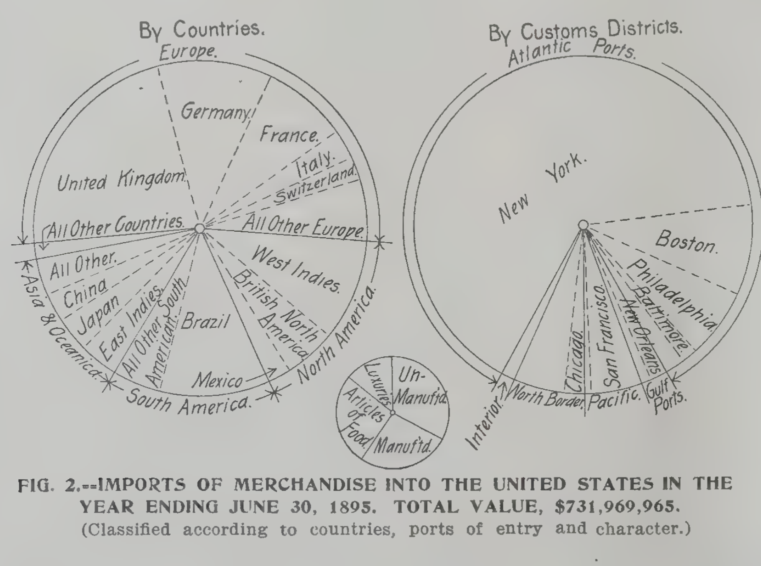

FIG. 2.--IMPORTS OF MERCHANDISE INTO THE UNITED STATES IN THE YEAR ENDING JUNE 30, 1895. TOTAL VALUE, $731,969,965.
(Classified according to countries, ports of entry and character.)

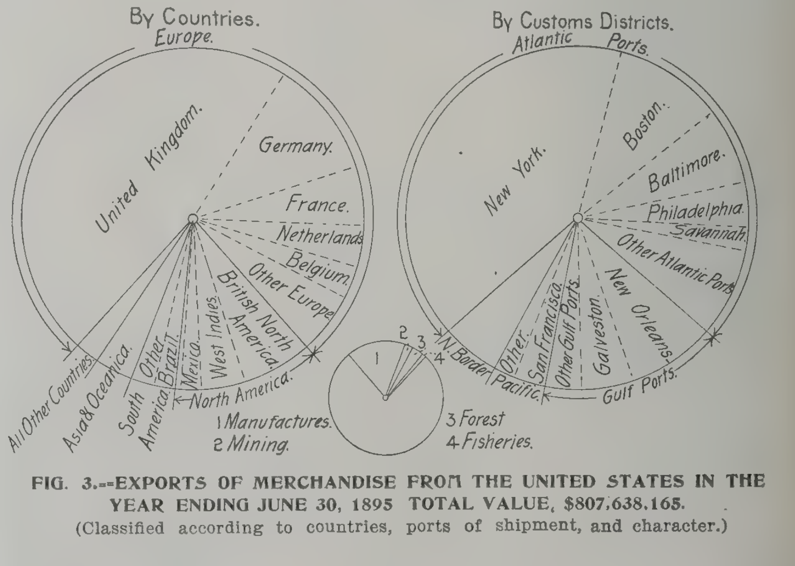

FIG. 3.--EXPORTS OF MERCHANDISE FROM THE UNITED STATES IN THE YEAR ENDING JUNE 30, 1895 TOTAL VALUE, $807,638,165.
(Classified according to countries, ports of shipment, and character.)

There is another profitable inquiry that we may make, and that is what proportion did the manufactured goods which we imported hold to those which were made and sold in this country. Turning again to the report of the Bureau of Statistics just issued, we find that the total value of manufactured goods imported into the United States, in the year ending June 30, 1895, was in round numbers $200,000,000. Thus if we accept the above estimate of the total value of U. S. manufactures ($10,000,000,000), and deduct from it the value of manufactures exported, we find that in round numbers there were $50 worth of American manufactured goods used in this country for every dollar's worth of manufactured goods which we imported.

And now let us see what volume of trade is being secured by the manufacturers of Europe outside of their own borders. Unfortunately, we have not at hand statistics showing the value of the exports of manufactured goods by the different countries of Europe. The total value of all exports by principal manufacturing nations is given as follows by Mulhall:

Nation.	Total value of exports in 1889.
Great Britain	£313,000,000
Germany	163,000,000
France	144,000,000
Holland	93,000,000
Russia	79,000,000
Belgium	50,000,000
Austria	44,000,000
Italy	38,000,000
Total	£924,000,000

We can only hazard a guess at what the increase or decrease has been during the past half dozen years and at what proportion of the above is manufactured articles. Suppose, however, that we assume 60% of the above to be manufactured goods and allow nothing for increase or decrease, we then obtain the present total annual value of European exports of manufactured goods (in U. S. money) at about $2,700,000,000. Certainly this is a huge enough total to offer an attraction to American manufacturers who find the home demand insufficient to absorb the entire capacity of their works. The United States exports of manufactures, as we showed above, now amount to about $135,000,000 per annum. Great Britain's exports of manufactured goods amounted in 1889 to, in round numbers, $900,000,000. Is it not reasonable to expect that the greatest manufacturing nation of the world may yet stand at the head in exports of manufactured goods?

There are some especial reasons which have been brought home to American manufacturers of late, why the cultivation of an export trade is especially desirable. We recall a notable case in the money panic of 1893, when one firm in this country which has a flourishing trade in many foreign lands, went quietly along in its business with no trouble for lack of money, while firms all about it, of equal or greater wealth, were at their wit's end to raise funds for current expenses. It needs no unusual gift of foresight to discern other reasons of financial trial in the future, and the manfacturer will be fortunate who in such periods can rely on foreign orders to keep his works running and on receipts from foreign sales to meet pressing liabilities.

Again, it is a fact which every intelligent student of commercial conditions recognizes, that a relatively small surplus of supply over demand has a marvellous effect in depressing prices. If American manufacturers can dispose abroad of their surplus products, constituting perhaps 1 per cent or 2 per cent or 5 per cent of their total product, it may serve to improve by even more than this percentage, the selling price of their entire output. This reason alone is sufficient to interest every manufacturer in the extension of American export trade. Even those who are not so situated as to be able to ship goods abroad may be benefited if some of their rivals turn their attention in this direction.

A question which will occur to almost everyone and which has already been debated more or less, is the effect which a change in our monetary standards may have upon export trade. If it is true, as has been generally claimed, that a change to a silver standard will lower rates of wages, measured on a gold standard, there appears to be good reason to believe that the American manufacturer would be in at least as good position to compete with his foreign rivals as he is at present. Further, in the general business depression which it is generally agreed must accompany a change in the monetary standard, manufacturers will have stronger incentives than ever to reach out for foreign customers while orders for the home trade are scarce.

Turning again to the figures of our foreign trade, we have deemed it worth while to reproduce herewith some very interesting diagrams just issued by the Bureau of Statistics of the Treasury Department. Fig. 1 shows graphically the total exports and imports for each year from 1840 to 1895. It will be seen that not till 1874 did our exports equal our imports; but that since that time they have been almost all the time materially in excess. The marvellous growth in the volume of our international exchanges which is shown by the figures, is not peculiar to the United States. Mulhall in 1889 declared that the volume of international commerce had increased forty-fold since the beginning of the century.

Fig. 2 shows graphically the total value of our imports and classifies them in three different ways: By the country from which they are brought; by the United States port at which they are entered; and by their character.

Fig. 3 shows similar information concerning our exports. The volume of trade of the different ports is a matter of especial interest. New York shows no signs of losing its supremacy as the great port of entry for imports, and it still controls nearly half the export trade. A most interesting feature is the growth of the export trade of the Gulf ports. It will be seen that New Orleans ships more than Baltimore, and Galveston more than Philadelphia. One more feature of the diagrams may be worthy of comment, and that is that Great Britain and Canada are our best customers, for they alone of all countries buy more of our goods than we buy of theirs.

Returning again in closing to the increase in the exports of our manufactured goods, it is interesting to find that the exports of the present year to Oriental ports show a gratifying increase over 1895. Since Jan. 1, of this year, 95,000 bales of American cotton goods have been shipped to China. This is a greater amount than we shipped in the whole of 1895 or 1894 or 1893. In 1892 we shipped 96,529 bales and in 1891, 142,668 bales. If the present rate is continued the shipments of the present year will eclipse our highest record. Nor is the proportion of the total trade in this quarter which America secures an insignificant one. Statistics of receipts at Shanghai show that from Jan. 1 to July 3, of the present year, there were received at that port 982,175 pieces of cotton drills and sheetings from American mills against only 613,500 pieces from all other countries. During the same period last year the figures were: American goods, 557,188 pieces; goods from all other countries, 338,471 pieces. It will be remembered that these goods are sold in direct competition with the products of the mills of Bombay, which not only have the advantage of surpassingly cheap labor and home-grown cotton, but are located within less than 5,000 miles of Shanghai by water, while the American goods must be carried by rail across the continent and then by steamer across the Pacific, making their total journey equal to half the circumference of the globe. If American manufacturers can successfully win trade under such adverse conditions, where shall limits be set to their achievements?

LETTERS TO THE EDITOR.

Relative Economy of Different Styles of Freehand Lettering.—Correction.

Sir: A typographical error appeared in your issue of July 30, in the article on "Relative Economy of Different Heights and Styles of Free-hand Letters," p. 79. In the latter part of the second paragraph the clause reading, "the height being increased 1-15 in. for each succeeding experiment," should read, "the height being increased 1-50 in. for each succeeding experiment." Yours respectfully, R. C. Vial.

Western Springs, Ill., Aug. 3, 1896.

The Relation Between Putrid Gases and Typhoid Fever.

Sir: In Engineering News of Aug. 6, a note appears regarding the relation between putrid gases and typhoid fever, referring to investigations by Dr. Giuseppe Alessi. This ground has been very well covered already by Sanarelli, and he is, I think, entitled to first honors in this line. His work at the Pasteur Institute, Paris, has been very fine. I referred to it in my "Water Supply," pp. 72 and 317. Very sincerely, Wm. P. Mason.

Hotel Kaaterskill, N. Y., Aug. 7, 1896.

Earthwork Slopes in the Tropics.

Sir: Reading the letter of Mr. Sylvanus Miller in Engineering News of June 25, and the editorial comment on same, these following suggestions occur to me:

From the language of the editor it is not clear that he intends to exclude the slope of embankment, when he speaks of earthwork slopes. It is possible that he refers to embankment slopes, as he mentions a slope of 1½ to 1, the usual slope of embankments. An earth embankment hardly becomes stable in the tropics, or anywhere else, except at a slope somewhat flatter than 1½ to 1. Mr. Miller plainly refers to the slope of excavations, and wherever the earth or other material is of such a nature that it will stand it is better to make the slope nearly vertical for excavations for railways, for the reasons given by Mr. Miller, less surface exposed to the rains, and the further reason of economical construction.

Specifications for the tropics appear to be written exactly as they are for the temperate zones. Slopes on railway excavations are made according to the nature of the material and the judgment of the engineer; but, in the end, more particularly according to the nature of the material. All of nature's laws are in full force in the tropics as elsewhere.

Mr. Miller in writing of canal construction, and that an earth slope for a canal will remain stable at any such slope as ½ to 1, will not be taken for granted by engineers. Has it been asserted by the builders of any canal that an earthwork slope of ½ to 1 was more stable than the usual slope (of 2 to 1) for canals?

One-half to 1 slopes of excavation for railways (in earth) are the rule throughout the greater part of Mexico, Arizona, New Mexico, Colorado, and I am told as far north as the Canadian Pacific Ry., but I think the slopes of ½ to 1 are hardly ever attempted in this same material for canals.

Probably the only material that would remain stable vertical would be solid rock, and we have an example of this in the Chicago Drainage Canal; vertical sides in solid rock excavation.

It is true that there is material here in Guatemala that in excavation will stand better at a slope of ¼ to 1 than flatter, because it is kept dry; but this same material if once subjected to the action of water is difficult to manage.

I have been in the tropics several years and have seen nothing to justify any hope of economy in attempting steep slopes for the Nicaragua Canal. No such hope is justified by the experience at Panama.

Charles Thornton.

Apartado 100, Guatemala, C. A., July 22, 1896.

Some Further Examples of Fictitious Accuracy.

Sir: I notice that in your editorial on "The Evils of Fictitious Accuracy," in your issue of July 30, you omitted from your summation one evil, which, although of not so much importance as those you mentioned, is still deserving of notice. I refer to the amount of time wasted by those engineers who are addicted to the habit of carrying out decimals to the bitter end when the data do not warrant it, or when such decimals have no real significance.

Take the case of railway earthwork. In spite of the fact that a difference in the cut of 1-10-ft. makes a difference of several cubic yards in the result, while a quite imperceptible bellying of the slope will make a like difference, perhaps in the same direction; some engineers will figure to the fraction of a yard, and use the approximate method of averaging end areas at that.

Some engineers seem to lose sight of the fact that the very object of their profession is to do well, safely, and for the least cost consistent therewith, what almost any fool could do very poorly and at a great expense. The real engineer will neither do careless and inaccurate work where fine work is needed, nor will he go to the other extreme of extravagant and useless refinement where only approximate results are required. Two illustrations of such "Ficticious Accuracy" have come to my notice, and they were such flagrant violations of engineering common sense that I deem them worthy of record.

Surveys and an estimate were made for a costly piece of work. A transit line was run and sufficient topography was taken to construct a tolerably accurate contoured plan, upon which a paper location was projected. Next came the profile plotted as accurately as could be done from such a paper location. The points thus determined were laboriously joined by means of a ruling pen and straight edge. After the grade line was established the center cuts were read from the profile and the quantities were computed by the average end area method, to fractions of a yard. The unit prices were, of course, mere estimates, and the amount of rock to be encountered unknown. No comment needed.

The other case was the gaging of a river some hundreds of feet in width. The engineer took fairly accurate observations by the method of rod floats. In computing the discharge (sometimes about 2,000 cu. ft. per sec.) he carried it out to the nearest hundredth of a cubic foot per day, and so reported it. It is doubtful if so eminent an engineer as the late Jas. B Francis, for example, would have felt justified in reporting the flow of a river to the nearest pint per diem, even had he been able to use a weir in the place of rod floats which reached anywhere from 1 in. to 2 ft. from the bottom of the stream. Yours truly, H. E. Abbott.

New York, Aug. 5, 1896.

An Exhibit of American Manufactures in China.

Sir: The Smithsonian Institution has received advice from the Department of State that it is the intention of the University of Peking to establish an exhibit of foreign machinery and mechanical appliances in connection with the Museum of the University. With a view to bringing this matter to the attention of the manufacturers and exporters of the United States a copy of this circular is sent to you, with the consent of the Department of State, with the request that, if you deem it proper to do so, you will publish it in the next issue of your journal.

Yours respectfully,
G. Brown Gour,
Acting Secretary.

Washington, D. C., August 10, 1896.

(The circular is as follows.—Ed.)

To the Honorable Richard Olney, Secretary of State,
Washington, D. C.

Sir: The Peking University, an important educational institution of this city, conducted under the auspices of the American Methodist Episcopal Mission, has recently opened in one of its buildings a museum which it is proposed to devote largely to the exhibition of foreign machinery and mechanical appliances. This museum is visited daily by increasing numbers of people of the better classes who are interested in acquiring some knowledge of foreign manufactures and inventions, and it is believed that it can be made an important means of advertising and introducing the products of American industry. The authorities of this museum would be glad to receive and exhibit working models, photographs or drawings of machinery and inventions or specimens thereof, such as plows, ships, firearms, cannon, electric machinery, cars, locomotives, wind-mills, looms, printing presses, wagons, engines, etc. Each exhibit which may be presented to them will be marked in Chinese with the name and address of the maker, together with the description and price if desired, and a capable translator will explain their use to inquirers.

This is an opportunity which manufacturers should be glad to avail of. Peking with a population of 600,000 is the literary and political center of the Empire. Advertising here should be more profitable than in any city in China. The Peking University is the center of a wide influence. It occupies commodious foreign buildings, lighted by electricity, and is attended by hundreds of young men in search of Western learning. The museum referred to is to be conducted solely for the purpose of increasing the usefulness of the University and attracting the attention of inquirers. Exhibits of the character above described will be gratefully received by it and will be advantageously employed for the benefit of exhibitors as circumstances will permit.

Correspondence on this subject and articles for exhibition may be sent to the Peking University, Peking, China, or to Mr. Charles H. Taft, Treasurer of the Peking University, No. 78 William St., New York City, and under an arrangement with the I. M. customs will be imported to China free of duty. The authorities of the University have applied to this legation for assistance in carrying out their plan, which with a view to such assistance I request that such publicity be given this despatch as the Department may deem fit.

Charles Denby, Jr.

Legation of the United States, Peking, June 5, 1896.

Why Does Wrought Iron Become Weaker and Cast Iron Stronger Under the Influence of Shocks?

Sir: Several inquiries of this nature have come to me during the past few months from people who have repeated successfully the tests recorded in the paper entitled "The Mobility of Molecules of Cast Iron," read at the Pittsburgh meeting of the American Institute of Mining Engineers, and first published in Engineering News of Feb. 27, 1896. The reply I have heretofore given—and now offer to others, through your columns—is this:

Assuming it to be a fact that wrought iron tends to become crystalline and brittle, when subjected to repeated shocks or prolonged stress, the tendency to such change may be due to the fact that the molecules of wrought iron are mechanically forced out of their natural order of arrangement by the hammering, forging or rolling of the metal. The "fiber" of rolled or forged iron is due to the mechanical "carding," as it were, of particles of iron and cinder, or scale, distributed throughout the mass; when examined under the microscope this is quite apparent.

When a shaft, axle, or other piece of forged or wrought iron is subjected, for a long period of time, to moderate stress or repeated vibrations, it is not inconceivable that the molecules—or particles of iron—thus mechanically disturbed and released from their enforced aggregations tend to rearrange themselves according to the laws of molecular attraction; such natural arrangement would be a crystalline one.

Molten cast iron, on the other hand, when poured into a mold and allowed to congeal, tends naturally to arrange the molecules according to this law, and, if a mass of fluid iron could be cooled with absolute uniformity thoughout the section, there would, I believe, be no difference in strength between a casting, whether annealed or not annealed; this result can be approximately accomplished by pouring a test bar in a mold so arranged that the bar in cooling is surrounded by a large mass of molten metal. Such a bar differs largely from a similar bar cast from the same metal and cooled in the ordinary way. Irregular cooling or rapid surface-cooling interferes with the natural crystallization of cast iron and so creates a condition of stress, which, in some cases, exceeds the elastic limit of the metal. A car wheel, for example, unless placed, while red hot, into an annealing pit, usually breaks in half, with a loud report, while cooling, but when properly annealed it is the strongest kind of casting.

A casting will gradually relieve itself of cooling strains if kept undisturbed for a sufficient length of time, and the "shocking system" simply shortens this time by enabling a quicker rearrangement of the molecules under the influence of taps, or vibrations.

The experiments recorded in my paper point clearly to this conclusion and the very large number of tests made afford a quantitative determination of the amount of strain existing in cast-iron test bars; this is found (as might be expected) to differ widely with different kinds of cast iron.

Discarding, for the moment, the wide difference in composition between nearly pure "wrought" iron and the complex alloy called cast iron, the difference in treatment of the two would seem to be quite sufficient to explain, in the manner herein given, why wrought iron tends to become brittle (if it does) under the influence of vibrations, while cast iron is actually strengthened, to a certain extent, by similar treatment.

A. E. Outerbridge.

16th and Hamilton Sts., Philadelphia, Pa., Aug. 4, 1896.

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How to Square a Circle and Rectify Its Circumference.

Sir: The following solution of the old problem of "squaring the circle," and rectifying the circumference gives remarkably accurate results and has suggested also a practical solution by a simple and handy instrument called the "Circle Rectograph."

The solution of the problem is based on the formula:

$$\left.\begin{array}{l}\text{Side of square with}\\ \text{same area as circle}\end{array}\right\} = R\sqrt{\pi} = \frac{2R^2}{\sqrt{R^2+\left[R-2\left(IV-V\right)\right]^2}}$$

in which R = radius of the circle, IV = the side of a square inscribed in it, and V = the side of a pentagon inscribed in it.

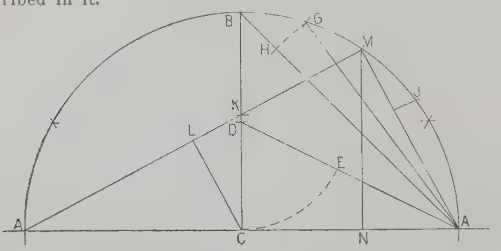

Fig. 1—Method of Constructing a Square Equal in Area to a Given Circle and Rectifying the Circumference.

In Fig. 1, let AA^1 be the diameter of the circle and C its center. Draw BC perpendicular to AA^1, lay off $CD = \frac{BC}{2}$; draw AD and lay off DE = CD; then AE will be equal to the side of regular decagon inscribed in the circle. With AE as a chord, lay off AJ and JG, then AG will be the side of a regular pentagon or = V in the formula. Draw AB and lay off AH = AG; BH will be IV − V in the formula. Lay off BK = 2BH = 2 (IV − V); CK = R − 2 (IV − V). Draw A^1M through K and CL perpendicular to A^1M;

$$A^1M = 2A^1L.$$

In the triangle CA^1K,

$$A^1L = \frac{(A^1C)^2}{A\,K},$$

$$A\,K = \sqrt{(A^1C)^2 + (C\,K)^2},$$

$$\text{Therefore } A^1L = \frac{R^2}{\sqrt{R^2+[R-2(IV-V)]^2}};$$

finally,

$$A^1M = 2\,A^1L = \frac{2R^2}{\sqrt{R^2+[R-2\,(IV-V)\,]^2}}$$

$= R\sqrt{\pi}$ = Side of square with same area as circle.

It remains to prove the exactness of the formula. Suppose R = 1. Then substituting the numerical values,

$$\sqrt{\pi} = \frac{2}{\sqrt{1+[1-2\ (1.41421-1.17557)\ ]^2}}$$

= 1.77245 which is the square root of π

To rectify the circumference: Draw MN perpendicular to AA^1 and draw AM; in the triangle AA^1M,

$$A^1N = \frac{(A^1M)^2}{A\,A^1} = \frac{R^2\pi}{2R} = \frac{R\pi}{2}$$

$= \frac{\text{Circumference}}{4}$; or Circumference $= 4A^1N$

Since the lines CL and AM are only explanatory, and lines BC, AD, AB, AG and MN need only be drawn so far as to mark the respective intersections, both constructions can be reduced as shown in Fig. 2, and in plain words we can say:

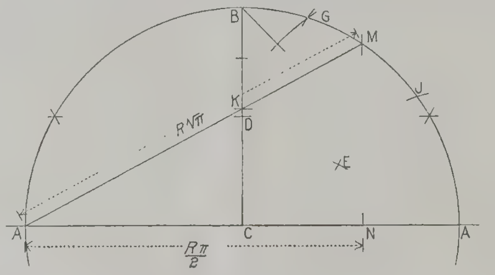

Fig. 2.—Abbreviated Construction.

1. For squaring a given circle: On a line perpendicular to the diameter given lay off from the circumference toward the center twice the difference between the sides of the inscribed square and pentagon; the chord drawn from one end of the diameter and through the point found will be the side of a square having the same area as the circle.

2. To rectify the circumference: The line through the second intersection with the circumference of the chord drawn perpendicular to the diameter cuts off $\frac{\text{Circumference}}{4}$.

A glance at Figs. 1 and 2 shows that a plain triangle containing the angle AA^1M would give the point M at once, and this is indeed all that is required.

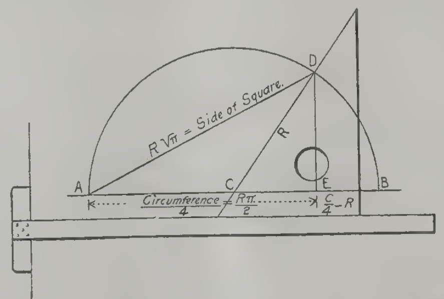
D
$R\sqrt{\pi}$ = Side of Square
R
A
C
E
B
$\frac{\text{Circumference}}{4}$
$\frac{R\pi}{2}$
$\frac{C}{4}-R$

Fig. 3.—Method of Application of the "Circle Rectograph."

But M can also be found by a triangle whose hypotenuse passes through the center of the circle. Since such a triangle need only be about half the size of the former, and for very exact constructions it is important to have the intersections at the best possible angles; that is, at right angles, I have preferred the latter triangle, and have named it the "Circle Rectograph." The "Circle Rectograph" and its application is shown in Fig. 3.

Directions for its use: Through the center of the circle lay the hypotenuse of the triangle by sliding the shorter edge along the T-square, parallel to the diameter given, mark the intersection D (formerly M) with the circumference and draw DE perpendicular to AB;

then will $AE = \frac{\text{Circumference}}{4}$;

AD = side of square with same area as circle.

The "Circle Rectograph" is made by Kolesch & Co., 155 Fulton St., New York city.

H. C. Fischer.

235 E. 19th St., New York, July 14, 1896.

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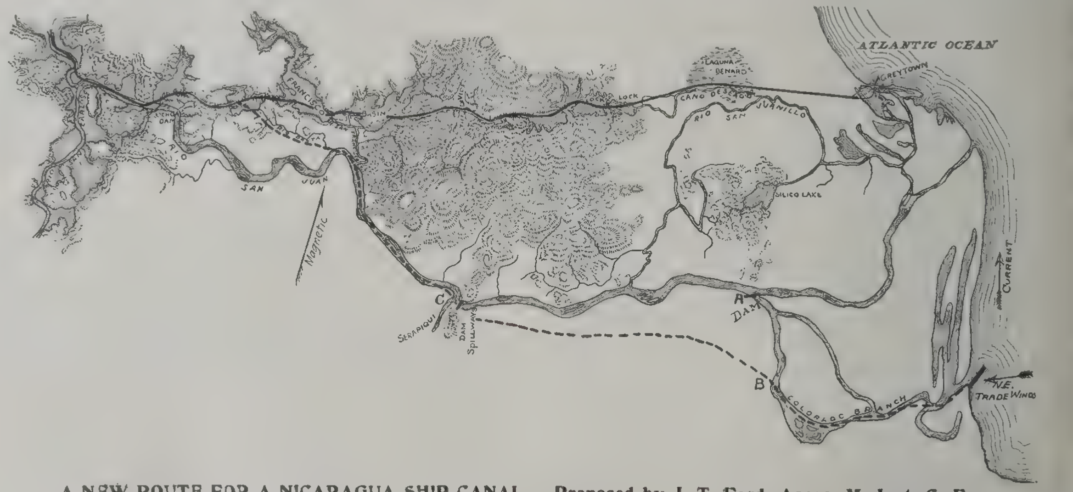
A Proposed New Location for a Nicaragua Ship Canal.

Sir: I hope you will forgive my troubling you again on the subject of the Nicaragua Canal, but it is my pet hobby to do my little best towards influencing some day, a real survey of the ground, and, if the Commissioners' able report is compared with my previous letters in your paper, of the following dates: July 6, 1893; June 20, Aug. 1 and 8, Oct. 10, 1895, as well as one in the "Railroad Gazette" of March 8, 1895, all antedating that report, it will be seen that nearly all my statements were justified. The Commissioners have, however, gone further than I had hoped, much to my regret, in giving the company such a fearful rating before the investing public and the U. S. Government, as to injure seriously, in my opinion, any chance for many years to come of regalvanizing the great project, either by private enterprise or government ownership; but it will be done some day, and Mr. Silvanus Miller's letter in your issue of June 25 has determined me to say another word in the hope that you will indulge me again and publish it. I am openly an enthusiast on the Nicaragua Canal, but an opponent of Mr. Menocal's route and of the methods of the old company; this attitude I have always held, as is shown by my letters above referred to. The skeleton sketch I send herewith is enough to convey my ideas on the Atlantic division without too much detail, I shall not touch on the Pacific terminus, as I think if Mr. Miller were familiar with the ground he would agree that we have but little choice there for a terminus within the limits of a reasonable expenditure. Salinas Bay is a very fair harbor, but so is the Harbor of San Francisco. As far as the Nicaragua Canal is concerned, it would cost too much to get there, and we must make the best we can of Brito.



A NEW ROUTE FOR A NICARAGUA SHIP CANAL. Proposed by J. T. Ford, Assoc. M. Inst. C. E.
(The proposed route is shown in dotted lines. The Menocal location is shown by a full line.)

Greytown, however, is quite a different problem, and there is ample room there for choice. I quite agree with Mr. Miller that the waters of the San Juan with their fearful freight of silt should be turned back to Greytown by cutting off the Colorado branch, say at or near point A; a simple pile and brush structure would do this easily, as it is practically at sea level and with little current for a great part of the year, and having the old channel to Greytown ready prepared, it would immediately scour out and again accommodate all the waters of the river as it used to do up to some 50 years ago. This feature has always formed part of my scheme, but now, when you have got the waters of the San Juan and their fearful sand drift at Greytown to leeward of us, for heaven's sake let them stay there and leave Greytown severely alone; we have then a channel with no CURRENT, and no DRIFT SAND, at sea level, practically all the way, already deep enough to float our dredges for 20 miles from the sea, and which we can deepen at small cost to any point which may be found convenient to use it. I select for argument sake point B as a likely point to leave the Colorado branch, and point C, the mouth of the Serapiqui River, as our first communication with the San Juan. Now, it will be said, we know nothing of the country between B and C. I only allow this, however, for argument sake, and if we do not know much, more shame is it, for the Canal Company. But I DO know that a favorable line can be got at SOME level between these points approximately, and proper surveys should have been made there. The mouth of the Colorado is certainly as good a place for a port as Greytown, though they are both pretty poor ones, but here at least we would be free of all drift, with marshy lagoons of great extent affording ample protection for shipping and capable of unlimited expansion for the sole cost of dredging under the most economical conditions. At point C it certainly will not be denied that a dam CAN be built at SOME elevation, say even with crest only 40 ft. above sea level, but I believe that 50 ft. above sea level could here be obtained. Whatever it may be, however, we obtain by this dam a certain amount of deeper slack water in the San Juan above, carving out ample spill-ways for discharging the river floods, in the hills on the north bank of the river at that point. Suppose now that we could not get up as high as Ochoa by using the present San Juan channel deepened and improved, because the crest of the Serapiqui dam be too low. We can, even then, leave the San Juan at any convenient point again, up the Rio Danta perhaps (I have been over this ground personally), and if we must have the fearfully dangerous high-level Ochoa dam (which I don't admit), and the San Francisco basin, with its appalling line of high mud embankments on soft mud bottoms, we can reach it conveniently in this way and adopt the Menocal route beyond, having gained the great advantages of avoiding the absurd Divide Cut, and the equally absurd proposition of making a practicable harbor of Greytown.

I write this all as a mere hypothesis, but I have a good deal of sound information to back it up nevertheless, and at least, is it sensible, on such a great work as this, to have left the south bank of the San Juan, from Ochoa to the sea, an absolute blank, as far as real surveys are concerned, or filled in with mere fancy work, as it has been on the company's plans, simply because of the petty squabbling and jealousy between Nicaragua and Costa Rica, about their boundaries and prospective rights of dominion over the canal, and the insistence on the part of Nicaragua, that the whole canal and its eastern terminus should be on her territory? But, of course, Mr. Menocal would never have got his concession at all if he had not made that promise.

My line for the proposed survey would certainly, if practicable, economize a great deal, and it is at all events worth the trouble of being proved to be wrong. The south bank of the San Juan should never have been ignored as it has been hitherto in such an important work, and by all means let us hope that the wise suggestions of the late able Commission will be adopted and the appropriation made by Congress for a proper survey. Yours truly,

J. T. Ford,
Asoc. M. Inst. C. E., Gen. Man. C. M. Ry. Co.
Cartagena, July 18, 1896.

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THE STRENGTH OF A CONCRETE SLAB was recently made the subject of an interesting test at the laboratory of the Massachusetts Institute of Technology, Boston, Mass. This slab was a section of flooring designed to be used in a courtyard for a dormitory building and which had to carry coal teams, etc. Brick arches had been specified for this floor, but on account of the lower bid for concrete flooring, the authorities decided to test it. In the test the slab was supported by four I-beams spaced 4 ft. 9 ins. c. to c. and was 5 × 14 ft. × 4 ins. with ¾-in. twisted steel bars spaced 6 ins. c. to c. and running lengthwise, and 3-16-in. bars running crosswise, 4 ft. 9 ins. apart, or directly over each I-beam. The composition of the concrete was 1 part Alsen's Portland cement, 1 part sand and 6 parts broken stone. The stone was crushed so that 2 parts passed a ½-in. ring and 4 parts a ¼-in. ring. Bricks were piled on in piers until a load of 16,770 lbs., or 724 lbs. per sq. ft. was obtained and a depression of 5-32-in. resulted. This load of course covered only the span between two I-beams. Next an impact test, consisting of dropping a timber weighing 164½ lbs. endwise onto the slab 20 ins. from the nearest I-beam and from a height of 7 ft. 10 ins. was made without causing any break or damage whatever. The third test was for shearing and consisted in thrusting with a screw jack against an I-beam laid transversly across the slab about midway between the I-beams, until a pressure of 20,700 lbs., with a deflection of 1 1-32 ins. was obtained before the concrete cracked. By means of the same screw jack a more local pressure covering an area of ½-in. × 9 ins. was tried. When placed so as to bring the pressure over two of the twisted iron bars the load borne was 6,200 lbs., and over one bar 7,700 lbs. were carried. It is stated that several faults of construction entered into this slab or else it would have shown still better results. Our authority for the above statements is the Ransome & Smith Co., of Chicago, Ill., which makes a specialty of this system of concrete and twisted iron construction.

THE DESIGN AND SPECIFICATIONS FOR THE FAIRMOUNT PARK BRIDGE.

In our issue of July 2 we published the accepted design made by the Phoenix Bridge Co., for the new bridge to be built by the Fairmount Park Transportation Co. in Fairmount Park, Philadelphia. After that date, as we briefly stated in our issue of July 16 (p. 48), a protest was presented to the Commissioners of Fairmount Park against the award of the contract, and the Commissioners referred the matter to Mr. Theodore Cooper, M. Am. Soc. C. E., for examination and report. As some of the questions at issue are of general interest to the profession, we print herewith several letters, from which our readers may gather the facts in the case and form their own conclusions.

For the easier understanding of the matter we may say that Gen. Russell Thayer, M. Am. Soc. C. E., is the Chief Engineer and Superintendent of Fairmount Park, Philadelphia, and is also Chief Engineer or Consulting Engineer (we are uncertain which), of the Fairmount Park Transportation Co., a private corporation which has obtained a franchise for the construction of an electric railway in Fairmount Park.

A little over a year ago General Thayer sent out invitations to bridge companies to submit proposals for this bridge, and several such proposals were received, but the final award was not made until June of the present year. We reprint the correspondence without further comment:

Philadelphia, Pa., May 31, 1895.

Pencoyd Iron Works, Pencoyd, Pa.:

Gentlemen: I should be pleased to receive from you on or before June 22 a proposal, accompanied by general plans and specifications for the construction of the superstructure of a steel bridge proposed to be constructed across the Schuylkill River, within the limits of Fairmount Park, by the Fairmount Park Transportation Co.

The enclosed blue print shows the general conditions existing and the general design of a structure that was prepared by me, but it is not intended to limit you to that particular design, except in so far as the length of spans, the elevation above water level, and the level and grade of the upper deck is concerned. It is quite probable that you may be able to submit a design much more attractive and more suitable.

The bridge will be a single deck structure, provided with a 10-ft. walk on north side of bridge, then a 40-ft. asphalt driveway for carriages, and next to the latter a double-track roadbed for extra heavy trolley cars. If considered desirable, the railroad portion of the structure may be separate and distinct from the driveway and footwalk, and the former may be from the latter by a space of 3 ft., but this is not required. Heavy ornamental iron railings will be required on each side of the roadway portion of the bridge, and on the outside of the railway portion.

In calculating the weight of highway portion of the structure in all its parts, the standard requirements heretofore adopted by the city of Philadelphia for such structures may be assumed, and in regard to the railway portion, the structure must be of amply sufficient strength to permit fast trains of heavily loaded cars to pass over same, with an ample factor of safety in all parts. These functions should be briefly stated in the general specifications.

Proposals will not include the masonry, and the company reserves the right to reject any or all bids. Any further information may be obtained by application to the Chief Engineer.

Yours respectfully,
Russell Thayer, Chief Engineer.

Address plans and proposals to Russell Thayer, C. E., Room 127, City Hall, Philadelphia.

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Philadelphia, Pa., June 10, 1895.

Poncoyd Iron Works, Philadelphia, Pa.:

Gentlemen: In order to give you ample time to properly complete specifications and proposals for the bridge proposed to be constructed across the Schuylkill River, for which you have some data, I have extended the time for receiving said proposals until 12 m., June 29, 1895. I enclose herewith additional data to be included in the requirements for the specifications for the structure.

Yours very truly,
Russell Thayer, Chief Engineer.

Memorandum of Specifications to be used in Designing the Superstructure of Bridge over Schuylkill River for Fairmount Transportation Company.

Lengths of Spans, Widths, Clearance, Etc.

The span lengths, elevation of grade line and clearance under the bridge to be as given on accompanying profile.

There is to be one sidewalk on north side of bridge 10 ft. wide, one roadway 40 ft. wide, both in the clear, and south of the roadway two tracks for electric cars, having a clearance of 12 ft. for each track.

General.

Cooper's Specifications for Highway Bridges, Edition 1890, to govern for unit stresses, quality of material, workmanship, etc., except as same may be modified below.

Structural Material.

All structural material to be soft steel except eye-bars, pins, I-beams and lateral rods, which are to be medium steel and except where it may be necessary to use rods requiring welding, in which case they are to be of wrought iron.

Roadway and Sidewalk Flooring.

The roadway and sidewalks are to be covered with asphalt pavement, carried on a solid steel floor, the asphalt wearing surface on the roadway to be 2 ins. thick and on sidewalk 1½ ins. thick, same being laid on bituminous concrete base or binder which shall be at least 3 ins. thick over highest point of the supporting steel work of the roadway, and 2 ins. thick over the highest point of the supporting steel work for the sidewalks, rivet heads not being considered in figuring the depth of concrete over the steel work.

Quality of asphalt wearing surface and bituminous binder to be as required by the specifications of the Dept. of Public Works for the City of Philadelphia.

Flooring for Railway Tracks.

Track rails to be laid on either white oak or long leaf southern yellow pine cross-ties, spaced with 6-in openings and secured to the steel work by ¾-in. bolts, through every third tie; the cross-ties being carried on longitudinal steel stringers.

Guard rails to be 6 × 8 in. yellow pine, dapped 1 in. over ties and bolted to every third tie with ¾-in. bolts, with additional bolts through splices.

Ties to be proportioned for an extreme fiber stress of 1,000 lbs. per sq. in., considering one axle load as being supported by three ties.

Hand Railing.

There are to be three lines of heavy ornamental iron railing, costing not less than $2 50 per lin. ft. of rail; one line on outer side of sidewalk, one line between roadway and electric car tracks, and one line on outer side of car tracks.

Loads to be Used in Calculations.

Dead Loads: The dead load is to include total weight of iron and steel in the structure, the weight of paving, wooden floor system, track rails, hand railing, etc. The weight of bituminus concrete to be taken at 140 lbs. per cu. ft., and the asphalt 95 lbs. per cu. ft., and all floor lumber at 4 lbs. per ft. B. M.

Live Load: In addition to the dead load, the structure is to be designed to carry 100 lbs. per sq. ft. on the roadway and sidewalks for the highway portion of the bridge, and 1,000 lbs. per lin. ft. on each electric car track distributed so as to produce maximum stresses.

In case two electric cars coupled on each track with loads of 20,000 lbs. on each axle distributed thus:

O—7 ft.—O——23 ft.—— O - 7 ft.- O.

or one wagon on the roadway with loads of 20,000 lbs. on each axle, wheels 5 ft. gage and 8 ft. wheelbase produce greater stresses in any of the members than loads specified above, then these members shall be proportioned for the concentrated loads as per diagram.

Unless the stresses in the trusses produced by live load when only partially covering the roadway and sidewalk transversely exceed by more than 10% the stresses produced by live load covering entire width of roadway and sidewalks, they need not be considered.

In case the partial loading produces stresses greater by 10% than the uniform loading covering the entire width of the roadway and sidewalks, then the truss members are to be proportioned so that the unit stresses under partial loading shall not exceed the specified unit stresses by more than 10% wind load.

The structure is to be designed to resist a wind pressure of 30 lbs. per sq. ft. on the vertical projections of each truss and railing, and the vertical projections of the floor system considered as a dead load and properly divided between the top and bottom lateral system, and in addition the top lateral system is to be figured for a moving load of 150 lbs. per lin. ft.

Limiting Thickness of Material.

No material less than ⅜ in. to be used except for fillers, and no rods having a smaller area than 1 sq. in. to be used.

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Commissioners of Fairmount Park, Philadelphia, Pa.:

Gentlemen: Under dates of May 31 and June 10, 1895, the A. & P. Roberts Co. received invitations to furnish a design and estimate for a bridge across the Schuylkill River in Fairmount Park. Said invitations were signed "Russell Thayer, Chief Engineer," and were accompanied by certain data and specifications for strength and loading to which the bridge should conform. In accordance therewith a design was prepared by the Pencoyd Iron Works, blue prints of which are herewith enclosed.

My attention was recently called by published articles in the daily papers, and also in the Engineering News of July 2 to the fact that the contract for this bridge had been let. I have no interest in the matter other than that of a citizen of Philadelphia, but deem it my duty to enter a protest against proceeding with the building of the structure, as shown in the articles above referred to:

I.—The bridge in question should contain three arches, not four.

II.—The masonry of the piers should be carried to the level of the roadway.

III.—The roadway, having considerable grade, will throw the arches out of a horizontal line, presenting an extremely bad effect in the adopted design.

IV.—The bridge as shown is much lighter and does not conform to the specifications issued by Chief Engineer Thayer in his invitation for proposals.

V.—At the time the present design was passed upon by your committee the plans were not in proper shape for a decision to be made, and General Thayer, as Chief Engineer, had in his possession information which it was his duty as General Thayer, Superintendent of Fairmount Park, to have furnished your committee. That the blue prints accompanying this communication were not shown the committee, and they had no knowledge of their existence.

I am credibly informed that no actual work has been done upon this bridge other than drawings, and I must respectfully urge upon you the reconsideration of the design for this structure, which can be made as the Washington Bridge in New York, an adornment to the Park, and not simply a means to carry a trolley line across a hole.

It is not a matter which can hereafter be remedied, and will stand an eye-sore, when there is no occasion for any such. Yours very respectfully,

Percival Roberts, Jr.

261 South Fourth St., Philadelphia, July 9, 1896.

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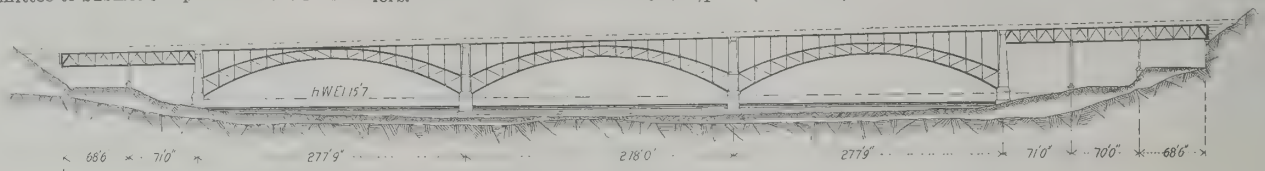
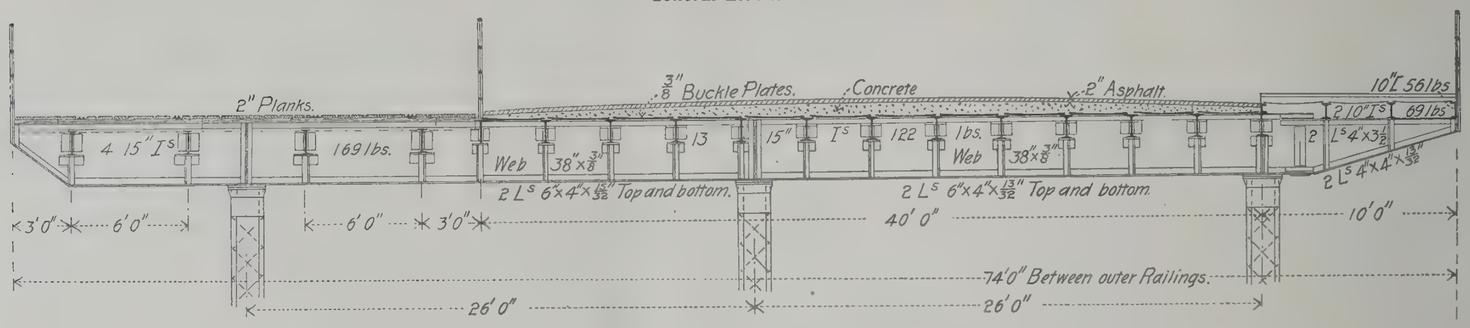
Messrs. Geo. S. Webster and A. J. Cassatt, Committee of Fairmount Park Commissioners, Philadelphia, Pa.:

Gentlemen: Referring to the conversation had with Mr. Webster to-day, from which I understood that it is the purpose of your committee to submit the plans for the four-arch bridge now contracted for by the Fairmount Park Transportation Co. to an expert bridge engineer for examination and report, I beg to present for your consideration the following facts:



General Elevation.



Cross Section Showing Floor Construction.

DESIGN BY THE PENCOYD IRON WORKS FOR THE NEW BRIDGE OVER THE SCHUYLKILL RIVER IN FAIRMOUNT PARK, PHILADELPHIA, PA.

I still insist that a bridge containing three arches is the only proper bridge to be erected in the location in question. Your committee having decided not to open up this matter, I will not occupy your time with my reasons for the same, but only call your attention to the fact that the piers of the accepted bridge on the low water line occupy 62 ft. of the water way of the stream, and at the bottom 84 ft. So far as I know, at the time the plans were submitted to your committee for approval they were in very defective shape, as no strain sheet accompanied them, and very little data was shown.

It is, however, stated and made part of the contract that the standard specifications of the Phoenix Bridge Co. of 1895, for highway structures, shall govern the design of the bridge.

General Thayer stated on Tuesday last, at the meeting of the Committee on Plans and Improvements, that the accepted design of the four-arch bridge complied in all respects with the specifications issued by him under date of May 31 and June 10, 1895. I regret exceedingly to be compelled to say that this statement is entirely incorrect.

I have now to enclose you copies of the above-named invitations to tender for the bridge, and specifications to govern the design of the same. I now assert that the bridge as shown in the Engineering News of July 2, 1896, is a weaker and lighter structure than called for by General Thayer, and also that the specifications of the Phoenix Bridge Co. permit a structure which must, not only under General Thayer's specifications be condemned, but is also much lighter and weaker than would be permissible under the present practice and specifications of the City of Philadelphia.

I respectfully call your attention to the following points, upon which I base the above remarks:

Comparative Permissible unit strains in Highway Bridges, Dead and Live Loads Assumed Alike.

Specifications.	Cooper's 1890. Soft steel.	Cooper's 1890. Medium steel.	City of Phila.	Phoenix.
Plate and shapes in tension in trusses:				
Per sq. in.	12,330	14,800	13.500	15,940
In. % of Phoenix...	77.3%	92.8%	84.7%	100.0%
Plates and shapes in tension in floor:				
Per sq. in.	12,000	14,400	13.500	17,850
In. % of Phoenix...	67.2%	80.6%	75.6%	100.0%
Compressive unit stress not reduced for buckling:				
(A) Chords.				
Per sq. in.	13,300	16,000	12,000	15,940
In. % of Phoenix...	83.4%	100.3%	75.3%	100.0%
(B) Posts.				
Per sq. in.	11,660	13,330	12,000	15,940
In. % of Phoenix...	73.1%	83.6%	75.3%	100.0%
Compressive unit stress reduced for buckling for l ÷ r = 50.				
(A) Chords for Cooper's, fixed ends for Phoenix:				
Per sq. in.	10,670	12,800	......	14,900
In. % of Phoenix...	71.6%	85.9%	....	100.0%
(B) Posts for Cooper, hinged ends for Phoenix:				
Per sq. in.	8,330	8,670	......	13,990
In. % of Phoenix...	59.5%	62.0%	....	100.0%
Lateral Bracing:				
Per sq. in.	15,000	18,000	......	25,000
In. % of Phoenix...	60.0%	72.0%	....	100.0%

Thayer's, Cooper's 1890 Modified.	Phoenix.
Quality of material: Soft steel, 54,000 to 62,000 (Clause 131). If medium steel used (see Clause 109). All holes reamed; all edges planed. Thayer distinctly specifies soft steel.	Quality of material: Medium steel reamed and planed, over ⅝-in. thick, 60,000 to 68,000 lbs. (Clause 66 and 67-92).
Live Load: 100 lbs. per sq. ft. No material less than ⅜-in. to be used except fillers.	Live Load: 100 lbs per sq. ft. floor, 80 lbs. per sq. ft. trusses. No material less than ¼-in. (Clause 31).

From the above data it will be seen that the proposed bridge is too high in its unit strains. The quality of the material does not conform to the specifications of General Thayer, nor to Cooper's, for the same quality of material. The workmanship does not conform to the specifications of Cooper. The trusses are designed for a live load 20% lighter than called for by Thayer. The thickness of material is less than permissible by Thayer.

If, therefore, the Phoenix Bridge Co.'s specifications are correct for the designing of this bridge, the specifications of Mr. Cooper, of Mr. Cooper modified by General Thayer, and the practice of the city of Philadelphia, and other first-class cities for municipal work of this character are incorrect, and should be modified in the interests of taxpayers.

I contend that the proposed bridge due to its position and liability to full loading should be designed with the same factors of safety as would be used in any other first-class municipal work, and respectfully claim that the above-given data conclusively proves that such is not the case.

If the four-arch bridge must be used, then let it be proportioned either under General Thayer's specifications as issued, or in conformity with the practice of the Engineering Department of the city of Philadelphia.

Yours truly, Percival Roberts, Jr.

Philadelphia, Pa., July 16, 1896.

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Commissioners of Fairmount Park, Philadelphia, Pa.

Gentlemen: In compliance with the request of your Sub-Committee on Plans and Improvements, I have made an examination of the general plans for the Fairmount Park bridge proposed to be built by the Fairmount Park Transportation Co.

Your sub-committee has furnished me with copies of the communications from Mr. Percival Roberts, Jr., and other papers relating to this work. The Phoenix Bridge Co. has sent me copies of the general plans of their proposed bridge and their specifications under which they propose to construct it. The general plans consist of three sheets of drawings, as follows, viz.:

1. A general elevation and cross-section at the centre of one arch.
2. Elevation of one arch, its strain sheet and plan of the metal floor.
3. Plan of cross floor beam and stringers.

As shown by these plans the structure consists of a metal approach on the west bank 180 ft. long, four main river spans each 208 ft. long between centers of piers, and a metal approach on the east bank 210 ft. long, making a total length of steel structure 1,222 ft. The carrying trusses of the approaches are lattice girders resting on vertical points. The main river spans are steel arches springing from masonry piers a few feet above high water line, and having a rise at the center of about 40 ft.

The total width of the structure is 79 ft. 3 ins., consisting of a sidewalk on the north side 12 ft. in width, a driveway 40 ft. wide, and a separate division 27 ft. 3 ins. wide reserved for a double-track electric railroad. The sidewalk and driveway are to be paved with asphalt. The approaches are to have a grade of 2.56%, and the main spans 1.202%, all rising towards the eastern bank.

The license under which this bridge is to be constructed says:

> The said bridge over the River Schuylkill shall be a substantial and ornamental structure of steel or iron, with stone piers and abutments, and the plans, materials and construction thereof shall be subject to the approval of the Committee of the Commissioners of Fairmount Park on Plans and Improvements. Proper provision shall be made on the said bridge for passages of carriages and foot passengers, and no charge shall be made for their passage over the said bridge.

The only question that has been raised in reference to this requirement is whether the proposed bridge is a "suitable and ornamental structure," not whether it is the most substantial and ornamental, nor whether a more substantial and ornamental structure could not have been made. Under a general requirement like the above, a reasonable interpretation must be taken.

Capacity and Strength of the Structure.

This bridge has been proportioned for the following requirements:

1. The floor beams and stringers are to carry a load of 100 lbs. per sq. ft. over all parts of the sidewalk and driveway, or a 20-ton load on a wheel-base of 9 ft. on any part of the driveway; and for 1,000 lbs. per lin. ft. of the railroad tracks or an electric car weighing 25 tons loaded, followed by another car weighing 20 tons loaded, on a total wheel-base of 78 ft.
2. The trusses are to carry the full area of the sidewalk and driveway over the whole span loaded with 80 lbs. per sq. ft., and 1,000 lbs. per lin. ft. over each railroad track.

I consider the above requirements for the loading satisfactory and sufficient. In addition it is required that all parts of the structure shall be proportioned under these loadings so that the maximum strain shall not exceed those allowed by the Phoenix Bridge Co.'s specifications. As far as is shown upon the general plans submitted, these allowed strains have not been exceeded.

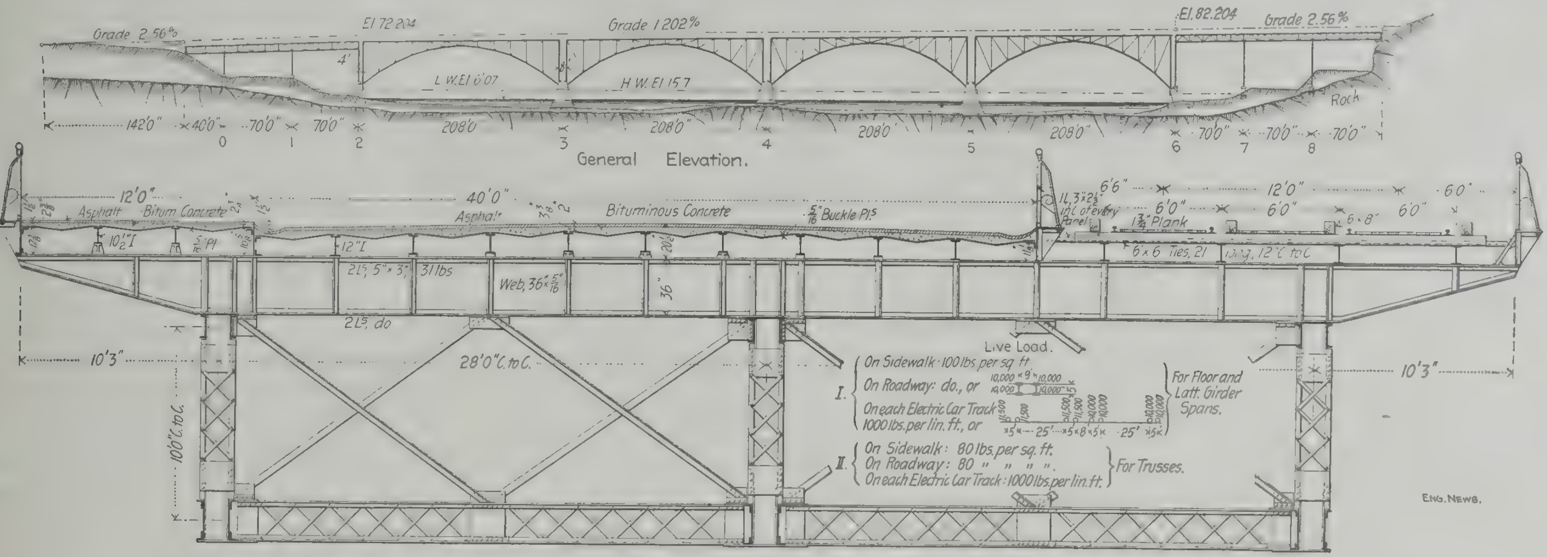
From the point of view of capacity and strength, the proposed bridge can be considered a substantial structure. There are, however, certain features of the structural parts of the work which I would recommend changed or modified:

1. The buckle plates of the driveway should be crowned upwards instead of downwards, as they can then be better drained and will be less subject to deterioration. They should also be riveted to the beams instead of bolted.
2. There should be at each side of the driveway a metal curb of an approved form.
3. The gutters should be shaped as is customary and not of the depressed form as shown. They should be drained into a pipe system leading to and down along the piers into the river. They should not drain directly into the river to the annoyance of persons using the river, or so as to permit the wind to blow it upon the structural work.
4. At the junction of spans, where expansion spaces are needed, an approved form of expansion joint should be placed in the paving that will be smooth and noiseless under the passage of vehicles.
5. There should be provisions made for putting now or at some future time hydrants at suitable distances, for washing the pavements.
6. The handrailing is not satisfactory from either the point of strength or appearance. This bridge will be liable

to have crowds upon special occasions, like boat races. which would tax severely the strength of the handrailing. It should therefore be about 4 ft. 6 ins. high above the sidewalk and of unquestioned strength. It is due to the structure that it should be an ornamental one, both from its effect upon the general external appearance of the whole structure, but also as seen from the roadways.

General Appearance of the Structure.

Where all conditions are equal, a three-spanned arch bridge is generally considered a more pleasing structure than one of an even number of spans. I estimate that under the same requirements, allowing for the saving of the cost of one pier, three spans at this point would have cost about $20,000 more. The location of the present piers was determined by conditions of the channel. The west abutment and the west river pier are now under way.



General Elevation.

Cross Section at Center of Span.

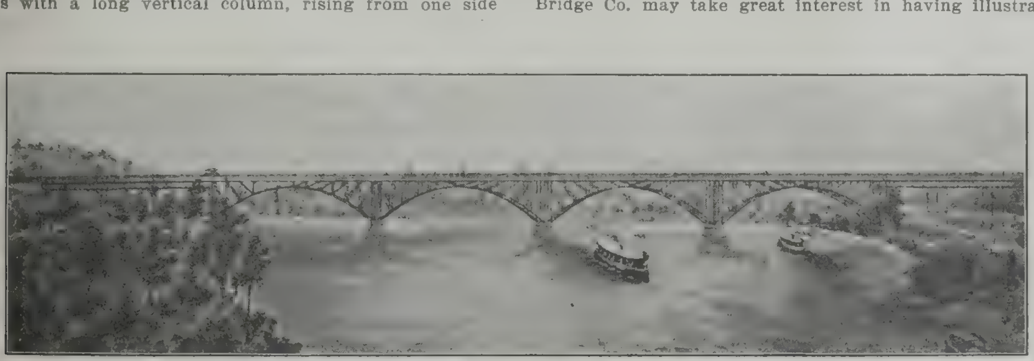
DESIGN BY THE PHŒNIX BRIDGE CO. FOR THE NEW BRIDGE OVER THE SCHUYLKILL RIVER IN FAIRMOUNT PARK, PHILADELPHIA, PA.

I do not consider the selection of three spans instead of four as of sufficient importance, under the circumstances, to recommend any change. I think, however, that certain changes are necessary in the proposed plan to give the structure that satisfactory and pleasing appearance that its location demands.

1. The general outline of the main spans at the top is a straight line. It will appear from a distance as curved downwards and would be very unsatisfactory in looks. This line should be cambered downwards about 2 ft. at the middle of its length, giving the skyline an actual curve of 2 ft. in 800. This curve on the roadway should be gradual, merging into the grades of the approaches. The effect of the two approaches, both inclined upwards and east, can be modified by the trees on the bank.

2. The fascia shown on the plans is too small and meagre in its treatment. The fascia, cornice and handrailing should be treated as a whole both for strength and architectural effect. Plates LVII. and LVIII. of the "History of Washington bridge over the Harlem River, New York," shows the fascia, cornice and handrail of the bridge. While this is of greater magnitude than required for the bridge under consideration, it shows the desirable method of treatment.

3. Weakness of look at the ends of spans. Each span ends with a long vertical column, rising from one side of the piers, so that at the point where the eye expects massiveness, there are only two long slim posts. Slender masonry piers extending above the footings of the arches would have relieved this effect on the river piers, but at the abutments a more massive work would have been required.



PERSPECTIVE VIEW OF DESIGN FOR FAIRMOUNT PARK BRIDGE.
By the Phœnix Bridge Co.

I think this can be largely remedied by making the metal work over the piers of a more massive looking character, without the use of false ornamentation. In like manner at the ends of the bridge the single light post and the sudden break at the lattice girder approaches detracts very much from the dignity of the structure. This can be remedied by making the approach spans next the arch spans, half arch spans corresponding in form to the main spans.

If the suggestions above indicated are carried out properly, I think you will have obtained for the City of Philadelphia a substantial and ornamental structure, and a suitable Park bridge. Yours respectfully,

Theodore Cooper, Consulting Engineer.

New York, July 30, 1896.

We reprint herewith from our issue of July 2, the design for this bridge presented by the Phoenix Bridge Co., and also show on the same scale and in the same style the design which was submitted by the Pencoyd Co. with its bid, in order that our readers may more readily compare the two. In accordance with our usual custom we have submitted proofs of the above matter to the parties interested, with an invitation to present replies or comments, for publication in connection with the above; and we have received the following letter from the Phoenix Bridge Co.:

◆

Sir: I am quite familiar with the correspondence of Mr. Percival Roberts, Jr., Vice-President Pencoyd Iron Works, in connection with the bridge now being constructed over the Schuylkill River in Fairmount Park, Philadelphia, which correspondence you kindly forwarded to me; I have also seen considerable additional correspondence that Mr. Roberts has seen fit to address to a number of Philadelphia city officials and copies of which were given to reporters of Philadelphia daily papers. The Phoenix Bridge Co., having been engaged to build a combined highway and trolley bridge of stated dimensions and under given specifications I have not felt at liberty to discuss these requirements either privately or publicly. After a careful examination of Mr. Roberts' letters I fail to find any scientific matter of public interest. The Pencoyd Bridge Co. may take great interest in having illustrated in your journal alongside of the Phoenix Bridge Co.'s plan their ideas of proper plan and length of spans, which might be adaptable to another location, but in the present case it is ruled out absolutely as unsuitable and not acceptable to the Park commissioners (see Russell Thayer's letter of invitation of May 31, 1895, above). The local conditions are such that the four-span crossing is necessary and was so fixed upon as long ago as 1894.

There are many specifications to choose from in undertaking to design a bridge, and their differences in some particulars can readily be expressed by percentages, without, however, enlarging our knowledge of their respective merits. This is all Mr. Roberts seems to have shown and in a manner that is manifestly misleading. Moreover, in comparing specifications, Mr. Roberts is also misleading and unreasonable. He compares the Phoenix Bridge Co.'s specifications, prepared in 1895, after several years of experience in the manufacture and use of steel construction, with the specifications of Theodore Cooper and of the City of Philadelphia prepared as early as 1890, when steel was first being used and its behavior during manufacture and in service somewhat uncertain. Mr. Theodore Cooper has a new highway bridge specification in press and the City of Philadelphia is changing their specification to agree with experience. Mr. Roberts, in making his comparisons, also used the limiting unit stresses, without bearing in mind that well known clause, which Mr. Theodore Cooper, from his wide experience has thought necessary to print on the outside cover of each copy of his specifications: "The most perfect system of rules to insure success must be interpreted upon the broad grounds of professional intelligence and common sense."

The Phoenix Bridge Co. try to interpret their own specifications on these lines and also any other specification which they are called upon to use from time to time. If Mr. Roberts had so desired he could have convinced himself by an examination of our detail stress sheet, giving sizes, etc., prepared several weeks before he saw fit to criticise the plan, that in no case have we used the limiting strains he finds, but have used our "common sense and professional intelligence" in designing and detailing the particular bridge under consideration, bearing in mind the duties it must perform. That we have not erred in our conclusions and judgment is borne out by the report just made to the sub-committee of Fairmount Park commissioners by their consulting engineer, Theodore Cooper, which you have reprinted.

Mr. Roberts' criticisms are answered in the following portion of Mr. Cooper's report:

> Capacity and Strength of the Structure.—This bridge has been proportioned for the following requirements: 1. The floor beams and stringers are to carry a loading of 100 lbs. per sq. ft. over all parts of the sidewalk and driveway or a 20-ton load on a wheel-base of 9 ft. on any part of the driveway; and for 1,000 lbs. per lin. ft. of the railroad tracks or an electric car weighing 25 tons loaded followed by another car weighing 20 tons loaded, on a total wheel-base of 78 ft.
>
> 2. The trusses are to carry the full area of the sidewalk and driveway over the whole span loaded with 80 lbs. per sq. ft., and 1,000 lbs. per lin. ft. over each railroad track.
>
> I consider the above requirements for the loading satisfactory and sufficient. In addition it is required that all parts of the structure shall be proportioned under these loadings so that the maximum strains shall not exceed those allowed by the Phoenix Bridge Co.'s specifications. As far as is shown on the general plans submitted, these allowed strains have not been exceeded. From the point of view of capacity and strength the proposed bridge can be considered a substantial structure.

Mr. Cooper's suggestions regarding number of spans, grade, pavement, cast curbs, gutters, hydrants, drainage, hand railing, auxiliary masonry piers, etc., are all matters in which the Phoenix Bridge Co. have no voice or interest, these points being determined by the committee of Fairmount Park or their representatives.

As I have intimated before, I find nothing to discuss in Mr. Roberts' letters that would be of great interest to your readers, and I can find no excuse or reason for their publication.

In June, 1895, we submitted tenders for the construction of the bridge in exact accordance with the letter and specifications received by Mr. Roberts (see copies above). In this competition with three other companies we were the lowest bidder and were so advised, and Mr. Roberts' interest as a bidder ceased. About a year later we were asked to enter into a contract for the construction of the bridge, various modifications having been made in loading, width of sidewalk, width of trolley portion, total length of structure, wooden floor, etc. After considerable discussion we finally entered into an agreement to furnish the metal work in place. After we were well under way Mr. Roberts took up the matter as "a disinterested taxpayer of the city of Philadelphia," intimating that the loading was light, the Phoenix Bridge Co.'s specification not good practice, there should be only three spans, etc., etc.

In view of Mr. Cooper's report, his rights as a taxpayer do not appear to have been trampled upon to any serious extent.

I am able to say without qualification that the bridge as designed, in my judgment, will conform to best modern practice, and when completed will be one of the most substantial and ornamental highway bridges in the country. The photograph which I send you herewith shows the bridge as it will appear when completed. I shall be pleased to have an opportunity to make to the Engineering News, at a later date a full representation of the special features and details of this bridge, which I believe will be of general interest.

Respectfully yours,
John Sterling Deans,
Chief Engineer, Phoenix Bridge Co.
Phoenixville, Pa., Aug. 8, 1896.

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TESTS OF NON-CONDUCTING COVERINGS FOR BOILERS AND STEAM PIPES.

The Boston Manufacturers' Mutual Fire Insurance Co. has issued a report by Prof. Chas. L. Norton, of the Massachusetts Institute of Technology, on the relative efficiency of different commercial coverings for steam pipes. His tests were made by a new method which consists in filling the pipe under trial with oil and heating the oil by a wire immersed in it which carries an electric current. The amount of heat radiated from the pipe is equal to the heat furnished by the current, which may be computed from the readings of a voltmeter and an ammeter. The accompanying tables give the results obtained:

Results of tests of Non-Conducting Steam-Pipe Coverings

Table I.—Test.—Temperature in the Pipe, 381.7° F., Corresponding to Steam of 200 lbs. Absolute Pressure; Temperatude of the Room, 72° F.

No.	Name.	Thickness, ins.	British thermal units per sq. ft. pipe per minute.	Ratio of heat loss to loss from bare pipe.	Weight, ounces per ft. of length.
1.	Nonpareil cork	0.90	3.04	0.254	21
2.	Magnesia	1.12	3.40	0.284	24
3.	Air cell No. 1	1.12	3.58	0.300	23
4.	Air cell No. 2	1.25	3.40	0.284	50
5.	Magnabestos	1.12	3.84	0.321	48
6.	Fire felt	1.00	3.99	0.333	46
7.	Calcite	1.25	5.02	0.423	29
8.	Bare pipe	....	11.96	1.000	..

Table II.—Temperature in the Pipe, 239.4°, Corresponding to Steam 10 lbs. above Atmospheric Pressure; Temperature of the Room, 72°.

No.	Name.	Thickness in ins.	British thermal units per sq.ft. pipe per min.	Ratio of h't loss to loss from bare pipe.
1.	Nonpareil cork	0.90	1.44	0.232
2.	Magnesia	1.12	1.59	0.262
4.	Air cell No. 2	1.25	1.58	0.261
5.	Magnabestos	1.12	2.32	0.383
6.	Fire felt	1.00	2.40	0.395
8.	Bare pipe	..	6.06	1.000

No. 1 was furnished by Stone & Duryee, Nos. 2 and 5 by Keasbey & Matthison, Nos. 3 and 4 by Asbestos Paper Co., No. 6 by H. W. Johns Co., and No. 7 by Phillip Carey Co.

Full details of the method of conducting the tests are given in Prof. Norton's report. The results given above are averages obtained from 5 to 15 tests of each specimen, and the variations in individual tests were so small that the values of the ratios of efficiency can be depended on as correct within ½ %.

The circular contains also some important information concerning the liability of wooden laggings of cylinders and boxing of steam pipe to char and take fire. Wooden coverings of cylinders and steam pipes are apt to become completely converted into charcoal, and this may take fire immediately upon the entrance of air through the outer coving.

A caution is given concerning the use of mineral wool as a steam-pipe covering, as follows:

> It serves only as a non-heat-conductor when in a very light and fluffy condition holding entrapped air. It is liable to be consolidaed by the vibration of the factory, leaving the upper part of pipes exposed, while the lower side is only guarded against radiation by this material becoming more and more solid and therefore less fit for its purpose. But this is not the worst. It is very dangerous stuff to handle. The fine needles getting under the nails will produce very injurious effects, and it is not safe to handle this material even in a laboratory without carefully protecting mouth and nose from the dust, which when breathed has produced hemorrhage. Much of this slag also contains sulphur or other elements which when wet or even dampened by escaping steam become very corrosive. Another type of a similar kind is known as Rock Wool. This appears to be made from glass and is therefore without corrosive effect, but is even more dangerous to handle than the mineral type. We therefore give this warning against the use of mineral and rock wool whenever offered to any of our members for covering pipes, and when used for any other purpose it should be handled with the greatest caution.

An addendum to the circular states that the caution regarding rock wool applies only to the use of the substance in its loose condition. A covering is made in which the material is so held in containing covers as to make it probably quite safe to handle and free from liabilty to injury by vibration.

Concerning asbestos and other materials used for coverings, the circular says:

> Asbestos is one of the most valuable substances ever discovered for use in making pipe coverings and boiler laggings, but it is not because the asbestos itself is a non-conductor of heat; on the contrary, in a solid or compact condition, it is rather a quick conductor of heat, and must therefore be used merely as a bond for other substances or medium for holding entrapped air. Asbestos being an incombustible and fibrous substance may be and is used as a bond for holding magnesia, and other non-heat-conducting substances in position. It is also used in the manufacture of the Air Cell Covering for the purpose of holding a very large amount of entrapped air. In this way it serves a purpose for which it would be wholly unsuitable by itself, as it is liable to become more and more solid under vibration, even if first used in a porous or fluffy condition without combination with other substances.
>
> The properties of magnesia in a loose condition holding entrapped air, the properties of what is known as fossil meal which is the diatomaceous earth, found under peat bogs, and the properties of cork in retarding the radiation of heat were well established by our previous investigation. The properties of air entrapped in a finely divided form, that is to say, entrapped in a material in which there can be little or no circulation of the air, have long been known. Hence success in making a pipe covering or boiler lagging has consisted in the combination of a bonding material of an incombustible kind, notably asbestos fiber, so as to hold the maximum amount of loose magnesia, loose fossil meal or entrapped air in the encasement which can be put on the outside of the pipe, and maintained without being impaired by vibration, or from other causes.

THE DETAILED COST OF 8-IN. PIPE SEWERS AT ITHACA, N. Y.

We have received from Mr. H. N. Ogden, Jun. Am. Soc. C. E., Chief Engineer of the Sewer Commission of Ithaca, N. Y., some figures relating to the detailed cost of 8-in. pipe sewers on 13 streets in that city, comprising a total length of 17,163 ft. The figures are given in the accompanying table and are supplemented by the following explanatory notes:

> The column of cost of labor is based on observed number of laborers at the following assumed prices, which may vary a little from those actually paid: Foreman, $2; laborers, $1.35; masons, $3.50; tenders, $1.50; pipe layers, $1.50; teams, $3.50. Pipe, 12½ cts. per ft., with Ys 25 cts. each additional. Brick, $8. No amount for superintendence or profit is included. Teams were used for hauling pipe and cement from cars, and for cleaning up the streets. Amount not very regular, and probably partly inaccurate. The cost of manholes was made up sometimes by adding cost of brick and cement to labor, and sometimes by multiplying the depth by a determined amount per foot of depth. The manhole covers were bought separately, and are here estimated at 1½ cts. per lb. Cement was furnished by the city and delivered to contractor on the car. The cost to city was 95 cts. per bbl. The amount of cement used ranged from 120 to 243 ft. of laid pipe per bbl. Pipe was deep-socket pipe, and is estimated at 12½ cts. per ft. on cars here; all 8-in. The average cut given is found from the average of the different cuts for different distances along the trench, or is the true mean cut. Underdrains, where used, were furnished by the city; cost of labor only is included on Green St. Cost per foot per foot deep is found by dividing cost per foot by average cut. It eliminates the difference in the depth of trenches, and gives a fair comparison between the cost of pipe laying in the different streets, and between the different foremen. Cayuga St. only is paved (brick on 6 ins. of concrete) and the cost of repaving is not included. The other streets have a gravel surface. There were three gangs all and four gangs half of the month during which time the above work was done.

Detailed Cost of 8-in. Pipe Sewers in Sec. 7 of the Sewerage System of Ithaca, N. Y.

Street.	No. of day's work.	Cost of labor.	Cost of teams.	No. manholes.	Cost manholes.	Cost of manhole covers.	Cost of cement.	Cost of pipe.	Total cost.	Length laid, ft.	Cut, ft. Max.	Cut, ft. Min.	Cut, ft. Ave.	Cost per ft.	Cost per ft. per ft. deep.	Remarks.
Wheat	4	$126.50	$5.00	3	$29.00	$18.27	$13.56	$154,25	$346.08	1,134	6.7	4.9	5.3	$0.30	$0.056	Wet clay; water 3 ft. down, baled out; no pumping or sheeting.
Corn	5	200.70	7.00	5	53.00	30.45	24.18	196.50	511.83	1,504	7.2	5.8	5.8	.34	0.058	Wet clay; water 3 ft. down; no pumping; occasional bracing.
Washington	1½	49.50	2.00	1	8.00	6.09	4.34	51.25	121.18	398	6.4	3.5	4.9	.30	0.061	Wet clay; no pumping or sheeting.
Titus	4½	318.90	9.00	3	37.00	18.27	21.70	178.38	583.25	1,391	8.5	6.0	6.8	.42	0.062	Loam over wet clay; water 6 ft. down; no p'mp'g; occasional brac'g.
Plain	7	209.00	10.50	5	52.00	30.45	21.23	166.50	489.68	1,332	6.9	5.0	5.9	.37	0.063	Wet clay; water 5 ft. down; 1 diaphragm pump; occasional bracing.
Buffalo	4	108.25	6.00	3	35.00	18.27	14.41	78.63	260.56	597	8.1	5.4	6.7	.43	0.064	Clay and gravel; much water in places; pump; braced; some sheet'g.
Fayette	4	195.05	4.00	3	30.00	18.27	13.64	132.50	393.46	984	6.0	5.1	5.6	.40	0.071	Wet clay; water 4 ft. down; occasional bracing and pumping.
Centre	7	347.00	10.00	5	61.00	30.45	25.11	189.25	662,81	1,334	8.7	6.0	6.8	.50	0.073	Wet clay; water 3 ft. down; 1 diaphragm; occasional bracing.
Green	11	418.85	13.00	7	80.00	42.63	36.58	260.13	851.19	1,919	6.4	5.4	5.7	.45	0.078	Half gravel; remainder clay; half close sheeted; underdrain pumps.
Clinton	11	519.85	14.00	9	98.00	54.81	38.90	318.88	1,044.44	2,403	6.8	4.5	5.4	.43	0.081	Wet clay, 1 pump; occasional bracing; some gravel pockets.
Albany	9	319.50	7.00	4	50.00	24.36	21.54	187.38	609.78	1,431	6.6	4.2	5.0	.43	0.086	Gravel containing water at 5 ft.; half sheeted; pump.
Geneva	7	373.47	10.00	3	30.00	18.27	27.12	176.13	634.99	1,323	5.8	4.8	5.3	.48	0.091	Sheeting and pumping entire; water at 5 ft.
Cayuga	10	468.25	4.00	6	66.00	36.54	32.47	194.50	801.76	1,413	8.1	5.4	6.3	.56	0.090	Loose gravel; brick pavement half braced; half sheeted; no pump.

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RULES FOR THE SANITARY PROTECTION of the water supplies of eight cities and nine villages have been established by the State Board of Health of New York in the past few years. The original authority for making such rules was given by Chap. 543 of the Laws of 1885, which required the approval of the County Judge of the county in which the waters are located. By Chap. 661 of the Laws of 1893, and amendments thereto, the rules established by the board take effect without the approval of local Judges. The cities for which rules have already been established are New York, Brooklyn, Rochester, Watertown, Syracuse, Elmira, Mount Vernon and Newburgh; the villages are Norwich, Cobleskill, Ilion, Fort Edward, Sing Sing, New Rochelle, Coxsackie and Skaneateles.

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THE RELATIVE EFFICIENCY and cost of plumber's work has been investigated in detail by the London "Lancet" through a special commission appointed for that purpose. The commission gives three reasons for the large number of unsanitary houses: (1) The "prevailing indifference and consequent ignorance of all classes" regarding sanitary appliances; (2) bad work and cheap material as a result "of putting such work up to the distorted competition of all who may choose to tender for it;" (3) "the cost of rectifying sanitary work." After discussing these three reasons the report is chiefly taken up with a description of the plumbing in three imaginary buildings, with detailed estimates of the cost of making it good. Floor plans of the buildings are presented and many sketches of plumbing details showing how not to and how to do it. The report is published as a supplement to the "Lancet" for July 4, 1896.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

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THE AMERICAN LINE STEAMSHIP "ST. PAUL," on Aug. 14, arrived at Sandy Hook in 6 days and 31 minutes from Southampton. The course covered was 3,046.1 knots and the average speed was 21.08 knots per hour. On Aug. 13 she made a record of 530.8 knots. The highest horsepower developed was 20,800, with a highest steam pressure of 198 lbs. per sq. in.; the average revolutions of the screws were 90½ per minute, with a maximum of 93 revolutions. The sea was generally smooth and weather favorable, with some fog, which caused a slight delay. The "St. Paul" thus lowers by one hour and 53 minutes the record made last week by her sister ship, the "St. Louis," and lowers her own previous fastest trip by one minute less than five hours. The average coal consumption on the "St. Paul" was 315 tons per day.

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THE HAMBURG-AMERICAN STEAMSHIP "Fuerst Bismarck" has made a new record of six days, 9 hours and 43 minutes, from Southampton to Sandy Hook. The average speed was 19.85 knots per hour. Her best previous record was 6 days, 10 hours and 32 minutes. The White Star steamship "Britannic" also lowered her former best record, of 19 years ago, by reaching Sandy Hook from Queenstown in 7 days, 7 hours and 31 minutes. She landed her passengers before sunset on Thursday, Aug. 13, and lowered her own record by about 3½ hours. She encountered heavy fogs for several days.

◆

THE U. S. ARMORED CRUISER "BROOKLYN" will leave the Cramp ship building yard on Aug. 22 for her trial trip off the Massachusetts coast. The course is from Cape Ann to Cape Porpoise, a distance of 41.5 knots. The dimensions of the "Brooklyn" are as follows: Length on load water line, 400 ft. 6 ins.; extreme beam, 64 ft. 8¼ ins.; mean draft, 24 ft.; displacement, 9,271 tons. The four engines are of the twin screw vertical triple-expansion type, with 16,000 I. HP.; she has a normal coal supply of 900 tons and a bunker capacity of 1,753 tons. The contract speed is 20 knots; but 22 knots is expected in the trial. Her main battery contains eight 8-in. breech loading rifles and twelve 5-in. rapid-fire guns; the secondary battery includes twelve 6-pdr. and four 1-pdr. rapid-fire guns, and four Gatling guns. She has five torpedo-tubes, and the armor is 3 ins. thick on the sides, 5½ ins. on turrets and 8 ins. and 4 ins. on the barbettes, with 6-in. and 3-in. protection decks. The "Brooklyn" will carry 46 officers and 515 men, and the hull and machinery were contracted for at $2,986,000 and the keel was laid on Aug. 2, 1893. The ship is designed to have a radius of action of 1,758 knots at full speed and 6,088 knots at a speed of ten knots.

THE CAISSON ACCIDENT, in the Brooklyn Navy Yard, is still under investigation. Civil Engineer A. G. Menocal, U. S. N., in his testimony, gives his figures and reasons for assuming that it would be safe to entirely remove the stone ballast before substituting concrete. According to the published testimony Mr. Menocal estimates the water pressure against the caisson at about 740 tons, producing "a friction" on the rubber gasket, between the caisson and the dock of 370 tons. To this friction he added the weight of the caisson itself, which was 225 tons. The buoyancy of the caisson was 390 tons and he thus assumed a margin of safety, against lifting, of "over 200 tons," which he considered safe enough. Mr. Menocal charged the accident to the extreme heat, which tended to soften the rubber in contact with the heated plates of the caisson. Civil Engineer F. C. Prindle, U. S. N., testified that the removal of the ballast was the cause of the accident, and he could not think of any other cause; in his experience the total removal of the ballast was unprecedented in a similar operation. Judging from results alone, the slightly slower method of gradually replacing the stone by concrete would have been the safer method, and would have altogether avoided any reliance upon risky factors of frictional safety.

◆

A NICARAGUA CANAL, says the Panama "Star and Herald," is to be cut by the Nicaraguan government to connect Pearl Lagoon with Pine Lagoon, and give access to the first lagoon from Bluefields, through Pine Creek. The canal would be about three miles long, and Mr. Frank Field is named as the contractor.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision Aug. 15 at Torch, W. Va., on the Baltimore & Ohio Southwestern Ry. An eastbound fast freight train had run past the place where it had orders to wait for a westbound express train, and the two trains collided. Both enginemen and the fireman of the express were killed, and three other trainmen were seriously injured.——A westbound express train on the Denver & Rio Grande R. R. was wrecked near Pueblo, Colo., Aug. 15, owing, it is thought, to distortion of the rails by the great heat. The engineman and fireman were killed and about 20 passengers slightly injured.——A passenger train on the Lake Shore & Michigan Southern Ry. was wrecked near Otis, Ind., Aug. 13 by the collapse of a culvert which had been washed out by a sudden storm. The engineman and fireman were killed.

◆

A HEAD COLLISION OF ELECTRIC CARS occurred on the Brunswick Traction Co., between New Brunswick and Milltown, N. J., Aug. 16. One car was trying to reach the next turnout beyond the one at which it should have waited for the other car.

◆

A BOILER EXPLOSION occurred Aug. 13 at the brick and tile works at Louisville, O., and two men were fatally injured.

◆

A STEAM ROLLER RAN AWAY on Glenmore Ave., New York city, recently, and went down a bank into a gully.

◆

A COLLISION BETWEEN LAKE STEAMERS occurred in the Lake St. Clair channel on the night of Aug. 14, and both vessels were sunk in 17 ft. of water, but nobody was killed. The vessels were the "Oceanica," 1,490 tons, with coal from Buffalo to Chicago, and the "William Chisholm," 1,581 tons, with ore from Marquette to Ohio ports.

◆

A HEAVY STORM in the neighborhood of Pittsburg, Pa., on Aug. 13, caused a flood in Pine Creek, and five persons were drowned at De Haven.

◆

A DYNAMITE EXPLOSION at New Holland, Pa., on Aug. 17, killed three men, injured seven others and caused considerable damage to property. The Pennsylvania Telephone Co. is rebuilding its line between New Holland and Lancaster, and uses dynamite in blasting out the post holes. The gang was preparing to start out to work and one man had gone into the shed to fetch the dynamite when the explosion occurred.

◆

AN INTEROCEANIC ROUTE is to be maintained by the National Railway of Tehuantepec, which has been leased by the Mexican government to Weetman, Pearson & Son, of London, for 50 years. This company, which has contracted for many large public works in Mexico, will improve the railway terminals and harbors at Coatzacoalcos on the Gulf and Salina Cruz on the Pacific.

◆

CONCRETE AND STEEL IN COMBINATION has been adopted with success on some of the sewers built by the Metropolitan Sewerage Commission of Boston. One of the main outlet sewers built by the commission at a point where it crossed private property in Mattapan came within 8 ins. of the surface, and at a time when the sewer was flowing very full the internal pressure became sufficient to break the arch of the sewer and flood the land adjacent to it. To prevent a recurrence of the accident Mr. Wm. M. Brown, Jr., Superintendent of the Metropolitan Sewerage Commission, purchased about 4,500 sq. ft. of expanded metal, bent this to the arch of the sewer and built a new 8-in. concrete roof, embedding the expanded metal in the concrete and placing it about 2 ins. from the outside of the arch. The expanded metal extended from the crown of the arch to the springing line on each side, and its strength is such that no fears are entertained as to the safety of the arch in future. We are informed that on other sections where similar trouble was experienced the sewer was entirely relocated and rebuilt at a lower grade for a considerable distance. The expense involved in this was, of course, far greater than in the simple repair with expanded metal described above.

◆

MAIL SERVICE BY ELECTRIC CARS has now been in operation in Brooklyn, N. Y., for two years, having been commenced on the Atlantic Ave. R. R. in August, 1894, the cars running between the general Post Office and Coney Island. The service gave satisfaction to the postal authorities, and it was not long before there was a demand for its extension to other parts of the city. The first step in that direction was in the transportation of mail pouches on the front platforms of cars, but later arrangements were made with the Brooklyn Heights R. R. Co. for the running of mail sorting cars over several of its lines. Of these cars there are now seven in regular operation, and by means of them a great saving of time in the distribution of mails is effected. The original electric mail service on the Atlantic Ave. R. R. is no longer maintained. The contract was not a liberal one from the company's point of view, being based on the amount of mail mater carried, estimated in pounds or tons, and the new management felt that the company was not getting enough out of it to make it worth while to continue the arrangement.

◆

A 30-STORY OFFICE BUILDING is to be erected on Park Row, New York city, on the site of the old International Hotel, and will be about 386 ft. high from the curb line. There will be 27 main floors and three floors in side towers, 30 in all. The foundations consist of piles driven into the sand, cut off below the water line and covered with the concrete and masonry bases for the columns. The outer walls will be carried by cantilevers, as in many other tall buildings of this character. The architect is Mr. R. H. Robertson, of New York city.

◆

HARD VS. SOFT WOOD FOR STREET PAVING has been considered by a special committee of the Paddington Vestry, London. In this parish the past practice has been to use soft wood with Portland cement joints. The surveyor of the parish reports that the life of this pavement is shorter than it was some years ago, owing to increased traffic, a higher standard of surface demanding more frequent repairs, and a decrease in the quality of the wood used owing to increased demand. The committee finds the present life of this soft wood under heavy traffic to be only six years, against 15 years for hard or jarrah wood pavement; and this committee finds a saving in cost in using the latter and recommends that all wood roads be renewed as soon as practicable with the best jarrah wood.

◆

DR. FRIDTHOF NANSEN, says a special despatch to the "St. James Gazette," has arrived at Vardoe, an island on the coast of Norway. According to the meagre reports current he left his specially-constructed ship, the "Fram," in March, 1895, and attempted to push towards the North Pole over the ice which his ship could not penetrate. Nansen claims to have attained latitude 86° 14′ N. This is 2° 50′ further north than the 83° 24½′ attained by Lockward and Brainard, of the Greely expedition in 1883. In 1891 Lieut. Peary reached latitude 83° 24′ N. From the point named some members of the expedition returned south to Franz Joseph Land and Dr. Nansen and Lieutenant Hansen reached Norway on the steamer "Windward," which had been conveying provisions to the Jackson-Harmsworth expedition. The "Fram" is supposed to be on her way to Vardoe or Bergen. Dr. Nansen sailed from Vardoe on July 21, 1893, intending to reach an alleged open sea north of the 82nd degree of latitude and to drift in the ice across the Pole. It may be stated that some of the reports concerning the manner of Dr. Nansen's undoubted return are contradictory, and nothing is known of the fate of his companions left on the "Fram."

◆

THE BLOOMING DEPARTMENT OF THE TROY Steel Company was started for the first time on Aug. 8. This new plant was commenced in September, 1895, and the machinery was built by the Mackintosh-Hemphill Co., of Pittsburgh, Pa., from the plans of Chief Engineer Arnold, of the steel company. The plant includes a pair of 42 × 60-in. reversing engines and in full operation the output of finished steel will be 800 tons per day. In making Bessemer steel the vessels are lined with calcine dolomite, instead of silica, ground fine, mixed with gas-tar and pressed into bricks under 500 tons pressure. The entire plant is expected to be in operation in about a month, employing 1,200 men.

ORE HOISTING AND CONVEYING MACHINERY AT ASHTABULA, OHIO.

We illustrate herewith an ore hoisting and conveying apparatus designed and built by the King Bridge Co., of Cleveland, O., and located on the ore docks of the Pittsburg, Youngstown & Ashtabula Ry., at Ashtabula, O., operated by Messrs. M. A. Hanna & Co., a firm whose senior member is not unknown to fame. The King Bridge Co. has a wide reputation as a builder of bridges, but it has also built quite a number of conveying machines of the general class represented, the earliest having been built in 1882. The present design contains a number of improvements suggested by the company's experience.

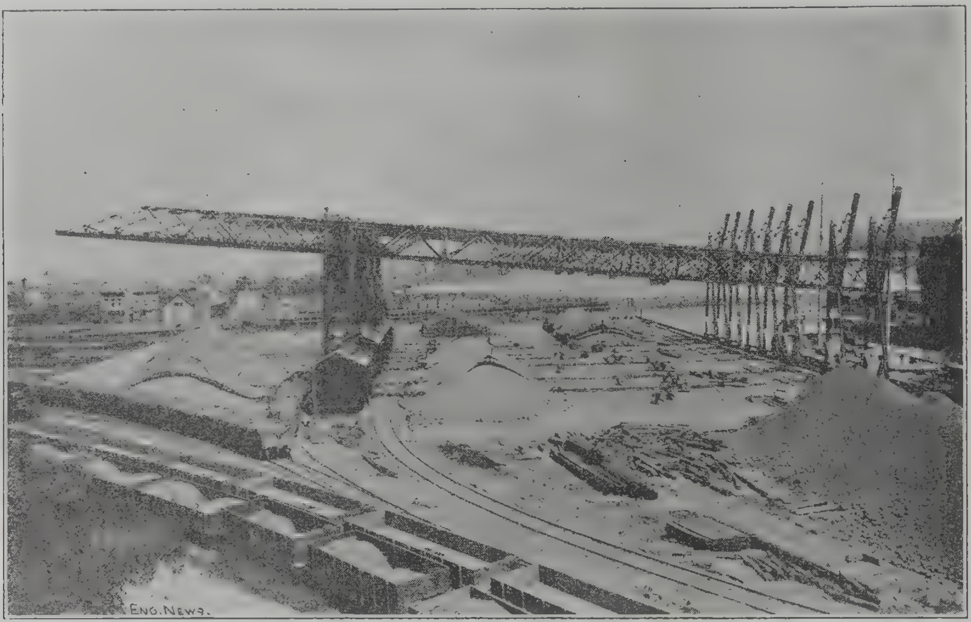

FIG. 1.--ORE-HANDLING MACHINERY ON PENNSYLVANIA CO.'S DOCKS AT ASHTABULA.
Designed and Built by the King Bridge Co., of Cleveland, O.
(Span between Towers, 180 ft.; Cantilever, 88 ft.; Apron in front, 34 ft.)

The structure, as now built, contains eight separate bridge trusses, each 180 ft. long, between the towers, with a cantilever 88 ft. long projecting over the rear tower and a folding apron 34 ft. long on the front tower, which can be raised and lowered so as not to interfere with the masts of vessels when they are taking position at the dock. The bridges are arranged in pairs, that is two of them have a common support in a tower at the rear, while there is a separate support or leg at the front for each bridge. The complete plant thus contains four towers at the rear and eight legs at the front. All of the towers and legs are supported by wheels on tracks consisting of two rails at the rear and one in the front. The moving of the plant from one point to another is done by steam or electric power applied to the wheels at the rear, and by hand gearing at the front.

The bridges are hinged to each side of the top of the rear tower and at the top of the front tower they are hung by means of adjustable connections. This mode of attachment allows the bridge or projecting apron, without being strained in the least, to be operated directly from the hatchway of a boat without moving the whole machine. There is a clear space under the bridges from top of the dock of about 30 ft., giving room for storage purposes, when it is not convenient to unload a vessel directly into the cars. The bridges are on a grade in order to increase the storage capacity of the dock.

The machinery is all operated from the engine room, where it is under the constant watch of the engineer. Outside of the engine room, on the bridge, there are only the sheaves and steel ropes.

The hoisting engines used on the plant described are of the Lidgerwood pattern, with reversing gear, and these, with the boilers, are placed in an engine room built in the rear tower. The rear tower is also propelled up and down its track on the dock by a gearing located in the engine house, from which power is furnished to raise and lower the apron at the front tower. The bridge is constructed with an upper and lower runway, the upper forming the track for the hoisting and the lower for the conveying carriage, from which are operated wire conveying ropes to which the buckets are attached. The hoisting drums can be so operated that the bucket is hoisted and conveyed at the same time, taking the shortest line between two points, and be stopped at any height and place. It does not need to be hoisted into contact with the carriage before the conveying takes place and it requires no latch mechanism, such as is usually employed in machinery of this description.

When the plant is completed with ten legs it will have more than ample capacity to unload the ore boats of the most recent design, which have 12 hatches and measure 432 ft. in length over all, with a capacity of 6,680 net tons of ore on 19 ft. draft.

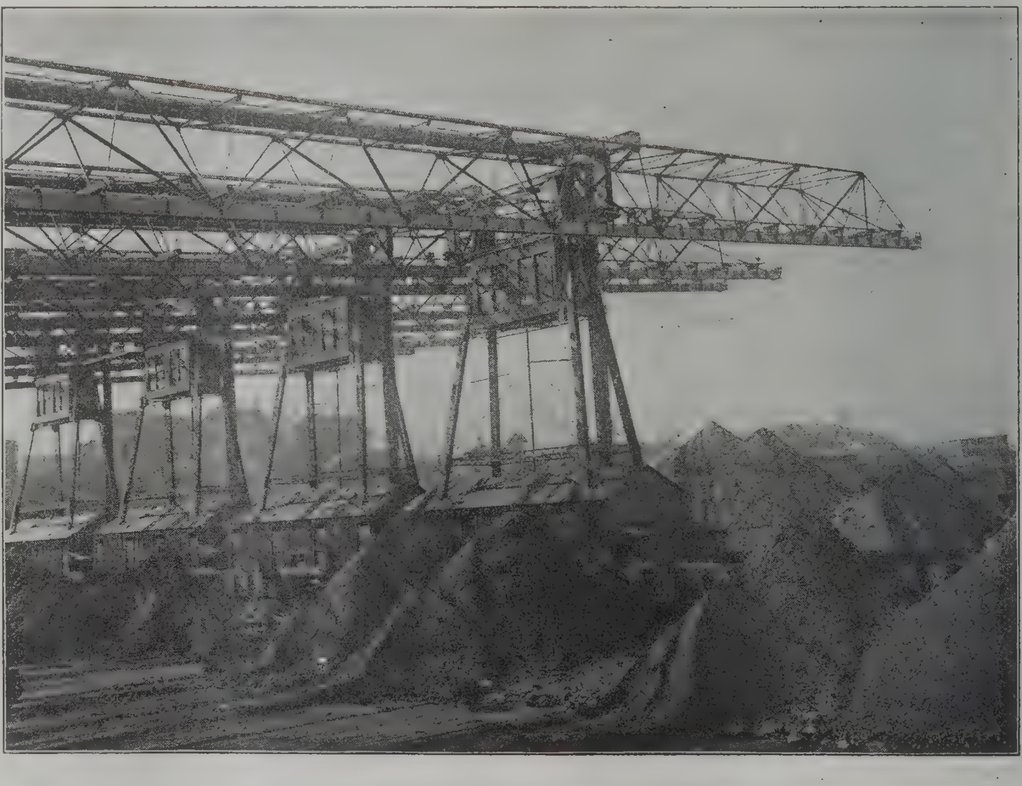

FIG. 2.--VIEW OF REAR TOWERS AND OPERATING HOUSES.

Concerning the actual operation of the plant as now built, with eight legs, Mr. Geo. B. Raser, the manager of the dock at Ashtabula, says, that on Sept. 26, 1895, the steamer "Roman," with 2,500 tons of ore, commenced unloading in cars at 6.30 a. m. and finished at 5.30 p. m.; and on Sept. 28, 1895, the steamer "German," with 2,540 tons of ore, commenced unloading in pile at 7 a. m. and finished at 5.30 p. m. An allowance in each case should be made for shut-down of one hour at noon, and in neither of these cases was any special effort made to obtain a record or special good showing. These boats were unloaded into cars standing on the two tracks near the water front, and not into the pile, and there is always a loss of from 30 to 50% of time occasioned in pulling out the loaded cars and replacing them with empties. The time thus lost it is the intention to save by laying two additional tracks for cars, besides the two now used, so that two cars may be placed under each hoist at the same time. One of these cars may be loaded while the other one, being full, is being replaced by an empty.

The general arrangement of machinery, mode of operation and important details and safety devices are all covered by the Rasch and other patents controlled by the King Bridge Co. The company intends hereafter to operate this branch of its business extensively. It is also at present engaged in perfecting a coal handling device for unloading cars directly into boats.

TRACK ELEVATION, CHICAGO & NORTHWESTERN RY., IN CHICAGO.

(With inset.)

The only railway company now prosecuting the work of track elevation in Chicago is the Chicago & Northwestern, which has about 3.6 miles of its Milwaukee Division undergoing this improvement. In previous issues* this journal has outlined and discussed the scope and progress of the work of abolishing grade crossings which the great western metropolis has undertaken, and where conditions permitted a definite statement the structural details of the work have been described. Compared with the task as a whole the progress thus far made seems small, but it is great in its promises of future results. Opposition and delay on the part of several of the railways entering the city will doubtless continue, but the larger number show a disposition to consider the question broadly and fairly and to meet the city half way in its efforts to solve a pressing and difficult problem. Among this larger number the Chicago & Northwestern Ry. Co. is notable for having taken up the work with good will and energy. This company has already elevated 1.85 miles of its line, is now at work on an additional 3.6 miles, and has contract to elevate another section of its line in the near future. In the following paragraphs the work of the Chicago & Northwestern Ry. is

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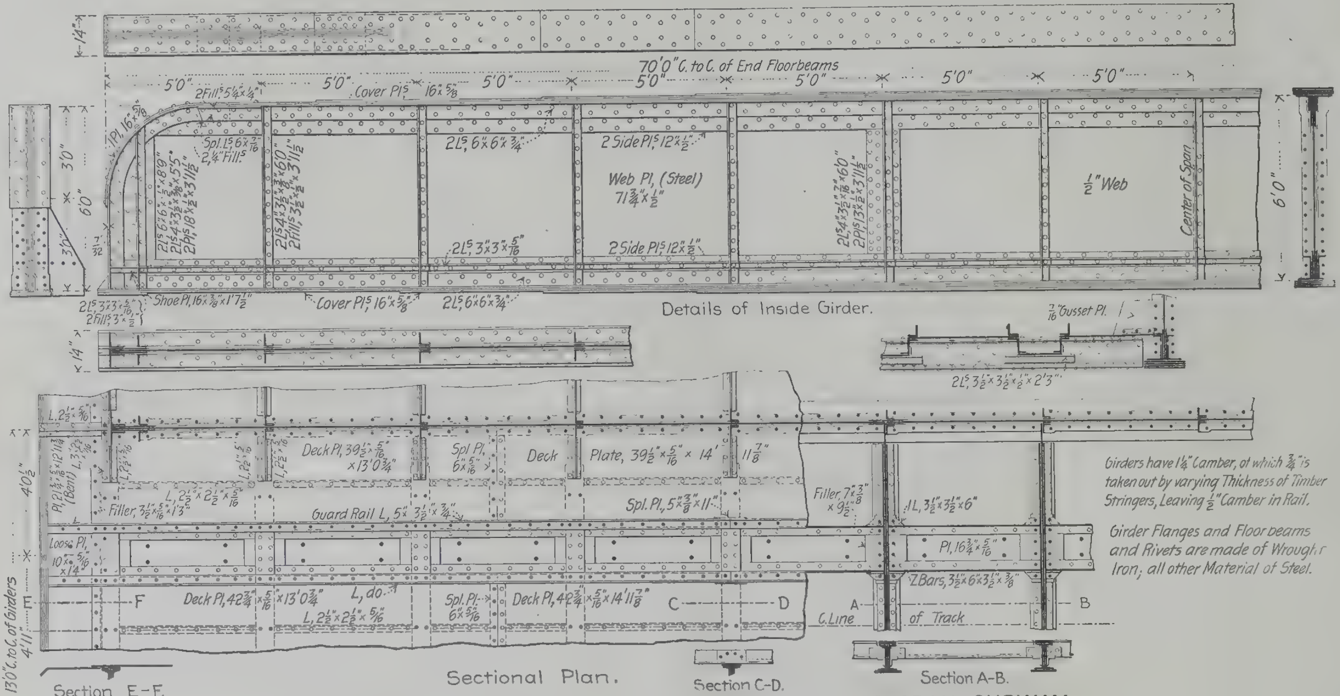
*Engineering News: March 9, Oct. 5 and 19, 1893; April 26, July 19 and Oct. 11, 1894; Jan. 23, 1896.


70'0" C. to C. of End Floorbeams
5'0"
Cover Pl^s 16"x 5/8"
2L^s 6"x6"x 3/4"
2 Side Pl^s 12"x 1/2"
Web Pl, (Steel) 71 3/4"x 1/2"
1/2" Web
Center of Span
2L^s 3"x3"x 5/16"
Shoe Pl, 16"x 3/8"x1'7 1/2"
Cover Pl^s 16"x 5/8"
Details of Inside Girder.
7/16" Gusset Pl.
2L^s 3 1/2"x 3 1/2"x 1/2"x 2'3"
Deck Pl, 39 1/2"x 5/16"x 13'0 3/4"
Spl. Pl.
Deck Plate, 39 1/2"x 5/16"x 14' 11 7/8"
Spl. Pl, 5"x 3/8"x 11"
Guard Rail L, 5"x 3 1/2"x 3/4"
Filler, 7 3/8"x 3/8"x 9 1/2"
L, 3 1/2"x 3 1/2"x 6"
Pl, 16 3/4"x 5/16"
Z Bars, 3 1/2"x6"x 3 1/2"x 3/8"
Deck Pl, 42 3/4"x 5/16"x 13'0 3/4"
Deck Pl, 42 3/4"x 5/16"x 14' 11 7/8"
A
B
C
D
E
F
C. Line of Track
13'0" C. to C. of Girders
4'11"
Section E-F.
Sectional Plan.
Section C-D.
Section A-B.

Girders have 1¼" Camber, of which ¾" is taken out by varying Thickness of Timber Stringers, Leaving ½" Camber in Rail.

Girder Flanges and Floor beams and Rivets are made of Wrought Iron; all other Material of Steel.

FIG. 2. GENERAL DETAILS OF BRIDGE FOR 66-FOOT SPAN SUBWAY.

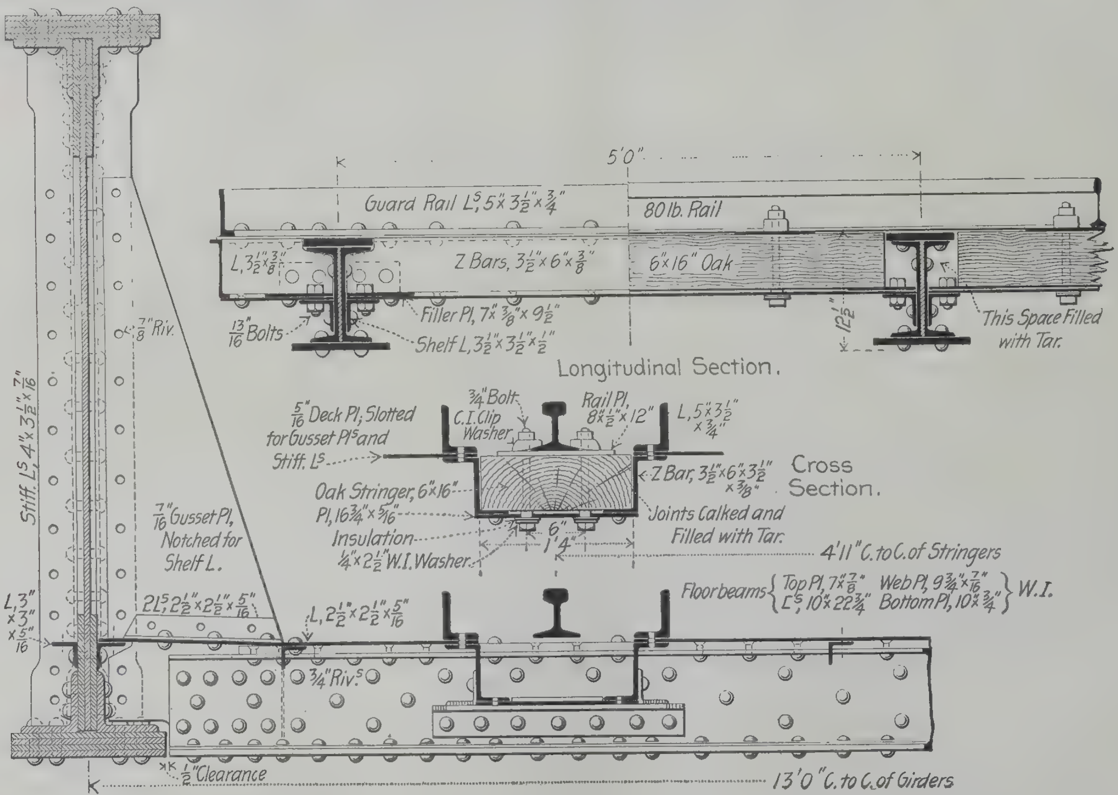

5'0"
Guard Rail L^s 5"x 3 1/2"x 3/4"
80 lb. Rail
L, 3 1/2"x 3/8"
Z Bars, 3 1/2"x 6"x 3/8"
6"x 16" Oak
13/16" Bolts
Filler Pl, 7"x 3/8"x 9 1/2"
Shelf L, 3 1/2"x 3 1/2"x 1/2"
This Space Filled with Tar.
12 1/2"
Longitudinal Section.
7/8" Riv.
Stiff. L^s 4"x 3 1/2"x 7/16"
5/16" Deck Pl; Slotted for Gusset Pl^s and Stiff. L^s.
3/4" Bolt
C.I. Clip Washer
Rail Pl, 8"x 1/2"x 12"
L, 5"x 3 1/2"x 3/4"
Oak Stringer, 6"x 16"
Pl, 16 3/4"x 5/16"
Insulation
1/4"x 2 1/2" W.I. Washer.
Z Bar, 3 1/2"x6"x 3 1/2"x 3/8"
Joints Calked and Filled with Tar.
Cross Section.
6"
1'4"
4'11" C. to C. of Stringers
7/16" Gusset Pl, Notched for Shelf L.
L, 3"x 3"x 5/16"
2L^s 2 1/2"x 2 1/2"x 5/16"
L, 2 1/2"x 2 1/2"x 5/16"
3/4" Riv^s
Floorbeams { Top Pl, 7"x 7/8" Web Pl, 9 3/4"x 7/16" L^s 10"x 22 3/4" Bottom Pl, 10"x 3/4" } W.I.
1/2" Clearance
13'0" C. to C. of Girders

FIG. 3. DETAILS OF SOLID FLOOR AND TRACK CONSTRUCTION FOR SUBWAY BRIDGES.

FIG. 5. VIEW

FIG.

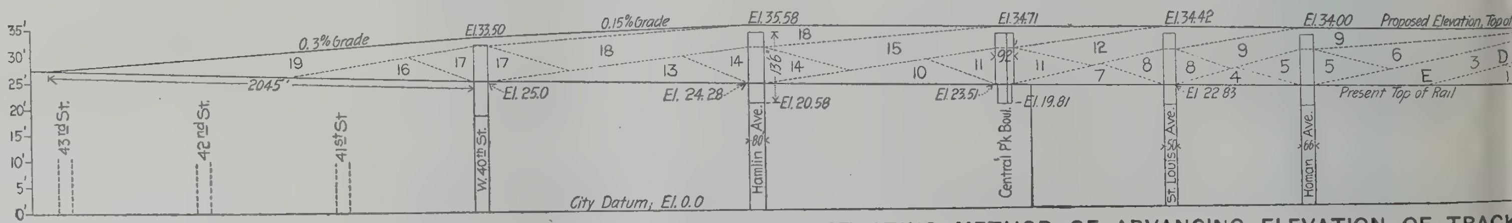
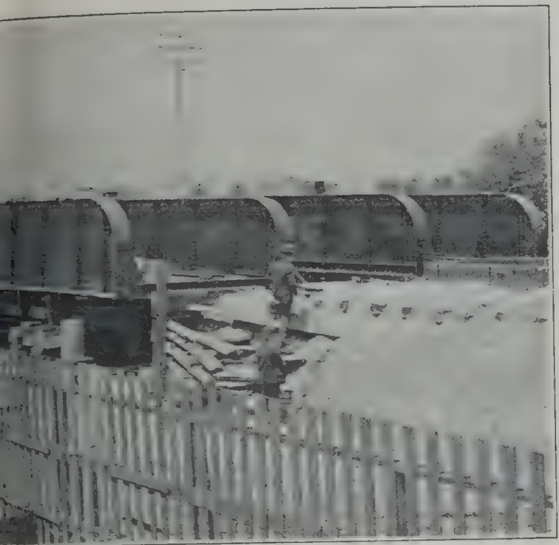


FIG. 1. CONSTRUCTION PROFILE ILLUSTRATING METHOD OF ADVANCING ELEVATION OF TRACK

TRACK ELEVATION, CHICAGO

J. E. Blunt, Chief Engineer, Louis H. Evans, M. Am. Soc. C

Lassig Bridge Works, Chi



METHOD OF PLACING SUBWAY BRIDGE
ON ITS SITE.

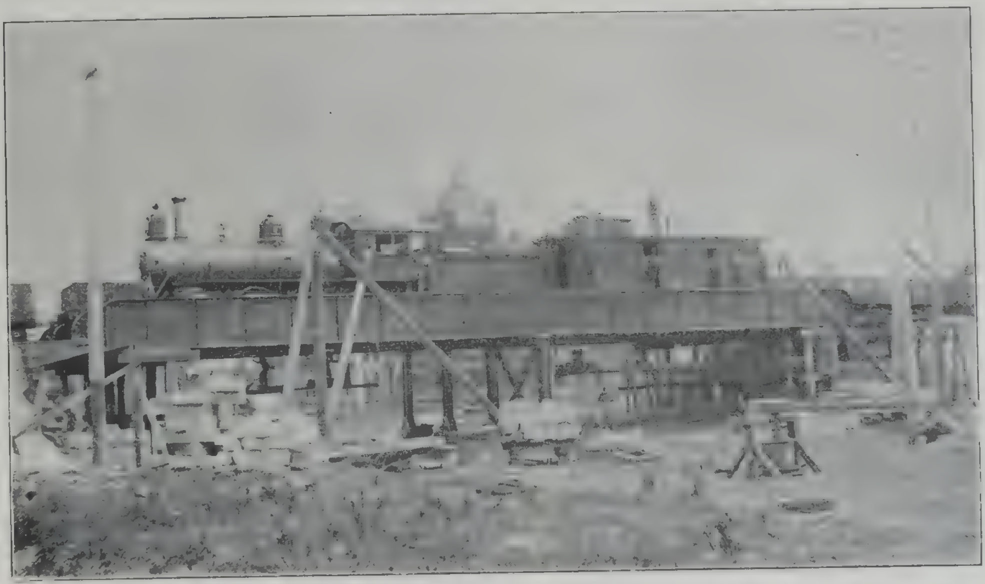
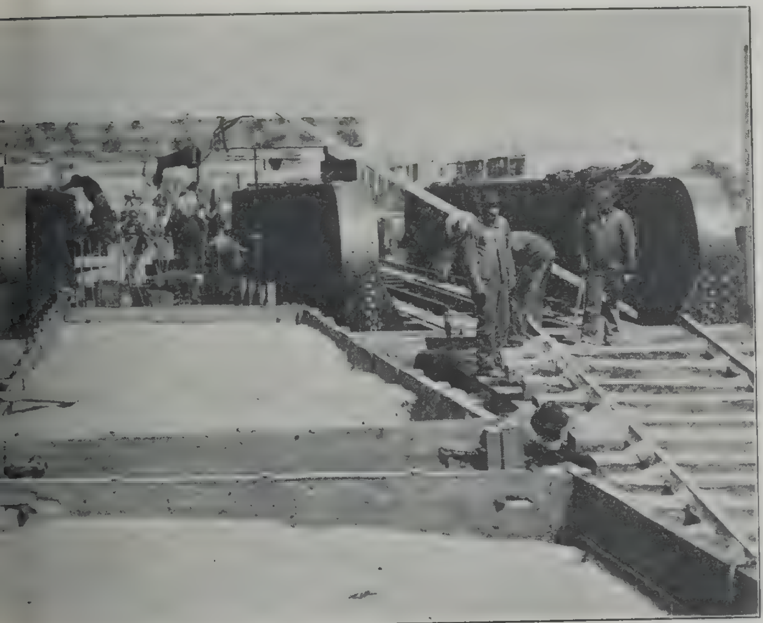


FIG. 8. VIEW OF 100-FOOT SUBWAY WITH TWO SPAN BRIDGE AT IRVING PARK BOULEVARD.



SHOWING METHOD OF PLACING BRIDGE FLOOR
FOR MIDDLE TRACK.

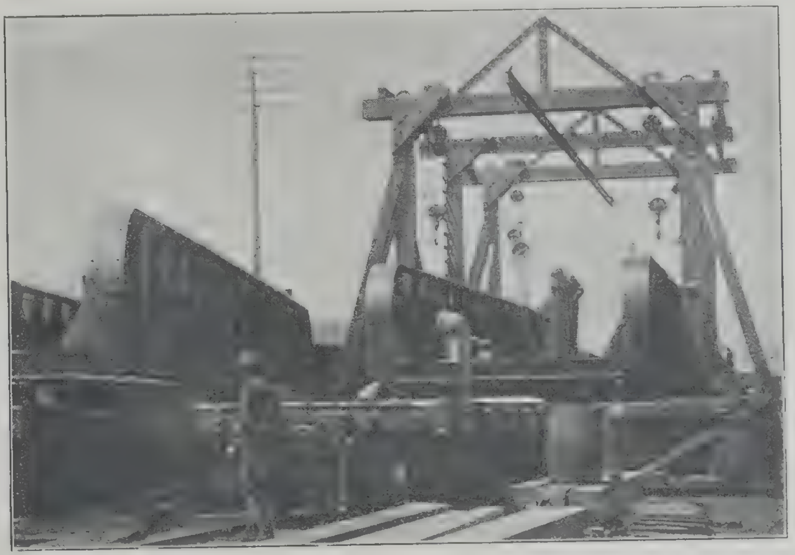
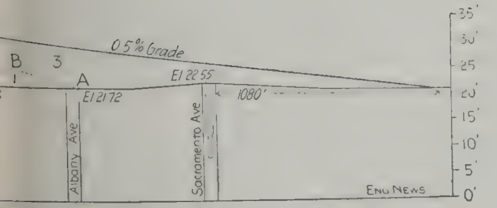


FIG. 4. FRAME FOR ERECTING SUBWAY BRIDGES.



ENA LINE.

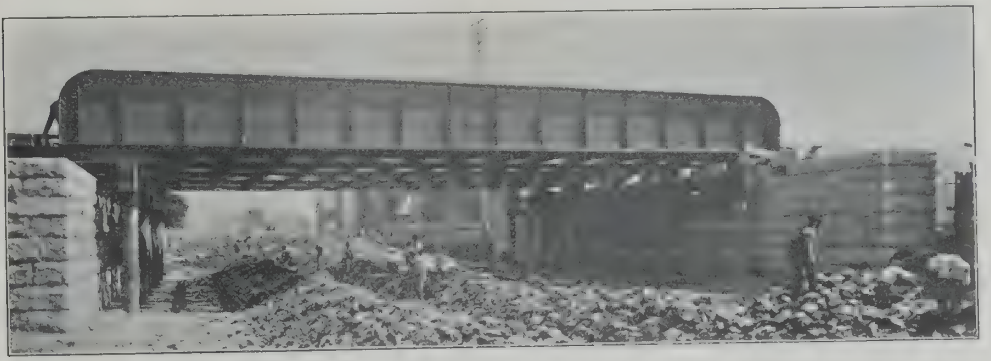


FIG. 7. VIEW SHOWING SUBWAY BRIDGE IN PLACE AND MASONRY NEARLY COMPLETED.

THWESTERN RY., CHICAGO.

gineer Track Elevation, Wm. Graham, Engineer of Bridges.

Contractors for Bridges.

described as completely as its present progress and available information will allow.

The Chicago & Northwestern Ry. system radiates west and north from Chicago in three main lines from the passenger station at Wells St. and Fifth Ave., just north of the main branch of the Chicago River. From the Wells St. station the Galena Division or line extends almost directly west. The other two lines have a common right of way northwest from Wells St. station to Clybourne Junction, about three miles, and then separate, one line going north to Milwaukee and thence to northern Wisconsin and Michigan, and the other northwest to St. Paul and Minneapolis. For sake of brevity in the following description these lines will be designated as the Galena, Milwaukee and Wisconsin lines, respectively.

The first work of track elevation done by the Chicago & Northwestern Co. was on the Galena line, and comprised the raising of about 1.85 miles of five-track railway, the construction of six new subways for crossing streets, and the remodeling of a seventh subway. The general character of the subway constructions, except that at Sacramento Ave., which was built in 1893 (Eng. News, Sept. 21, 1893), and is only remodeled in the present construction, is shown by the accompanying table:

Name of street.	Elevation, track.	Depression, street	Length, floor.	Length, inclines.	No. tracks, bridge.	Span of bridge.	No. of spans.
	ft.	ft.	ft.	ft.		ft.	
Kedzie Ave...... ..	10.69	3.82	130	110	5	66	1
Homan Ave	11.3	3.5	149.7	100	5	66	1
St. Louis Ave	11.59	3.18	150	91	5	50	1
Central Park Blvard..	11.16	2.34	120	115	5	92	2
Hamlin Ave	11.3	3.22	120	92	5	80	3
W. 40th St...........	8.5	6.1	306	175	9	66	3

Note.—The grade of all inclines is 3.5%. The names ot some of these streets have been changed since the work was begun. At Sacramento Ave. the roof of the subway was raised 3½ ft. and its floor a corresponding distance.

It will be seen that the work naturally divided itself into two processes: (1) The construction of the subways at street intersections, and (2) the elevation of the tracks between the cross streets. As the subway construction can be better described later on it will be left for the present and attention turned to the elevation between streets. This was simply earth embankment work; and according to the terms of the ordinance signed with the city, retaining walls were to be built wherever necessary to keep the embankment within the limits of the company's right of way. This right of way is only 100 ft. wide, and with only five tracks retaining wall was needed only along a part of the distance, but some time in the future when other tracks are added the wall will be extended as needed. These walls were built of limestone masonry with a concrete footing and present no features out of the ordinary.

Probably the most interesting part of the embankment work was the method of filling adopted. Fig. 1 shows this method quite clearly. The bottom solid line shows the original grade of the tracks and the top solid line the grade after elevation. The broken lines show the different sections of the embankment numbered in the order they were built. For example, triangles No. 1 were first built with sand hauled by train, the tracks being raised little by little until they conformed to the grade indicated by the line A, B, C, D, E. It will be noticed that the tracks crossing Kedzie Ave., at C, had not been elevated thus far, but now the girders for the two outside and the center tracks, with floor system, tracks, etc., complete, were brought to Kedzie Ave. mounted on jacks on flat cars, and were hoisted onto temporary pile abutments, but not up to full grade. Two tracks, it will be noticed, were unobstructed by this work. The girders being hoisted to their temporary positions, triangles 2, 2 were filled in, which as the quantity was small, was done in one day. The tracks now followed the grade A, B, F, D, E, and the trains run over the two outside tracks and the center track. The bridges for the remaining two of the five tracks were then raised onto their temporary abutments. Everything was now ready for filling the irregular prism 3, raising the bridges to full grade, and the girder erection at Homan Ave., after which triangles 4 and 5 were filled, and so on west until the work was completed.

This method was new with this work so far as we know, and proved decidedly efficient. Only one street was closed at a time, the grade was never greater than 1%, and not more than 1,500 ft. of track was unsurfaced at one time. In the elevation now in progress on the Milwaukee line practically the same method of filling is being used, except that as there are here only three tracks the fill for each track is brought to its full height before the track is swung to one side and up onto it. This means that all three tracks are swung a distance equal to the distance between centers of tracks to one side.

Attention will now be turned to the track elevation on the Milwaukee line which is in progress. Altogether there are 3.6 miles of three-track line to be elevated, comprising the construction of 20 subways and about 300,000 cu. yds. of fill. Not all of this work will be done this season, however; only 12 subways and about 153,000 cu. yds. of filling being now contemplated. The general method of embankment construction has already been described, and need not be mentioned further.

Out of the total 20 bridges to be constructed across intersecting streets, 13 will have spans of 66 ft., five spans of 80 ft., one a span of 100 ft. and one a skew span of 139 ft. These last two spans will be included in the work now under construction, but all the other bridges built this year will have spans of 66 ft. Generally the streets will be depressed from 2 ft. to 4.5 ft., only five being changed more or less than these amounts. The track will be elevated about 9 ft. above its present grade and the clearance of the subways will be generally 10 ft. or 12 ft., only two structures having a greater clearance, 13.5 ft. All 66-ft. streets are to be crossed by a single span, but two or more spans will be used for streets of greater width.

For the purpose of illustration one of the 66-ft. bridges will be used, as the others differ from them only in size. The city ordinance required simply that the bridges have iron or steel girders, watertight floors, and masonry or masonry and metal column foundations. This is essentially the construction adopted. Fig. 2 shows the girder and floor construction in detail, and Fig. 3 gives an enlarged detail of the track construction particularly is noticeable. The floor beams consist of two channels riveted back to back with a filler plate between, extending to within about 1 ft. of the beam ends. These beams are fastened to gusset plates, which slip into the spaces left by the filler plate at each end of the beam, and are spaced 5 ft. c. to c. The stringers consist of two 6 x 16 ins. oak timbers carried in a trough formed by two Z-bars and a plate, and riveted to the floor beams. Between the oak stringers the space is covered with 3-16-in. deck plate which closes the floor solid and prevents dripping of dirt or water onto the subway floor beneath.

It will be seen that there are several advantageous features to this floor. It has a small depth, gives an even distribution of the wheel loads, is very simple to construct and erect, and is not of excessive weight, 540 lbs. per ft., in proportion to its supporting strength. The wooden stringer gives an elastic rail bed and tends to reduce noise. To this latter condition the division of the floor plates into comparatively small sections also contributes. The designer of this floor was Mr. Louis H. Evans, M. Am. Soc. C. E., Engineer of Track Elevation, Chicago & Northwestern Ry.

The design of the subway bridges having been explained attention may be turned to the method of erecting them. From the shops of the Lassig Bridge Works, Chicago, the builders, the various parts are shipped assembled in convenient sections to the erecting yard of the railway company. Here is located the erecting frame shown by Fig. 4, by means of which the two girders and floor system for one track are erected complete. Blocked up on two flat cars, the structure weighing 70 tons, about, is conveyed to the bridge site, where everything has previously been put in readiness for its reception.

At the bridge site the first work is to excavate under the tracks, keeping them all the time blocked up to carry the traffic, and then to build the concrete foundations for the abutments. There being three tracks, piles are then driven at each side of the proposed line of one of the side tracks and at each end of the bridge site, which will serve as temporary abutments. As shown by Fig. 5 the flat cars carrying the bridge for this track are backed onto the site; the bridge raised off them by screw jacks and blocked up on the piles; and finally the cars pulled from under. It will also be noticed from the illustration that the embankment has been brought up to the bridge site in the direction of progress and is held by a timber bulkhead. As soon as the cars are withdrawn a similar bulkhead is built at the end opposite the first and the filling begins so that the track may be carried over the bridge and onward. By the method of filling before described, it requires only a few trainloads of dirt to accomplish this end. Inside the timber bulkheads the masonry abutment work is also progressing.

The bridge for the other outside track, consisting of two girders and a floor system, is placed in exactly the same manner as the first. There remains then only the work of putting in the floor system for the center track, which is done on the bridge site, as clearly shown by Fig. 6. The completion of the abutments, the leveling and testing of the bridge, and the depression of the street now remains.

Fig. 7 is a view of one of the bridges with the abutments nearly completed and the street depression in progress. As the abutment foundations are completed before the bridge is placed, there only remains the masonry walls to be built. An I-beam is attached to the bottom of the bridge, so as to extend transversely across it about over the line of the facing course of masonry. On this runs a trolley which carries a pulley hoist, for handling the stone. The stones are brought to the site on cars and unloaded by a wrecking crane. From the stone pile a fixed derrick supplies the stone to the trolley hoist.

The street depression is simple excavation, about the only difficulties encountered being the occasional changing of water and sewer pipes. It is required by the ordinance that the grade of the approaches shall be 3½%, and that the width of roadway and sidewalks shall remain unchanged. The approaches are to be paved as was the original street, but the subway floor proper is to have a vitrified brick pavement laid on ½-in. of sand on a 6-in concrete foundation. Drainage is to be provided for by suitable catch basins and connections with the sewer.

In the foregoing, reference has been had to single span 66-ft. subways only, and as already stated the work comprises one 100-ft. span and one 149-ft. skew span subway. Fig. 8 shows the bridge for the 100-ft. span subway, and explains clearly the center column support and the apparatus used in the masonry construction. The 149-ft. subway is located where Lincoln Ave. joins Addison St., at an angle, and its outside or longest bridge girder is 235 ft. As indicating the rapidity of work, the bridge (one track), of which this girder is a part, was erected ready for traffic in five hours from the time it left the erecting frame in the yards. The regular rate of progress for 66-ft. bridges is seven single-track bridges erected in six days. About 3,000 cu. yds. of sand are hauled by train and put into the embankment each day and the contractors for street depression add to this about 1,000 cu. yds. per day. This makes the rate of progress 6,500 lin. ft. per month of three-track, 66-ft. right of way elevated 9 ft.

Altogether the work now in progress on the Milwaukee line will cost about $1,000,000, and as will be inferred from the foregoing it is entirely north of Clybourne Junction, where the Wisconsin and Milwaukee lines join to enter the city station. In the same manner the elevation of the Wisconsin line will begin north of Clybourne Junction and extend north, unaffecting the common line from the Junction south. No work has been done on this line, but the ordinance providing for its elevation has been passed by the Chicago City Council, and the construction it requires is in all respects similar to that just described. There will be 26 subways, including one subway for pedestrian travel only. Of this number 18 will have bridges of 66-ft. span, five bridges of 80-ft. span, one a bridge of 73-ft. span, one a bridge of 100-ft. span, and one, the foot subway, a bridge of 10-ft. span. The length of line to be elevated will be 4.6 miles. It is not definitely known when work will begin on this line, as the ordinance requires simply that it shall be completed within eight years, but the policy of the railway company seems to be to get the work accomplished as soon as practicable and it is entirely possible that the summer of 1897 will see it begun.

For the information from which this article has been prepared we are indebted to Mr. Louis H. Evans, M. Am. Soc. C. E., Engineer of Track Elevation, Chicago & Northwestern Ry.

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TEST OF WATER-BEARING GRAVEL AT BEAVER FALLS, PA.

An interesting test to determine the quantity and quality of water that could be obtained from water bearing gravel, at Beaver Falls, Pa., was conducted in 1894, by Jas. H. Harlow & Co., of Pittsburg. The gravel in question overlies a blue silt, practically impervious to water, which, in turn, overlies sandstone rock, about 40 ft. below the surface, and was located at the junction of Wallace Run and the Beaver River. The test showed that a sufficient quantity of water for a small water-works plant could be secured but that a large part of the water came from the river, which is polluted with sewage and likely to become more so.

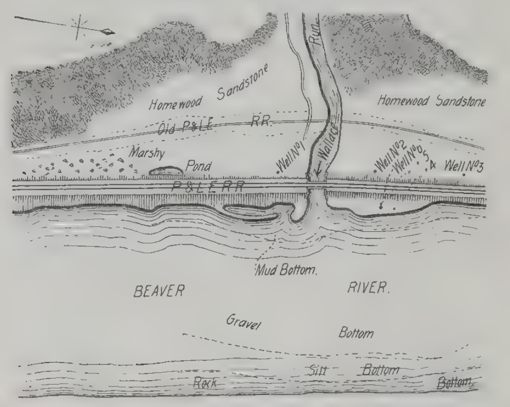


Fig. 1.—Plan Showing Location of Test Wells at Beaver Falls, Pa.

James H. Harlow & Co., Pittsburg, Engineers; Simon Harrold, Beaver Falls, Contractor.

The following particulars regarding the test are taken from the report on the subject, made by the engineers to the officials at Beaver Falls.

The site chosen for the test was selected in accordance with the best data available, and in accordance with a belief that the gravel stratum overlying the rock was exposed at the surface of the bed of Beaver River.

The two streams, Wallace Run and Beaver River, are described in the report as follows:

> Wallace Run enters the Beaver River from the west, and and drains about three square miles of farming country. The stream descends rapidly from its source and flows over a broken surface of soil and rock. At the mouth of the Run no water has been visible for the past month and if any water is passing down the Run it is below the surface.
>
> The Beaver River, above the mouth of Wallace Run, has a drainage area of 2,964 sq. miles, about 1,600 miles of this being within the state of Ohio. Within this drainage area we have, as per census reports of 1890, 255,732 population, an average of 86.3 per sq. mile. This population has undoubtedly increased within the four years that have elapsed since 1890, and by 1900, if the increase in population be the same as the last decade, we may expect at least 300,000 population. During the decade of 1880 to 1890 nearly all of the increase within the drainage area of the Beaver River was within the following cities and villages, viz.: Newcastle, Pa.; Greenville, Pa.; Butler, Pa.; Sharon, Pa.; Youngstown, O.; Niles, O.; Warren.
>
> The average increase of the above places for the past decade was 70%, and we may expect a similar increase for the present decade, or in 1900, when these places will probably have a population of at least 130,000.

The tests for capacity were conducted under the supervision of Mr. H. F. Labelle, Principal Assistant to Jas. H. Harlow & Co. The plans, as carried out, provided for the sinking of four wells to rock and of a fifth well, 8 ins. in diameter, at such a point in relation to the others as should finally be deemed best for the pumping trial. The specifications for the pumping test provided for 20 days continuous pumping and stated that:

> If for any reason caused by defective machinery or negligence of the contractors or their employees the pump shall be stopped at any time for a period exceeding one-half hour, it shall be optional with the engineer to begin a new test, and no payment shall be made for any pumping that may have been done previous to the beginning of this new test.

The test was to be made with a pump having a capacity of not less than 250 gallons per min., or 360,000 gallons a day.

The arrangement for measuring the pumpage from the wells is described in the report as follows:

> The pump was to discharge into a measuring flume at one end of which was a weir similar to that used by Francis and others. This flume was 16 ft. long, 3.71 ft. wide, 1.75 ft. deep, inside dimensions. The weir was placed 1.29 ft. above the bottom of the flume and had a length of 1.005 ft. Across the bottom of the flume and 2 ft. from the weir was placed a ¾-in. pipe plugged on the end inside the flume, and the open end extending through the side of the flume into a gage box. In this pipe were drilled several ⅛-in. holes to admit the water and show the depth on the weir. In the gage box was fastened a glass tube which was connected to the open end of the ¾-in. pipe by gum tubing. The zero of the glass gage coincided with the weir, and by noting the height of the water in the glass gage the depth of the water on the weir was ascertained. In the gage box was placed, in addition to the glass gage, which was read direct, a Bristol's recording gage. This gage makes its own record on the circular card which was rotated once in 24 hours by clock work. The records for this gage were failures, and have not been given in the accompanying tables. The object of this recording gage was to show if any stoppages occurred during the absence of the assistant, and to give the time such stoppages did occur. The gage did show when the pump stopped, but not accurately the depth on the weir and the only advantage gained by its use was its moral effect on the man in charge of the pump, as he did not know of its inaccuracy.
>
> The water from the well enters the opposite end of the flume from the weir, and of course entered with considerable force. To make the water approach the weir uniformly and quietly there were placed across the flume three wire screens of ⅛-in. mesh.

After advertising for bids the contract for sinking the wells and making the pumping test was awarded to Mr. Simon Harrold, of Beaver Falls. The first well was begun on June 11, and the five wells were completed about July 1. The wells are shown in plan by Fig. 1, and in section by Fig. 2. The stratification at the first four wells is indicated by the sections, Fig. 2, the elevations being heights above sea level. The depth of each stratum for the various wells are extracted from the reports, slightly condensed, as follows:

> No. 1.—2.5 ft. of vegetable ground; 6 ft. yellow loam; 5.6 ft. fine sand with some water; 7.4 ft. coarse sand and fine gravel; 17.3 ft. blue silt, this silt lying on sandstone rock, which is yellow in color; total depth, 38.8 ft.
>
> On June 13 the water stood in well No. 1 at elevation 735.23, the water in the river being 735.01, showing water was 0.22 ft. above that in the river.
>
> No. 2.—2 ft. of vegetable ground; 4.8 ft. loam and stones, some gravel, water put into casing disappearing immediately; 8.7 ft. sand, without much gravel, water bearing; 7.1 ft. of coarse sand and small gravel; 18.4 ft. blue silt similar to No. 1; 3.5 ft. fine gravel to rock, light gray in color; total depth, 42.5 ft.
>
> No. 3.—21 ft. of sandy loam, with the sand increasing gradually downward; 1 ft. sand and gravel; 8.7 ft. sandy loam, merging into gray silt at the bottom, where light gray sand and rock was found; total depth, 30.7 ft. The casing of this well was afterwards withdrawn.
>
> No. 4.—6 ft. of sandy loam; 10 ft. sand and gravel; 43.5 ft. blue silt similar to Nos. 1 and 2, merging into blue clay, with a little gravel at the bottom of the well. This silt overlies a sand rock light gray in color.

Well No. 5 was sunk to within 2 ft. of the top of the flue silt. It showed practically the same stratafication as well No. 4. The well was 8 ins. in diameter, cased, the lower 5 ft. of the casing being pierced with 1,400 holes, each 3-16 ins. in diameter, and the extreme end of the casing being roughly plugged with stone to prevent the admission of sand.

Owing to trouble with the pumping plant the contractor did not start his 20-days run until July 25.

The weir discharges were computed by the Francis formula,

$$Q = 3.33\, H^{\frac{3}{2}}\, L,$$

with corrections for end contraction and velocity of approach.

The detailed results of the capacity test are given in tables accompanying the test. The yield decreased from some 340,000 gallons per 24 hours for the first two or three days, to 215,000 gallons at the end of the test.

The report states that with a 5-ft. head the quantity of water that could be depended on within a radius of 175 ft. from the pumping well, which was the range of influence of the pumps, would be about 260,000 gallons a day. The conclusion is reached that

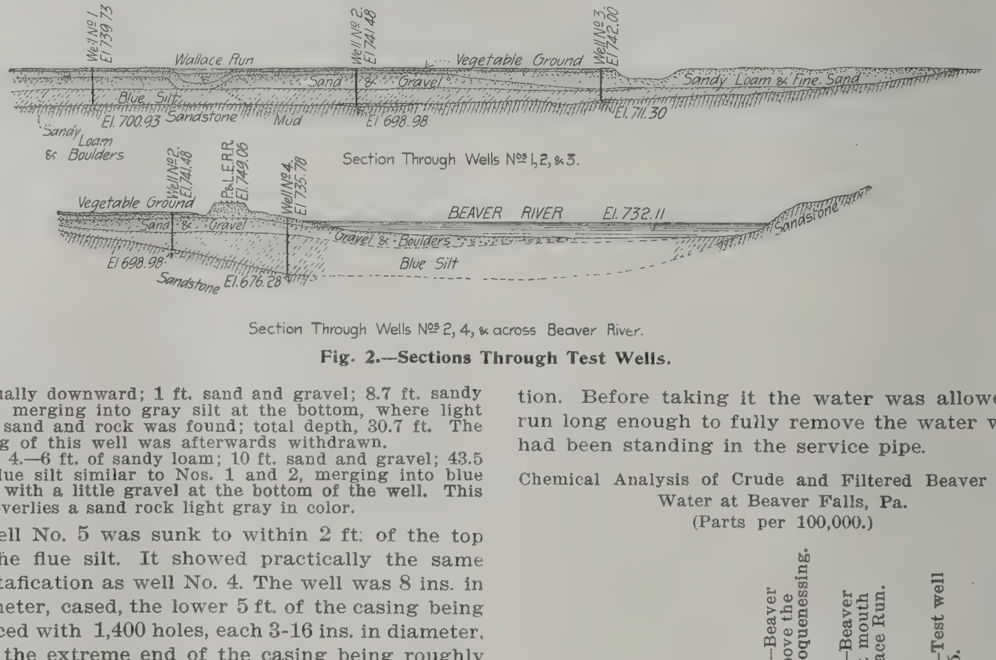
> it is probable a number of wells can be distributed along the bank of the Beaver River and into this same sand and gravel bed, and almost any quantity of water obtained, at least as long as the river lasts.

No comments are made regarding the effect of pumping on well No. 3. As to No. 1, the report expresses the belief that it "had no direct connection with the sand strata pumped from," water in this well usually standing above that in the river.

Wells Nos. 2 and 4 generally rose and fell with river, if the pumping was continued at a uniform rate. On one day the river rose at the rate of 0.1 ft. in eight hours, and the water in wells Nos. 2 and 4 about 0.08 ft. in the same time, the rate of pumping meanwhile increasing about 10,000 gallons an hour.

Another confirmation of the connection of the wells with the river was the temperature observations. When pumping was begun, the temperature of the water in well No 5 was 57° F., and in the river 76°, a difference of 19°. When pumping was stopped, on Aug. 14, the well water had a temperature of 71° and the river water 77°, a difference of only 6°.

Passing from the quantity to the quality of the supply, the report gives the results of chemical tests made by Mr. Jas. O. Handy, Chemist of the Pittsburg Testing Laboratory. These are reproduced in the accompanying table. Sample No. 1 was selected as indicating the character of the river before being affected by the salt wells on the Connoquenessing, and by the sewage of Butler, Pa. It was tested for chlorine, only, which seems unfortunate, since a test for organic matter would have aided in judging how much of the increase in chlorine was due to sewage contamination. Sample 3, from the test well, was taken from the discharge pipe of the pump. Sample 4 was selected as representing the character of the water being supplied to the borough by the water company at the time of the test. It was supposed to have passed through Hyatt filters at the pumping station. Before taking it the water was allowed to run long enough to fully remove the water which had been standing in the service pipe.



Section Through Wells Nos 2, 4, & across Beaver River.

Fig. 2.—Sections Through Test Wells.

Chemical Analysis of Crude and Filtered Beaver River Water at Beaver Falls, Pa.
(Parts per 100,000.)

	No. 1.—Beaver R. above the Connoquenessing.	No. 2.—Beaver R. at mouth Wallace Run.	No. 3.—Test well No. 5.	No. 4.—Faucet in Todd's drug store, Beaver Falls, Pa.
Albuminoid ammonia		0.0208	0.0138	0.0220
Free ammonia		0.0192	0.0266	0.0032
Nitrites		small	high	high
Nitrates		none	trace	trace
Chlorine	2.68	11.42	8.98	12.57
Sulphate of lime	6.80	6.82	6.02	6.31
Carbonate of lime	4.53	4.53	4.85	4.51
Sulphate of magnesia		1.07	0.00	1.19
Carbonate of magnesia		0.98	0.50	0.91
Chloride of magnesia		2.03	3.28	2.14
Sodium chloride		18.35	14.81	18.11
Sodium carbonate		6.38	1.91	9.45
Silica		0.26	0.40	0.28
Oxide of iron and alumina		0.28	0.00	0.20
Total		40.70	31.77	43.10
Hardness		14.40	13.90	14.22

The engineers' comment upon the analysis is as follows:

Chlorine.—Chlorine in No. 1 is an indication of probable sewage from the towns above the Connoquenessing, but in samples Nos. 2, 3 and 4 the chlorine represents largely the salt, which is known to come from wells on the Connoquenessing. Sample No. 4 has the largest amount, and it is possible the difference between it and No. 2 is due to sewage entering below Wallace Run. Sample No. 3 has the lowest of any below the Connoquenessing, and this difference is probably due to the admixture of ground water into well No. 5 from the sandstone hillside. We think in this instance there is no special difference in the several waters, if the high amounts show an excess of salt, which is harmless.

If we can assume that there was but little chlorine in the water that came from the sandstone, we may estimate from the amount of chlorine in samples Nos. 2 and 3, that 90% of the water pumped was from the river, and 10% from the hillside. We are inclined to think, however, that more than 90% of this water comes from the river.

Ammonias.—As the figures stand, sample No. 3, as shown by the albuminoid ammonia, is the best. If the water is largely river water (No. 2) it shows that it has been oxidized in passing through the sand. If there is a considerable amount of land water, as indicated by the chlorine, this lower amount may mean dilution only.

The albuminoid ammonia in sample No. 3, taken in connection with the free ammonia and high nitrites, would seem to show that the organic matter had been partially filtered or to a considerable extent oxidized, but that the oxidation was still going on, and is incomplete.

Sample No. 4 seems to be substantially the same water as sample No. 2, the albuminoid ammonia being practically the same. The low free ammonia and nitrites would seem to show that decomposition by oxidation had not yet begun, or at least carried to any great extent. The low amount of free ammonia may be accounted for (as it is a gas) by having been agitated in some manner, possibly by passing through pumps. The sum of ammonias is the sum of the decomposing and decomposed organic matter which may be either animal or vegetable. The former decomposes with much more rapidity than the latter, and contains much more nitrogen. In the case of sample No. 2, from the Beaver, which flows generally in a rapid stream, and at the time of the year when the streams are low and vegetation active, and considering that within the drainage of the Beaver are several large towns each of which have sewerage systems discharging into the river, we may conclude that the large amount of ammonia is an indication of sewage contamination. In a water at Lawrence, Mass., that was polluted to such an extent as to cause a great deal of sickness, 0.0037 free ammonia, and 0.0158 albuminoid ammonia was found, the sum of the ammonias being 0.0195. This is much lower than any samples that we have.

Lime.—The sulphate and carbonate of lime both cause scale in boilers and from a manufacturing standpoint should be gotten rid of. To a city largely given to manufacturing, it is important that these should be disposed of, even if at considerable expense. The sulphate of lime deposits a hard scale that has to be removed by the use of considerable force. The carbonate of lime deposits a soft scale that can usually be blown off with the water and steam, if this is done often enough. Samples Nos. 3 and 4 are practically the same in this respect.

Sodium Chloride.—This is common salt, and the quantity shown here is not noticeable to the taste and is not harmful.

Sodium Carbonate.—This is known in commerce as soda-ash and is used in making soap and glass. It has a tendency to neutralize the lime and soften the water. Nos. 3 and 4 are practically the same as far as relates to these substances.

Bacterial examinations of water from four sources were made by Dr. E. G. Matson, Professor of Pathology in the Western Pennsylvania Medical College, Pittsburg, Pa., with the following results:

Sample No.	Source.	Bacteria per cu. cm.
1.	Beaver River at Wallace Run	892
2.	Test well No. 5	874
3.	Test well No. 2	327
4.	Faucet in Todd's drug store, Beaver Falls	475

Samples Nos. 1, 2 and 4 correspond, respectively, with samples Nos. 2, 3 and 4 of the chemical tests. The water from the river and main well (No. 5) contain what Dr. Matson regards as a suspiciously high number of bacteria, and there is no material reduction of bacteria in the passage of the water from the river through the gravel to the well. Sample No. 3 is also condemned as being river water insufficiently filtered in its passage through the gravel. The number of bacteria in the city water does not reflect with certainty the efficiency of the filters, as the relation between the crude and filtered samples is uncertain and there may have been bacterial changes in the water while passing through the pipes.

The final conclusions drawn by the engineers from the pumpage, chemical and bacterial tests, and such surveys, borings and river soundings as were made, are as follows:

(1) That the water from the test well at the mouth of Wallace Run is clear and limpid so far as can be discovered by the naked eye.

(2) That the water obtained from the sand strata at the mouth of Wallace Run is mainly from the Beaver River. This is shown by the physical, chemical, and bacteriological examinations.

(3) That the quantity of water obtainable from the sand strata at the mouth of Wallace Run and above is practically limited only to the quantity flowing in the Beaver River, and the possibility of the surface of the gravel being covered with an impervious deposit brought down during floods.

(4) That the water in the Beaver River is contaminated by sewage from the towns above, and to an extent that is dangerous.

(5) That the water now delivered to your citizens is substantially Beaver River water, and that its quality might be improved upon.

(6) That if no other supply of water can be found other than the Beaver River, Wallace Run is a proper location for the works, and by a properly designed system of filtration the water can be purified of its sewage and lime, so that it will be fit for domestic and manufacturing purposes.

(7) The sand strata would clarify the water so as to make considerable less work for the filter, and reduce the cost of operation.

We would, however, advise some other source of a water supply if it can be found.

PAST AND PRESENT TENDENCIES IN ENGINEERING EDUCATION.*

By Mansfield Merriman, M. Am. Soc. C. E.**

The present status of engineering education in the United States is the result of a rapid evolution which has occurred in consequence of changes of opinion as to the aims and methods of education in general. These changes of opinion, whether on the part of the public or on the part of educators, together with the resulting practice, may be called tendencies. All progress that has occurred is due to the pressure of such views or tendencies; hence a brief retrospect of the past and contemplation of the present may be of assistance in helping us to decide upon the most advantageous plans for the future.

Thirty years ago public opinion looked with distrust upon technical education. Its scientific basis and utilitarian aims were regarded as on a far lower plane than the well-tried methods of that venerable classical education whose purpose was to discipline and polish the mind. What wonderful changes of opinion have resulted, how the engineering education has increased and flourished, how it has influenced the old methods, and how it has gained a high place in public estimation, are well known to all. The formation of this society in 1893, its remarkable growth, and the profitable discussions contained in the three volumes of its transactions, show clearly that technical education constitutes one of the important mental and material lines of progress of the nineteenth century.

Engineering courses of study a quarter of a century ago were scientific rather than technical. It was recognized that the principles and facts of science were likely to be useful in the everyday work of life and particularly in the design and construction of machinery and structures. Hence mathematics was taught more thoroughly and with greater regard to practical applications, chemistry and physics were exemplified by laboratory work, drawing was introduced, and surveying was taught by actual field practice. Although engineering practice was rarely discussed in those early schools, and although questions of economic construction were but seldom brought to the attention of students, yet the scientific spirit that prevailed was most praiseworthy and its influence has been far reaching.

This scientific education notably differed from the old classical education in two important respects: first, the principles of science were regarded as principles of truth whose study was ennobling because it attempted to solve the mystery of the universe; and second, the laws of the forces of nature were recognized as important to be understood in order to advance the prosperity and happiness of man. The former point of view led to the introduction of experimental work, it being recognized that the truth of nature's laws could be verified by experience alone; the latter point of view led to the application of these laws in industrial and technical experimentation. Gradually the latter tendency became far stronger than the former and thus the scientific school developed into the engineering college.

The very great value of laboratory experiments, and of all the so-called practical work of the engineering school of to-day, is granted by all. Principles and laws which otherwise may be but indistinct mental propositions are by experimentation rendered realities of nature. The student thus discovers and sees the laws of mechanics, and is inspired with the true scientific spirit of investigation. It should not, however, be forgotten that if such practical work be carried beyond the extent necessary to illustrate principles, it may become a source of danger. The student of average ability may pass a pleasant hour in using apparatus to perform experiments which have been carefully laid out for him, and yet gain therefrom little mental advantage. Especially is this true when the work assumes the form of manual training which, however useful in itself, is properly considered by many as of too little value to occupy a place in the curriculum of an engineering college.

The tendency toward the multiplication of engineering courses of study has been a strong one, especially on the part of the public. This has resulted in a specialization that, as a rule, has not been of the highest advantage to students. In some institutions this has gone so far that the student of civil engineering learns nothing of boilers and machines, while the student of mechanical engineering learns nothing of surveying or bridges. The graduate is thus too often apt to lack that broad foundation upon which alone he can hope to build a successful career.

The development of the scientific school into the engineering college has been characterized throughout by one element of the happiest nature, that of hard work and thoroughness of study. The numerous topics to be covered in a limited time, their close inter-relation, and the utilitarian point of view, have required many hours per week and earnest work by each student in preparation for each exercise. The discipline of hard and thorough work is one whose influence can scarcely be overestimated as a training for the duties of life, and in every university it is found that the activity and earnestness of the engineering students is a source of constant stimulus to those of other departments. Thus scientific and engineering education has tended to elevate the standard and improve the methods of all educational work.

The length of the course of study in engineering colleges has generally been four years, and whatever tendencies have existed towards a five-years' course have now for the most part disappeared. With higher requirements for admission, particularly in English and in modern languages, a reduction of the length of the course to three years may possibly be ventured in the future, particularly if the long summer vacation be utilized for some of the practical work, as indeed is now the case in several institutions.

There has been and now is a strong tendency toward a reduction in the length of the college year. While formerly forty or forty-two weeks were regarded as essential, the process has gone on until now some colleges have but thirty or thirty-two weeks, a reduction of nearly twenty-five per cent. having been effected in twenty-five years. Undoubtedly the long vacation is utilized to great advantage by the majority of students in actual work, yet the fact remains that it is not good business economy to allow the buildings and plant of a college to lie idle for so large a part of the year. It is perhaps possible that in the future the summer schools may be so developed that the work will be practically continuous throughout the year, thus giving to students the option of completing the course either in three or four years.

The report of the committee on requirements for admission, which will be presented later in the session, sets forth many facts which show the tendencies now existing. Almost without exception a higher standard is demanded, both that students may enter with better mental training, and that more time may be available in the course for technical subjects. While the general line of advance is toward an increase in mathematics and in modern languages, there is also found, particularly in the central states, a demand for broader training in science. It has already been pointed out that our early engineering schools were strong in scientific training, and that the tendency has been to replace this by industrial applications. If the requirements for admission can be extended to include the elements of chemistry and physics, with some botany or zoology, the engineering student will enter with broader views, a keener power of observation, and a scientific spirit, that will greatly increase his chances for success in technical studies.

The general increase in requirements for admission tends to raise the average age of the student. It is now usually the case, owing to the greater length of time needed in preparatory work, that the average age of the classical student is one year higher than that of the engineering student; or the former has had one more year of training than the latter. One more year of training means much as an element for success; one more year in age means an increase in judgment, which is of the highest importance for a proper appreciation of the work of the course. The older men in a class usually do the best if not the most brilliant work, and after graduation their progress is the most satisfactory. It thus appears that all tendencies that raise the age of entrance are most important ones and deserve hearty encouragement.

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*Presidential address before the Society for the Promotion of Engineering Education at the meeting in Buffalo, N. Y., Aug. 20, 1896.

**Professor of Civil Engineering in Lehigh University.

Having now considered some of the general elements and tendencies in engineering education, it will be well to take up the program of studies, especially in regard to those subjects that are common to all technical courses. The three volumes of the transactions of this Society, contain many carefully prepared papers and interesting discussions which enter into questions of detail concerning nearly all topics in the curriculum. Here, however, can only be noted briefly the main lines of development and the indications for future progress.

Mathematics is undoubtedly the most important subject in all courses of engineering study, and it has been demanded for years that it be taught with great thoroughness. This demand has been met more completely in the independent engineering colleges than in the engineering courses of the universities. Much, however, remains to be done in this direction, and probably it cannot be satisfactorily accomplished until a change in method has been effected. The fundamental element in the charge of method must be, it seems to me, in a partial abolition of the formal logic of the text-books, and an introduction of historical and utilitarian ideas. Mathematics is a tool to be studied for its uses, rather than for its logic or for the discipline that it can give; hence let its applications be indicated frequently and not be systematically kept out of view. If the student gains the impression that his mathematical exercises are merely intended to train the mind, his interest and his progress will usually be slow. If, however, he learns what mathematics has done in the past, how it joins with mechanics to explain the motions of the distant planets, as well as to advance the material prosperity of man, there arises an interest and a zeal that helps him to overcome all difficulties.

The great advantage of numerical exercises in all branches of pure and applied mathematics, and the deplorable lack of good preparation in arithmetic have been expressed by many educators. In numerical computations the average engineering student is weak in spite of the numerous exercises in his practical work. To remedy this defect better instruction in arithmetic is demanded in the common and high schools, while in engineering colleges the teachers of mathematics should constantly introduce numerical work and insist that it be done with a precison corresponding with the accuracy of the data.

Next to importance in mathematics comes mechanics, the science that teaches the laws of force and motion. In most institutions the rational is separated from the applied mechanics and often taught by the mathematical department. Probably less improvement has resulted in the teaching of rational mechanics during the past quarter of a century than in any other subject. That mechanics is an experimental science whose laws are founded on observation and experience is often forgotten, and the formal logic of the text-books tends to give students the impression that it is a subsidiary branch of mathematics. The most interesting history of the development of the science is rarely brought to the attention of classes, and altogether it appears that the present methods and results are capable of great improvement.

It should not be overlooked, however, that in recent years the so-called absolute system of units has been introduced into mechanics, and is now generally taught in connection with physics. Here the pound or the kilogram is the unit of mass, while the unit of force is the poundal or the dyne. Although this system possesses nothing that is truely absolute, it has certain theoretical advantages that have commended its use, notwithstanding that no practical way of measuring poundals has been devised except by the action of the force of gravity on the pound. Engineers have continued to employ the pound weight as the unit of force, and the calculations of the physicist must be translated into the units of the engineer before they can be understood. The student of rational mechanics thus has the difficulty at the very outset of two systems of units, and great care should be taken that each be thoroughly understood and the relations between them be clearly appreciated by application to many numerical problems. In view of these and other difficulties, and of the novelty of the subject in general, it appears that some engineering colleges do not give to rational mechanics as much time as its importance demands.

Physics in some colleges, is taught by a course of five or six exercises per week, extending over a year, while in others the elements are required for admission and the regular course is correspondingly abridged. The marvelous development of electrical theory and practice has naturally tended to make this the most important topic in the course, sometimes indeed to a material abridgment of mechanics, acoustics, thermodynamics and optics. Considering how great is the importance of each branch of physics and the advances that are made every year in new directions, it may also be concluded that more time can be profitably given to both theory and to experimental work. Physics is a fundamental subject whose principles and results are of constant application in every walk of life, and a student who thoroughly covers a well arranged course has gained a mental discipline and a scientific habit of mind that will be of greater value than the technical details of a purely engineering specialty.

Undoubtedly the most powerful tendency in engineering education has been in the direction of the development of those special technic subjects which may be grouped under the name of Construction and Design. In civil engineering this has led to plans for railroad, water supply, and bridge constructions; in mechanical engineering to engine and machine design, in mining engineering to projects for mine plants, and in electrical engineering to the design of dynamos and motors. These courses have been demanded by the public and by the students themselves, and have been often elaborated to an extent beyond the best judgment of teachers of engineering. To the extension of such courses there is no limit, but it is a question whether the process has not already gone too far. For instance, it would not be difficult to arrange a course of twenty or thirty exercises on water pipes in which should be discussed all the methods of manufacture and processes of laying cast-iron, wrought-iron lap-welded, steel-riveted, and wooden mains, together with a comparison of their relative economies under different conditions in different parts of the country. These lectures, however, would plainly be of such a technical nature that the advantage to the student would be slight; they would give valuable information but little training.

In all courses in construction and design the practical limit seems to be reached when the exercises are of such a nature as to give mere information and little scientific training. The aim of all education, and of engineering education in particular, should be to render the student conscious of his mental power and sure of applying it with scientific accuracy so as to secure economy of construction. Fundamental principles are hence more important than the details of a trade, and all exercises in design should be arranged so that the student may think for himself rather than blindly copy the best practice of the best engineers.

The subject of applied mechanics, which occupies an intermediate place between rational mechanics and the work in design, has been so differentiated that the mechanics of materials is now almost the only topic common to all engineering courses. The strongest line of development has here been in the introduction of testing machines and in the making of commercial tests. This work is of high value, although it may be doubted if the use of one or two large testing machines is as advantageous as that of many smaller ones which are designed especially to illustrate principles. The student of the present day enjoys, however, advantages that were unknown a quarter of a century ago, and the marked progress in applied mechanics, from both the scientific and technical point of view, is a source of congratulation.

English and modern languages are generally called culture subjects, and it is well known that of all the topics in the engineering course these are the ones in which students have the least interest. The great importance to an engineer of being able to clearly and correctly write his own language can scarcely be overestimated. Further it may be said that no engineer can hope to attain eminence unless he can read German and French literature. These opinions have long been held, and furthermore it has been recognized that engineering students and graduates are often lacking in that general culture which the world demands as one of the conditions of success. Great improvements have been made in the methods of teaching English and modern languages, and probably still greater ones are yet to result. In the ideal engineering colleges of the future, perhaps these subjects will be required for admission, as is now done by at least one institution, but at present they must generally be taught. The main line of improvement to secure better results will be, it seems to me, in partially abandoning the idea of culture and placing the instruction upon a more utilitarian basis. If English be regarded as a means to an end instead of linguistic drill, if the aim of teaching French and German be to read fluently the language of to-day instead of laboriously to decipher the meaning of the poets of centuries ago, true zeal on the part of students will arise and a truer culture will result.

At the close of the college course the student presents a thesis showing his ability to apply the principles and rules of engineering in the investigation or design of a special problem. The tendency has been strong to abandon subjects which involve mere description or compilation, and to insist upon those that will require the student to exercise his own powers. Thus the value of the work to the student has been greaty increased, and the theses of each class are a source of stimulus to the following ones. Although the view held by some that theses should be monographs setting forth important conclusions of original investigations, is one that can not in general be realized, it is a gratification to note that each year a few theses are produced which are sufficiently valuable to warrant immediate publication.

The formation of engineering clubs among students for the discussion of the details of professional work is one of the most important tendencies of recent years. No exercise is so valuable to a student as one entirely originated and performed by himself, and the preparation of a paper which is to be presented to and criticized by his fellows ranks highest of all among such exercises. Recently there has been forced upon my notice a remarkable activity in the three engineering clubs of a certain engineering college, more than fifty papers having been read and discussed during the year by a total of about three hundred and fifty students, besides a number of others read before the mathematical club. In meetings of this kind the scientific and economic questions under discussion in the engineering journals receive a detailed attention which the professor in the class room often finds it impossible to give, while the advantage to students in expressing themselves in debate is very great.

Occasional lectures to classes by practicing engineers have been introduced in many institutions during the past decade, and with uniformly good results. In engineering education there is no conflict between theory and practice, and every professor cordially welcomes distinguished engineers to explain their great structures and achievements to his classes. It is an inspiration to students to see and hear those men who have so successfully applied sound science to economic construction, and whose influence has been uniformly to elevate the standard of the profession.

After four years of work the engineering student receives his degree and is ready to commence the actual work of life. What the letters are that designate the degree is a matter of small importance. Moreover, if we examine the lists of the alumni who graduated ten or fifteen years ago, the conviction arises that their particular course of engineering study has not been an absolute factor in determining their actual line of engineering work. It is found that graduates in civil engineering are engaged in mining, in machinery and in electricity, and that graduates in other courses are employed upon work in which they received no especial technical instructions. Thus it appears, also, that the particular course of engineering study is not so important a matter as students and the public generally suppose. In fact a young man thoroughly grounded in fundamental principles and well trained how to apply them, has almost an equal chance for success in all branches of engineering practice.

Looking now over the field of tendency thus briefly outlined, it is seen that there has been ever present a powerful impulse towards specialization, to which, indeed, nearly all others have been subordinated. This has demanded a higher standard of admission, great thoroughness in all fundamental subjects, and a rigid adherence to scientific methods. Engineering education has had an active and healthy growth. It now enjoys the respect and confidence of the public, and its future is sure to be more influential than its past. It is not specialization that has caused its success, but rather the methods which specialization has demanded. Those methods have resulted in imparting to students zeal and fidelity, a love of hard work, of veneration for the truths of science, and a consciousness of being able to attack and overcome difficulties; these elements of character are, indeed, the foundation of success in life.

Looking now forward into the future it is seen that in our efforts for the promotion of engineering education a wide field for work still lies open. The student should enter the engineering college with a broader training and a more mature judgment. The present methods of instruction are to be rendered more thorough and more scientific. In particular, the fundamental subjects of mathematics, physics, and mechanics, are to be given a wider scope, while the languages and the humanities are to be so taught as to furnish that broad, general culture needed by every educated man. In general let it be kept in mind that education is more important than engineering, for the number of men who can follow the active practice of the profession will always be limited. Hence let it be the object of engineering education to influence the world in those elements of character that the true engineer possesses, so that every graduate may enter upon the duties of life with a spirit of zeal and integrity, with a firm reliance upon scientific laws and methods, and with a courage to do his work so as best to conduce to the highest welfare of his race and his country.

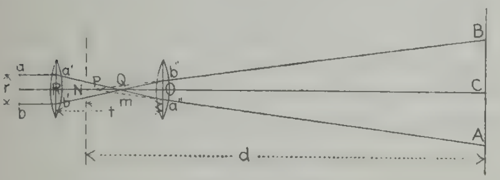
THE RICHER TACHYMETER.

By F. D. Lyphart, C. E.

This instrument has been in extensive use in Europe for a number of years and is called after its manufacturers, Maison Richer, Guyard, Canary & Co., successors, 13 Rue de la Cerisaie, Paris. It chiefly differs from American stadia instruments in being equipped with a so-called "analytic lens." This lens is inserted in the telescope between the object-glass and the wires, and its object is to do away with the customary constant, and to afford a means of perfectly adjusting the instrument for the correct reading of distances, simply by altering the distance of this lens from the object-glass.

The following history and theory of the tachymeter is taken from the work of Dr. Charles M. Schlos on "Surveying and Leveling." The analytic lens was originally introduced by an Italian, Prof. Porro; but it was improved upon and adapted to practical use by a French civil engineer, I. Mainot. In a work published by the latter, and describing the modified tachymeter, he gives careful hints for the employment of the instrument in the field, and for the calculation and plotting of the results of surveys made with it.*

In describing the theory of the tachymeter, for the sake of simplicity, a horizontal line of sight is assumed in the accompanying demonstrations, though the same reasoning will apply to an inclined position of the telescope. In the figure, a′ b′ is the analytic lens; lines are drawn from the stadia wires a and b parallel to the axis of the telescope, and these lines, on passing through the lens meet at the focus Q. When they meet the object-glass they are again broken and strike the rod at A and B; while the projection of the latter lines it would intersect at a point P, back of the focus Q. The distance P C is proportional to the reading A B on the rods; and if the dotted line represented the axis of the instrument, we would have for the required distance d the equation:



$$d = PC + PN = k\,AB + PN.$$

If P N can be made = 0 the apex of the triangle A P B will be moved to the center of the instrument, and the equation will become:

$$d = PC = k\,AB$$

and the constant is eliminated. Since P is the vertical image of the point Q, so far as the object-lens is concerned, we have:

$$\frac{1}{OQ} - \frac{1}{OP} = \frac{1}{F}$$

F being the focal distance of the object lens, and consequently:

$$OP = \frac{F \times OQ}{F - OQ}$$

If f = the focal distance of the analytic lens and F = distance between this lens and the object-glass, we have

$$OP = \frac{F\,(t - f)}{F + f - t};$$

and if m is taken as representing the distance between the object-glass and the center of the instrument:

$$PN = ON - OP = m - \frac{F\,(t - f)}{F + f - t}$$

With P moved to the center of the instrument:

$$PN = 0, \text{ or } m = \frac{F\,(t - f)}{F + f - t};$$

hence

$$f = t - \frac{m \cdot F}{m + F}$$

The above is the formula for the analytic lens. For the coefficient k, which expresses the proportions of the real distance to the reading on the rod, we have

$$k = \frac{CP}{AB} = \frac{OP}{a''\,b''} = \frac{F\,(t - f)}{F + f - t} \cdot \frac{1}{a''\,b''}$$

The triangles Q a″ b″ and Q a′ b′ being similar, we have the equation—

$$\frac{a'\,b'}{a''\,b''} = \frac{QR}{QO};$$

or, if we call the distance of the stadia wires from each other = r, we have

$$\frac{1}{a''\,b''} = \frac{f}{t - f} \cdot \frac{1}{r};$$

consequently,

$$k = \frac{F\,(t - f)}{F + f - t} \cdot \frac{f}{t - f} \cdot \frac{1}{r} = \frac{F\,f}{F + f - t} \cdot \frac{1}{r}$$

or,

$$r = \frac{F\,f}{F + f - t} \cdot \frac{1}{k}$$

This equation gives the distance of the stadia wires from each other for a fixed value of k, generally taken either at 100 or at 200. It is, however, practically impossible to place the stadia wires exactly at the required distance apart; and, as a rule, k is not exactly 100 or 200. The last equation but one shows, however, that k depends on the value of t, the distance between the analytic and the object lens. Consequently, by checking this distance, k can be given the exact desired value, and the instrument can be adjusted for the correct reading of distances.

By changing t, P N will not remain exactly equal to zero; but the resulting inaccuracy is so small that it may be safely neglected in stadia surveying.

In the Richer Tachymeter the analytic lens is made movable; but this arrangement is objectionable, because it is necessary to take the telescope apart to alter the position of the lens, and a perfect adjustment can only be made after several trials. It is suggested that a more convenient means could be devised which would permit a backward and forward movement of the lens, without turning around and without affecting the line of collimation.

Messrs. Buff & Berger, of Boston, refer to the analytic, or Porro lens in their "Handbook and Illustrated Catalogue," and object to it on the ground that it disturbs the line of collimation and unfits the instrument for accurate work. This is true for use where extreme accuracy is required. But the writer has found the Richer Tachymeter of great advantage in ordinary engineering surveys, and in the hands of an expert it gives surprisingly satisfactory results. It is a favorite instrument among European engineers for railway surveys in rolling or mountainous country, as it favors quick work and gives the engineers a reliable means of checking the measurements. Mr. W. F. Shunk is certainly right when he says in his "Field Engineer" that: "Astronomical nicety, whether with transit or level, in an ordinary railroad survey is a mere waste of time."

Porro's lens is objectionable, however, in causing a loss of light, just as in the case of any extra lens; and on this account it should only be used in an inverting telescope. If the figures on the stadia rod are painted upside down, much trouble, on this account, would be avoided. In the Richer Tachymeter the wires are replaced by lines etched on the plane side of the field lens of the eye-glass, which is a Ramsden lens. It is also worth mentioning that the graduation, both on limb and vertical circle is centesimal instead of sexigesimal as usual. This is done with a view of facilitating the reading of the metallic logarithmic slide-rule which takes the place of tables in the use of this instrument. The objection to this graduation is that it makes the instrument unsuitable for running in curves and for similar purposes, especially when American field methods are employed.

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*"Leves de plans a la Stadia, par J. Mainot," published by Ch, Dunod, 49 Quai des Grands Augustins, Paris,

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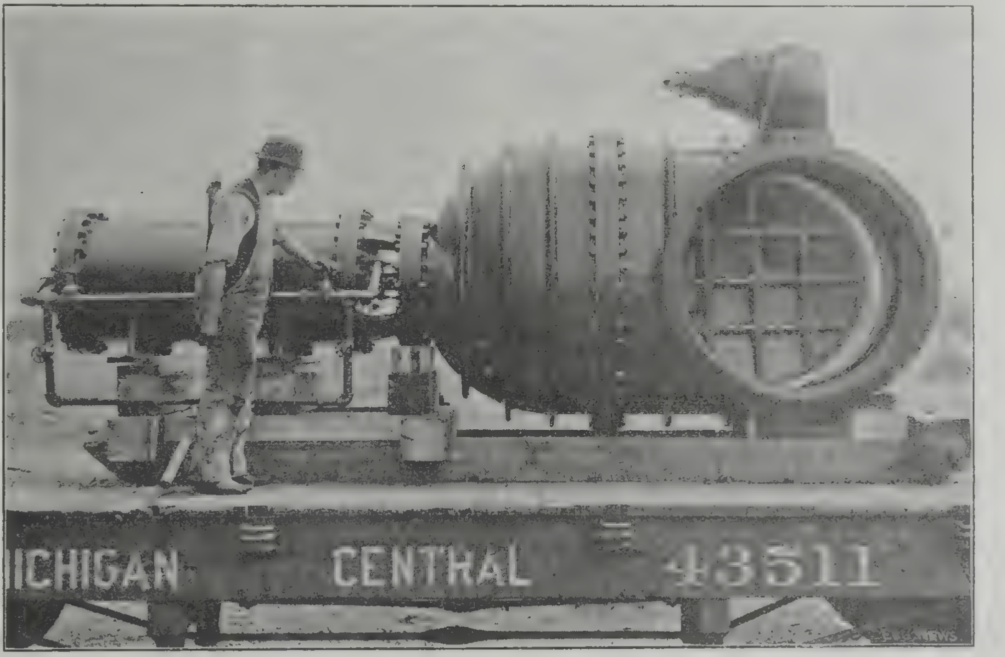
A 42-INCH HYDRAULIC VALVE.

The time and labor required in opening or closing an ordinary geared valve on large water mains is so great that these devices do not receive, in some cities, as many tests to determine whether they are in good working order as the good of the water-works system demands. Aside from this, there are times when it is highly desirable to shut a valve very quickly, and it is always advantageous to operate the valve system or any portion of it with a minimum of time and labor. Obviously one of the simplest means of improving on gear valves operated by hand is to utilize the pressure existing in the water mains to move the valves. This has been done on a line of 42-in. pipe in Detroit, for which the Michigan Brass & Iron Works of that city has furnished twelve 42-in. valves. The same company has also made six 30-in. hydraulic valves for the water-works of Toledo, O.

One of the 42-in. valves loaded on a car for shipment is shown by the accompanying view, from which its general design will be evident. This view does not show the auxiliary hand pump through which the feed to the hydraulic cylinder is made. This pump is for use when there is no pressure on the main, or in case of some emergency. Another feature of the device not shown by the view is designed to prevent the closing the valve under pressure without having the by-pass open. To guard against this, two gages are used, one connected with the by-pass on each side of the gate. By watching the gages the operator can see whether everything is working properly, and if not he can stop the large gate by simply closing the valve on the feed or outlet gate. All the trimmings of the valve are carried on heavy bronze rollers which operate on bronze tracks imbedded in the base of the valve. All contact surfaces bring bronze against bronze. The 42-in. valve complete, without pipe, weighs 14,000 lbs.



VIEW OF 42-IN. GATE WITH HYDRAULIC PISTON ATTACHED, FOR THE WATER-WORKS OF DETROIT, MICH.
Made by the Michigan Brass & Iron Works.

The pressure at Detroit is nominally 35 lbs. per sq. in. in the line on which these valves are placed. The valves there, the manufacturers state, have been closed in one minute. The time of operation, however, is under absolute control so that the valve can be moved as slowly as may be desired. For the above information we are indebted to Mr. Fred. H. Cozzens, Secretary and Treasurer of the Michigan Brass & Iron Works.

Shortly after the valves were placed at Detroit, Mr. L. M. Case, Superintendent and Secretary of the water-works, wrote us in response to our inquiry that they were giving satisfaction.

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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

In connection with the editorial in our last issue on the subject of the export of American manufactures, it is of interest to note that the Carnegie Steel Co. has just secured an order for 9,000 tons of steel rails for Japan. Concerning this the New York "Journal of Commerce" says:

> The order is for 9,000 tons for delivery up to the end of the year, and was placed with the Carnegie Steel Co. by Mitsui & Co., of Japan, after inviting bids in England and in this country. While the price paid could not be learned it may be said that the bid of the Carnegie Co. was sufficiently below the English market to justify its acceptance in spite of the higher freight rates from this country. The contract calls for 60-lb. rails. * * * *
>
> This is the second large order that has been placed in this country for steel rails on Japanese account, the Illinois Steel Co. having filled an order for 10,000 tons a few months ago, and it is expected that the steel-rail business with Japan will develop into a steady and important item of trade. It is expected that the demand in Japan for railway material will in the near future show a marked increase.

It would appear from the above item that American manufacturers can beat those of Europe in steel rails as well as in cotton cloth, even when seriously handicapped in the competition.

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The paper on the pooling of freight equipment which we print on another page discusses a subject of the greatest importance to the railways of the country. There is probably not a single reform which the railway companies of the country could institute (unless it be a radical revolution in the rate-fixing and traffic soliciting departments), which would bring such great returns as a general agreement to pool freight car equipment.

We have often pointed out that the expenses of handling freight in terminals and yards are becoming a larger and larger proportion of the total freight traffic expenses. The latest statistics show that there are over one-fourth as many locomotives engaged in switching service as in road service on freight trains in the whole United States and in some sections the proportion rises to one-third. This does not tell the whole story either, for the locomotives of way freight trains spend a large part of their time in switching work at unimportant stations. An enormous proportion of this switching service would be needless if the railways would only agree upon some plan of joint ownership. And this is only one, and by no means the most important of the benefits that would result from such a system.

The fact is that the railways have progressed so far toward common use and ownership of their freight equipment, that actual joint ownership is merely an obvious next step in advance. At present the car which one railway company owns spends half or more of its time in the service of other companies, and is treated in many respects when it is away from home exactly as if it were common property. Under the proposed pooling arrangement a company owning cars would receive, it would appear, just as much revenue from them as at present, would be more sure than now of having cars to furnish its shippers in times of heavy traffic, and would share with all other railways the benefits resulting from the pooling which Mr. Cavanagh's paper well sets forth.

The fact that so many cars are owned by equipment trusts might be thought a difficulty; but this could easily be overcome by leasing the cars to the proposed joint equipment association instead of transferring them outright. It is to be hoped that the railway presidents, who have of late shown so commendable a disposition to work in harmony with each other, may see their way clear to arrange for co-operation in this important field.

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The metric system and the advisability of its compulsory adoption in this country was before the Engineers' Club of Philadelphia for discussion last spring, and the July number of the club's "Proceedings," which has just come to hand, contains a report of the discussion and the action taken, which is of no small interest. The discussion was started by the receipt by the club of a circular letter from the American Metrological Society, asking the club's signature to a petition favoring the passage of the metric bill now before Congress, and the reading of the letter "evoked a very spirited discussion," in the words of the official minutes. Finally a committee of five was appointed to report at a later meeting what action the club should take in the matter. At the meeting on April 18 this committee presented a report favoring the approval by the club of the metric bill, and further extended discussion and reading of correspondence took place. It was finally decided to submit the question of the adoption of the committee's report to a letter ballot; and at the next meeting of the club the result of the ballot was announced, 100 favoring the report and 60 being against it.

From a condensed report of the discussion which appears in the "Proceedings," we find that Messrs. Wm. and Coleman Sellers, Wilfred Lewis and S. M. Vauclain were the chief opponents of the metric system. Those favoring it, on the other hand, included Mr. Geo. B. Roberts, President of the Pennsylvania R. R.; Mr. Francis Schumann, President of the Tacony Iron & Metal Co., which uses the metric system in its shops; Mr. A. Falkenau, who also has used the metric system, and many others.

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A loop terminal has very generally been acknowledged to have many important advantages over a head-house or dead-end terminal, more especially for lines having a heavy traffic of one class of trains, as on city and suburban lines. These advantages are especially important in the case of elevated railways, where the great majority of the traffic is simply an in and out movement for each train, with only the switching necessary for changing engines and changing the train from the up-town to the down-town track, or vice versa. The amount of room required for the loop system, however, has generally prevented its adoption on elevated railways. In another column we describe a loop line which will be a terminal for the joint use of four elevated railways. On this line there will be a daily traffic of 1,000 to 1,500 trains, and it is a notable feature that no reverse movements will be required, the incoming trains of each line passing round the loop to the outgoing track. This is a city terminal, and there will be no changing of engines or putting on of new cars, all such work being done at points on each individual line. Apart from the great convenience which will be attained in the prompt handling of the traffic there will be a great convenience for through passengers from one part of the city to another, as they can leave an inbound train from the north or west side at a station on the loop and take an outbound train for the south side at the same station. It will be evident that to effect the necessary connections between the several lines there must be a somewhat intricate system of switches, and that to safely and promptly handle the traffic a very complete system of signaling and interlocking will be required, and these points appear to have been fully covered in the loop line above mentioned, the main principle on which the plans have been prepared being that of ensuring the greatest safety and efficiency, while the cost of the work has been but a secondary consideration. This is undoubtedly the right way to go to work, more especially in a case where there will be such a heavy traffic at the outset, and where (judging from the experience of other elevated railways) the traffic is so likely to rapidly increase. The advantages of the loop system were pointed out by Mr. W. L. Derr in a paper on "Railway Yards and Terminals," in our issue of June 9, 1896, and the system has been somewhat extensively adopted for street railways, but it has been very little applied to steam railways. In fact at present we can only mention the Chicago loop line, the loop terminal of the Brooklyn Elevated Ry. at the Brooklyn Bridge, and the terminal of the Mexican National Ry. at Manzanillo (Eng. News, July 5, 1894). An objection frequently made is the amount of space required, but this objection has been very much exaggerated, and we question whether there are many places where the system could not be applied if desired.

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In the Province of Manitoba, civil engineering is now a "close profession," the government of that province having passed a law at its last session, putting certain restrictions upon the practice of engineering, in accordance with the request of a committee appointed by the Canadian Society of Civil Engineers. The work which has been done by that society toward the establishment of the engineering profession upon a similar basis to that of the other professions was summarized in our issue of April 30, 1896, and we reprint in another column the law recently passed by the Manitoba legislature. It will be noted that its provisions are exceedingly mild. It is declared in substance that after July 1, 1896, no person shall be entitled to call himself a civil engineer or to act as an engineer in connection with any public work involving over $500 expenditure, unless he is a member of the Canadian Society of Civil Engineers or of some other national society of civil engineers "of good standing," or unless he was practising as a civil engineer in Manitoba at the date of the passage of the act, or unless he is a "duly qualified civil engineer" and entitled to use the title of Civil Engineer by virtue of some statute in force in the province, or unless he holds the degree of Civil Engineer conferred by some institution of learning in the province. The breadth of these exceptions is praiseworthy; but it is also to be noted that the law provides no pains or penalties for those who disregard its provisions. It states who shall be entitled to use the title "Civil Engineer," and to practise the profession, but if any one chooses to write C. E. after his name, or to practise as a civil engineer, without the qualifications laid down, the law neither defines the nature of his offence nor specifies its punishment.

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The presidential address of Prof. Mansfield Merriman before the Society for the Promotion of Engineering Education is an admirable summary of the present tendencies in engineering education in this country and it can be read and studied with profit by practising engineers as well as by the professors in engineering schools. Every engineer, so long as he continues in active practice, must be to a greater or less extent engaged in the work of engineering education—training one pupil, himself; and so long as he gains in ability, it is because, consciously or unconsciously, he is carrying on the work of self-education. We might comment upon the various topics which are brought forward by Mr. Merriman, but he has so tersely and ably set forth principles and ideas with which this journal is in hearty accord that we can do no better than cordially commend his address, as admirably setting forth the directions in which progress should be made. We desire, however, to call especial attention to his remarks respecting the tendency toward over-specialization in the engineering schools. He well says that the particular course of engineering study to be pursued by a student is by no means so important a matter as students and the public generally suppose. The young man thoroughly grounded in fundamental principles and well trained in the methods of applying them has almost equal chances of success in all branches of engineering practice.

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In our issue of July 30 was published a report of the U. S. Geological Survey on the "Mineral Products of the United States" for the calendar years 1886 to 1895. Mr. David T. Day, Chief of Bureau, now sends us a new chart which, from revised figures of the Director of the Mint, corrects the productions of gold and silver, in 1895, as published in the former chart. To make the corrections plain we publish both the original and corrected figures for 1895, as follows:

	Original.		Corrected.	
Coin'g val.:	Quantity, Troy oz.	Value.	Quantity, Troy oz.	Value.
Silver....	47,000,000	$60,764,300	55,727,000	$72,051,000
Gold......	2,272,629	47,000,000	2,254,760	46,610,000

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WHO SHOULD PREPARE SPECIFICATIONS?

In a letter which we recently received from a well-known engineer the following sentence occurred:

> The preparation of specifications has always been regarded as the function of engineers, who ought to know the character of the work they want, and it is not desirable that this time-honored custom should be changed.

We presume that there are not a few engineers who hold similar views and who regard the formulation of specifications by manufacturers in this or that or the other field of engineering, as in some sense an infringement on the province of the engineer, and a thing to be resented and condemned. It seems worth while, therefore, to discuss the pros and cons of the question, and see just what the attitude of the profession should be on this important matter.

In the first place let us remember not to use the word engineer in too narrow a sense. The manufacturers of to-day are in very many cases able engineers, just as well educated, just as broadly experienced and often more expert in the special line in which they are engaged than is the average engineer who acts as an adviser to those who purchase their products. Take for example the matter of bridges. No one doubts that the chief engineers of the leading bridge companies are among the most able of living experts in this field of engineering. But the average practising engineer does a little in this line and a little in that, and occasionally is placed in charge of a bridge letting. Is it reasonable to expect that he will be so well posted and so expert in the latest and best practice in bridge work that he can draw as good a detailed specification as can be made by the engineer of a bridge company, who is devoting all his time to this one specialty six days out of seven?

Clearly we cannot decree that the manufacturers or the manufacturer's engineer shall not prepare specifications on the ground of ignorance or incompetence. But it may be urged that the manufacturer should not prepare specifications because he will frame them to suit his interests instead of those of the purchaser. The maker of steel, for example, it may be said, will set his limits of sulphur or phosphorus at a point which will suit the ores that he can purchase most advantageously; the paint manufacturer will specify a paint which will carry a goodly amount of cheap adulterants, without transgressing the requirements; the bridge-builder will draw a specification under which poor riveting may be passed, and light sections will be permissible.

Now it would be idle to deny that there is a tendency for the manufacturers to do things of this sort. They must meet keen competition in the markets, and in order to make their prices compare favorably with those of their competitors they must not agree to furnish too good an article. But on the other hand, there are other powerful forces at work to restrain the manufacturer from writing a specification for an article which shall be distinctly inferior with respect to safety, durability, or appearance. If the steel-maker furnishes metal too high in phosphorus, a serious accident may result and the cause may be traced back to his steel. If the paint-maker substitutes cheaper oils for linseed, his customers will complain of his paint as lacking in durability. If the bridge-builder draws a specification by which defective workmanship is made permissible, one of his bridges may fall and the damage to his reputation may injure his business a thousand times as much as the profit that he might make from drawing too liberal a specification.

Clearly, then, the motives which impel the reputable manufacturer to furnish first-class goods to his customers are very strong; and were specifications drawn by this class of manufacturers alone, probably less fault would be found with manufacturers' specifications; but it must be admitted that manufacturers are not all of this class. There are manufacturers who care nothing for the reputation of their goods—who are not working to build up a business but to reap quick profits. There are others whose policy it is to obtain business not by the merit of their products nor their low prices, but by their ability in securing orders from the officers of corporations who are more concerned to line their own pockets than to protect the interests entrusted to them. Clearly, from manufacturers of these latter classes, we can expect nothing excellent, either in products or in specifications describing what the product should be.

Manufacturers, of honesty and reputation, welcome, we believe, invariably, the preparation of specifications by an able and conscientious engineer, because it protects them from the unfair and unequal competition with manufacturers of the classes we have just described. The energetic and honest manufacturer prefers to bid under a strict specification, which defines in every detail what will be required. He can safely make a close bid on work of that sort. But he detests a competition in which a specification of vague platitudes leaves every opportunity open to dishonest competitors to do business according to their methods. Competition of that sort is not competition at all; it is merely a match at wire-pulling.

Now, it is an unfortunate fact that the engineers in charge of works are too often unequal to the task of writing a strict and detailed specification. How often do we see especial emphasis laid in some one feature in a specification, while others of equal or greater importance are left unmentioned. It is also an unfortunate fact that in too many cases important purchases are made of engineering materials without the advice or aid of any engineer. It is surely better where such purchases are made in open competition to have manufacturers' specifications than none at all.

We believe that the most perfect system of preparing specifications and purchasing goods in existence is that which has long been in use by the Motive Power Department of the Pennsylvania Railroad. It has been described before, but we may briefly summarize its chief features. In the first place all the supplies which the great corporation requires, from steel to soap, are bought under strict and detailed specifications. The original draft of these specifications is made by the company's chief technical experts, and copies of this draft are sent to all the manufacturers in that particular line with which the company has any dealings, with a request for criticisms and suggestions. These are all given careful consideration and such are adopted as seem to promise any real improvement. Upon these finally amended specifications all goods are bought. But the process does not stop here, for all specifications are held open to amendment, and are revised from time to time in accordance with increased knowledge or improved processes.

We can imagine no system that could be fairer to all parties concerned, or better calculated to secure for the purchaser an excellent quality of goods at the minimum price consistent with good quality. It may be said that this system is only adapted to the purchase of regular lines of supplies by a great railway corporation; but we believe that many much smaller corporations and many municipal corporations could adopt such a system with profit. There is no reason why a city should not have its standard specifications for bridges, cement, sewer work, paving of various classes, etc., and many cities, indeed, already have them. But the main point on which we desire to lay emphasis is the systematic consideration of the opinions of those who are to work under the specifications—both in their original formulation and in their periodic revision.

Of course, it is true that with all possible use of standard specifications by municipal and private corporations, there still will remain a vast amount of contract work for which special specifications must be drawn if the work is to be properly carried out. We do not urge, by any means, that such specifications had better be made by manufacturers or by contractors; nor do we believe that specifications from this source are likely to be adopted by purchasers to economize in engineering expenses. But we do urge that no prejudice should stand in the way of the acceptance of the points of excellence which may be found in specifications prepared by manufacturers.

It is too little understood by the public generally and too little appreciated even by engineers themselves that the plans and specifications for a structure should actually contain the finished work. and do contain it if they are properly drawn. The actual work should be the mere carrying out of what the engineer has built on paper. Bearing this in mind, the importance of excellent and detailed specifications is easily understood. The real engineer seeks aid in the preparation of his specifications from every possible source. He consults the precedents which the experience of the profession has established, and he will not fail to consider and profit by the experience of those whose province it is to carry out in practice the ideas which he originates.

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LETTERS TO THE EDITOR.

A Blast Which Wouldn't Go.

Sir: In blasting coraline rock I placed a charge of 4 lbs. Hercules No. 2 dynamite in a 7-ft. hole, and set it off with single-ply fuse. The cartridge attached to the fuse fired clean without setting off the charge, I then opened the hole to the charge and placed directly over the charge 2 lbs. more of dynamite which also fired clean without setting the charge off. Will some of your readers explain the cause? Truly,

Miami, Fla., Aug. 9, 1896. Wm. Varnedoe.

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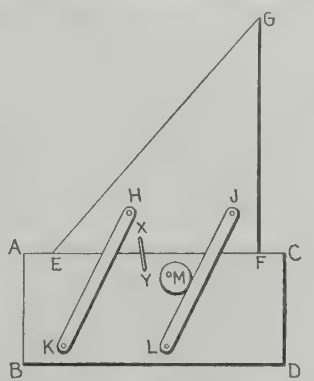
A Home-Made Section Liner.

Sir: You will find herewith a drawing of a section liner, which may be easily and cheaply made by any one who is the least "handy." A B C D is the base to which the triangle, E F G, is fastened by the brass connecting pieces, H K and J S. The regulator, M, is a circular piece of brass eccentrically fastened to the base and against which the connecting piece, J L, works. X Y is a rubber band to aid in the adjustment, which is easily made by the brass regulator for any width of space from zero to the difference between the two parts of the diameter of the regulator. Very truly yours,



A Home-Made Section Liner.

W. D. Sell, Jun. Am. Soc. C. E.

Logan, W. Va., Aug. 1, 1896.

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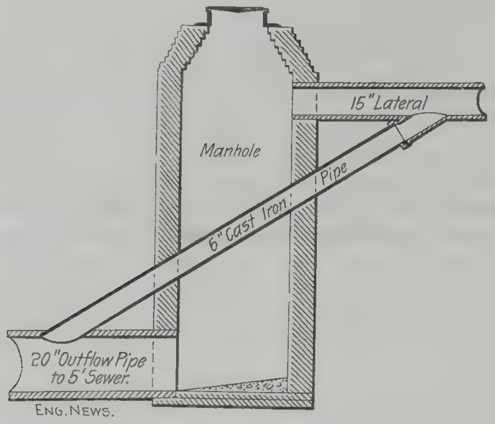
A Problem in Connecting Lateral and Main Sewers.

Sir: In some sewer construction upon which the writer has been engaged recently, a problem arose concerning the solution of which the opinion of other engineers is desired. A 5-ft. brick sewer was being constructed along a main street to replace a sewer which had been constructed at from 4 ft. to 6 ft. higher level. The laterals from the cross streets had emptied into this old sewer at grade; but when the new sewer was built several feet below the old one, the outlets of these laterals were, of course, several feet above its grade. The problem was the best method of connecting these laterals with the new sewer. One of the methods suggested is shown by the accompanying cut. The inclined pipe is a dry weather pipe and is of iron. Very truly, B. H. S.

Chicago, Ill., July 17, 1896.



Proposed Method of Connecting Laterals and Main Sewers, When the Two are at Different Elevations

A Question of Professional Ethics.

Sir: On p. 73 of your issue of July 30, 1896, "E. K." would like an opinion on the question of Engineering Ethics. I think he can find his answer in the 2d, 3d and 4th lines of the second column of p. 75.

Respectfully yours, James H. Harlow.

Pittsburg, Pa., Aug. 14, 1896.

(The point raised by "E. K." related to the propriety of the acceptance by an engineer for a department of public parks of the position of chief engineer of a railway to run through the parks. Mr. Harlow refers, in reply, to the following sentence from an address on "The Legal Duties of Engineers and Architects," delivered before the Engineering Association of the South by Hon. Jas. C. Bradford, of Nashville, Tenn.:—Ed.)

> One of the commonest rules of the law of principal and agent is, that a man shall not serve two masters.

Fire Tests of Loaded Columns.

Sir: Referring to your editorial in your issue of Aug. 13, on the report of work done by the Committee on Fireproofing Tests, permit me to call your attention to a slight error. The hydraulic apparatus has a capacity considerably in excess of the loads put upon the columns during the tests reported. It is so arranged as to allow the use of a hydraulic pressure of 2,500 lbs. per sq. in., while the greatest testing load was only 1,500 lbs. The loads that were actually put upon the columns represented the maximum limits permitted by the building laws of large and prominent cities.

I also note your suggestions in regard to future work and can state that it is the committee's intention to continue these tests so as to cover the various conditions of practice. Just at present, however, the committee is hampered for want of funds. These tests are very expensive to carry out, on account of their being made on full sized members. The funds so far raised have been entirely through voluntary contributions and the committee proposes at an early date to call a meeting of the Advisory Board, in order to take necessary steps for the further continuation of its work. Yours very truly,

H. de B. Parsons.

(We may add with respect to the matter of funds for further tests, that the bulk of the funds thus far expended by the committee were necessarily devoted to the construction of the gas producer, the testing chamber, etc. The actual expense of making the tests, when the plant was once ready, was comparatively small. It is to be hoped, therefore, that ample funds may be forthcoming to continue these tests on an extensive scale.—Ed.)

The Metric System or Duodecimal Notation?

Sir: Will you allow me to say a few words more upon the question of weights and measures, in reply to your editorial of July 30, which has just reached my eye.

You are right in anticipating considerable delay in making any change in our present system. But it is only a question of time, and therefore not worthy of argument. Some change is inevitable. All are agreed on that; so that, too, is unworthy of argument. Any change which is to be satisfactory must be sweeping, and therefore costly and troublesome beyond estimate. This, also, we may as well accept as inevitable, without wasting time in its discussion.

The only question worthy of the time of clear-sighted men is that of what system is to take the place of the present lack of one. Which one will be the most satisfactory and will cost the least to acquire?

In its discussion, do you not find more satisfactory the frank perspicacity of Mr. Herbert Spencer, in his letter to the "Popular Science Monthly" for July, than the cautious circumlocutions of London "Engineering," that most conservative of all the journals which ever stumbled along twenty years behind the leaders of progressive thought? If the prejudices of the ignorant masses are likely to delay this reform, for which we are so athirst, why add to them the prejudices of the enlightened? It is as futile to discuss the probability of the coming of this inevitable step in progress as to hope to evade the law of gravitation. How may it come most easily is the only topic worthy of paper and printer's ink.

Yours truly, Sidney A. Reeve.

(We are by no means certain that a change is inevitable. It is not likely to be made until there is a popular demand for it, and a change in our system of weights and measures, or in our system of notation, would be certain to encounter popular ridicule and opposition, instead of popular approval.—Ed.)

Notes and Queries.

W. P., Little Rock, Ark., asks for information concerning dump scows for use in dredging material where the depth of water to be secured is only 2 to 3 ft.

A MELAN ARCH WITH ROCK FACING AT ATLANTIC HIGHLANDS, N. J.

We illustrate herewith a handsome masonry arch which has just been erected at Atlantic Highlands, N. J., under direction of the Melan Arch Construction Co., of New York city. The arch is of the well-known Melan construction (steel beams embedded in concrete) and has a facing of field stone which gives it an exceedingly picturesque appearance. The arch has a 50-ft. span and has a width of 25 ft. over all, with a 20-ft. roadway. For the Melan construction 6-in. steel beams weighing 13 lbs. per ft. were used, spaced 3 ft. c. to c. Earth filling was placed over the haunches. The road which crosses the arch has a grade of 6% and the arch is built on a skew of 53° 8′.

MELAN ARCH WITH FIELD STONE FACING AT ATLANTIC HIGHLANDS, N. J.
The Melan Arch Construction Co., New York City, Engineers.

Atlantic Highlands is a well-known summer resort on the south shore of New York Bay. The borough government contributed $800 toward the cost of the structure and the remainder of the cost was made up by voluntary contributions by public-spirited citizens. Our photograph shows the surroundings of the arch still in an incomplete condition. These will soon be neatly graded and turfed, and ivy will be planted and trained over the arch. The structure is an excellent illustration of the growing tendency toward the choice of designs of aesthetic merit for bridges located in suburban towns and fashionable summer resorts.

THE POOLING OF FREIGHT EQUIPMENT.[*]

By J. R. Cavanagh.[**]

There is probably not a road in our association but what at some time during the past few years has seen a period when it has simply been impossible to obtain cars to handle the business offering. These conditions were not caused by lack of equipment in the country, but by the existing methods of handling cars. There are to-day at least 25% more freight cars than are necessary to move the largest volume of traffic we have ever been called on to care for. At no time do we find every section of our vast country in want of some class of cars simultaneously; but under the present system there is no provision for moving the surplus equipment from one section to another.

There are in the United States, Canada and Mexico over 1,175,000 freight cars owned by railway companies, representing an investment of about $580,000,000, which has not for years earned enough to pay the interest on the investment, depreciation and repairs.

The question arises—"What can we do to increase the performance of our cars?"

Plan after plan has been suggested; roads have kept on building cars, but with no apparent relief. The only remedy is the general pooling of all freight cars, the adoption of the per diem system, a uniform standard in sizes of cars, and the full enforcement of car service.

Referring to the proceedings of the Eastern railway car service officers in September, 1894, we find the following resolution:

> Resolved, That a general distributing office or clearing house, with subsidiary bureaus, be established for the purpose of regulating and increasing the supply of cars between railways to meet the legitimate demands of traffic.

I believe that the time is not far distant when we have got to come to a general distributing office, or something of the kind. A few contend that it is "too large a subject," "too many conflicting interests to harmonize," etc. The same remarks were made by many of our most prominent railway men when the Joint Traffic Association was suggested, but it came, is here, and apparently to stay.

There has been too much selfishness in the past which has resulted in disaster to the majority. We must unite now on some plan that will stop the enormous leaks caused by:

1. Idle equipment in one part of the country while another part is suffering for want of the same identical cars.
2. The handling of empty cars of similar class in contrary directions on account of route or initials.
3. The switching of empties out of sidings, freight houses, etc., only to switch in the same class of cars to load via lines other than those owning the cars switched out.
4. **Unnecessary switching to get some particular car out** of a string of empties, when the first car is exactly the same kind of a car but with other initials.

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[*] A paper read before the Association of Railway Officials at Toledo, O., July 21, 1896.

[**] Superintendent of Car Service; C., C., C. & St. L. Ry., Indianapolis, Ind.

5. The expense of traveling car agents, car tracing clerks and car service associations. (The latter will be merged into district bureaus.)

As an illustration, take the sleeping car companies. Were all contracts to be annulled to-morrow between them and the railway companies, twice the number of sleeping cars now in service would not care for the current business, making no provision for equipment needed during large conventions, gatherings, etc.

Take the private stock car companies. No railway company can show up any such average mileage per car per day. While railway companies average 35 to 50 miles, the private car companies run 75 to 100. You see a string of their cars in Montana to-day, at the seaboard in a few days, and a week later away down in Texas or Mexico. Their cars are always in active service because handled by one central authority to meet the requirements of the various sections.

In forming a car pool or equipment company I would recommend that we start in with the box cars first, because that class of cars is in more general demand and in 90% of the cases represents the item of equipment from which we receive most complaints of shortage.

With a view of economy in painting, clerical work, car recording, accounting, etc., I would recommend something after the following plan:

1. Have a distinctive mark to represent the class of car, thus:

"A," for box cars; "B," stable stock cars; "C," common stock cars, single deck, etc.

Abolish all car initials and use the distinctive letters instead.

Each kind would commence at 1 and number up, thus: A box car 34 ft. long (inside) 60,000 lbs. capacity, would simply be marked "A D E," 5,910. In a short time every switchman, bill clerk, auditor's clerk, car distributor, record clerk and employe or shipper would know at a glance what a car was. There would be no necessity of consulting a guide. Instead of reporting a dozen or more initials on car reports, we would simply use the "pool" marks. In many cases this would reduce the number of initials to report over 70%.

Of box cars alone the Guide shows that there are over 630,000, at an approximate valuation of over $310,000,000, and distributed as to lengths as follows:

20 ft. long	275	36 ft. long	15,057
22 " "	33	37 " "	2,393
23 " "	84	38 " "	1,339
24 " "	995	39 " "	957
25 " "	478	40 " "	5,157
26 " "	514	41 " "	150
27 " "	36,615	42 " "	158
28 " "	97,668	44 " "	15
29 " "	39,658	45 " "	31
30 " "	54,743	46 " "	55
31 " "	1,338	47 " "	2
32 " "	30,242	49 " "	2
33 " "	134,311	52 " "	14
34 " "	200,533		
35 " "	7,079		630,176

The first step necessary to form a pool (after the roads have agreed to it) is the establishment of a general or central office in charge of a general manager. Then divide the country into districts, similar to or in conformity with the freight traffic associations, such as eastern, central, etc., each district to be in charge of a district manager or distributor; each road to handle its own distribution as at present; daily reports to be rendered to the district office, which, in turn, consolidates and transmits the same to the central office.

The pool would have to be organized by each road taking as much stock in the equipment company as the valuation of its equipment amounted to, each company to receive its pro-rata earnings as each class of cars it owns in the pool bears to the total number of cars or valuation of that class: Thus all 34 ft. box cars, 50,000 capacity would be marked "A D D." If the L. S. & M. S. Ry. owns 11% of the valuation of all cars in that class, it would receive 11% of the earnings.

If such a thing is necessary the identity of the cars can be preserved by assigning each road's cars of the same class into consecutive series or numbers: Thus, C., C., C. & St. L. Ry., 34 ft., 30 ton box cars 18,000 to 18,999 would be assigned "A D E" 1 to "A D E" 1,000; N. Y. C. & H. R., 52,000 to 55,999 would be assigned "A D E" 1,001 to "A D E" 5,000, etc.

Each road in the pool will be entitled to the same number of cars in each class as it owns in the pool, providing it needs them, and must accept up to its quota when offered for storage.

Compensation should be based on both the earning capacity of car and per diem, if possible. Thus:

30 ton and over, per diem 30 cts., or ⅝ ct. per mile.
25 ton and over, per diem 25 cts., or ½ ct. per mile.
20 ton and over, per diem 20 cts. or ⅜ ct. per mile.
15 ton and over, per diem 15 cts. or ¼ ct. per mile.
Under 15 tons, per diem 10 cts., or ⅛ ct. per mile.
For all cars in excess of 39 ft. add an agreed per cent.

By graduated compensation as suggested above, in addition to the justness of the proposition, roads would use only such cars as are necessary to handle the business. Thus, a road that could use ¼ ct. cars would not call for ⅝ ct. cars, allowing the latter to go into such service as the ¼ ct. equipment would be incapable of handling.

Car repairs could be based on proportion of mileage or per diem, or on such basis as may be agreed upon by the Master Car Builders of lines interested. This means uniform standards sooner than under present methods.

The car pool means decreased expenses from

1. The increased performance of all cars, permitting the handling of a given quantity of business with a minimum number of cars—obviating the building of any new equipment for five or six years.
2. Decrease in empty and foreign mileage.
3. Saving in switching at terminals and stations.
4. Reduction in train mileage.
5. Decrease in inspectors, repair shops, material, maintenance of way, car repairs, wheelage or trackage over foreign rails, clerical work, telegraphing, etc.
6. Increased earnings from greater supply of cars and reduction in expenses.

The district manager for the Joint Equipment Association would have charge of distribution of equipment, handling of demurrage or car service matters, car repairs and all matters pertaining to the equipment. This would be an improvement over present methods, for the reason that the car owner would have a representative at every point seeing that the best service was gotten out of the equipment, while under present conditions at many points foreign equipment is abused, misused and held on account of being a "wanderer from home."

After the box cars have got to working in the pool, then add stock or other classes as fast as considered advisable or as the trustees representing the owners may decide.

The difficulties to be overcome are not as great as might appear upon first consideration of the subject, as an organization can be formed by which all roads desiring to become members (stockholders) would be protected equitably in their rights.

Last fall I took the trouble to inquire about the probable loss to railways from cars lying idle at junction points, switching, etc. Replies were received from a number of representative men. The lowest estimate showed from loss of revenue, cost of transfer, and loss in car mileage for one year over $25,000,000, and the above simply on account of owners not allowing their cars to go beyond junction point.

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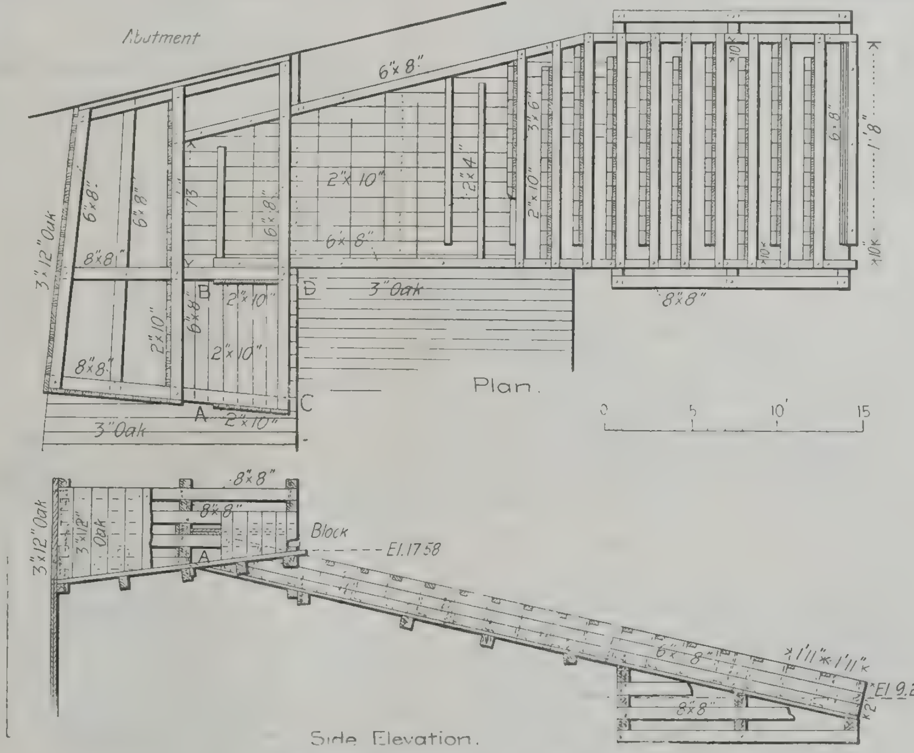
FISHWAY FOR DAM AT STERLING, ILL.

We illustrate herewith a fishway built in the dam of the Sterling Hydraulic Co., at Sterling, Ill., under the direction of Mr. L. L. Wheeler, M. Am. Soc. C. E., to whom we are indebted for the blue print from which our illustration has been prepared.



FISHWAY IN DAM AT STERLING, ILL.
Designed by L. L. Wheeler, C. E.

Mr. Wheeler states that the plans furnished in response to his application to the U. S. Fish Commission and the Illinois Fish Commission did not appear to be adapted to the conditions he had to meet or likely to be satisfactory if followed. The form and dimensions of the cribs and fishway were in part fixed by local conditions, and they were built from remnants left from repairing the dam. The cribs were packed with stone, except over the upper end of the fishway. The timbers A C and B D are simply blocked on the crest of the dam, leaving the water free to spill over the crest C D. The openings A B are of equal size, and it is intended that the head on the opening B shall be practically constant. The minimum distance the water travels in overcoming a fall of 8.4 ft. is 200 ft.

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CIVIL ENGINEERING A CLOSE PROFESSION IN MANITOBA.

It is probably not known to many of our readers that civil engineering is now a close profession in the province of Manitoba, Canada, and that the indiscriminate use of the title of "civil engineer" or "C. E." is illegal, as is also the practice of engineering by any but a member of a national association of engineers.

We have from time to time recorded the steps taken and the progress made by the Canadian Society of Civil Engineers in its movement to secure legislation making the society a close corporation, and the matter was editorially discussed in our issue of April 30, 1896. At the last annual meeting it was voted that the council should appoint a committee of three in each province to see if the government of the province would pass the proposed bill to limit the practice of civil engineering to members of the Canadian Society of Civil Engineers. In Manitoba the matter was acted on very promptly, and the bill was at once submitted to and passed by the government of that province, which has thus the distinction of being the first government in the world to make engineering a close profession. It may be noted that in all the Canadian provinces the practice of surveying has been limited by law to surveyors who have passed the government examination, while in some (including Manitoba) only members of the provincial society of surveyors are authorized to make surveys.

We are indebted to Mr. H. N. Ruttan, M. Am. Soc. C. E., City Engineer of Winnipeg, Man., for a copy of this law, and we reprint it herewith in full. The principal feature of the bill is contained in the last paragraph, and we have briefly commented upon it in another column.

An Act respecting the Profession of Civil Engineers.

(Assented to 19th March, 1896.)

Whereas, it is deemed expedient for the better protection of the public interests and for the general advancement of Mechanical Science, and more particularly for promoting the acquisition of that species of knowledge which has special reference to the profession of a Civil Engineer, and to encourage investigation in connection with all branches of knowledge connected with the profession, and in order to enable persons requiring professional aid in any work, to which such knowledge of Civil Engineering is applicable or necessary, to distinguish between qualified and unqualified Civil Engineers;

Therefore,

Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Manitoba, enacts as follows:

1. This Act may be cited as "The Manitoba Civil Engineers Act."

2. The Civil Engineers of Canada, heretofore incorporated by an Act of the Parliament of Canada, being Chapter 124 of the Acts passed at the Session held in the 50th and 51st years of Her Majesty's reign, under the name and style of "The Canadian Society of Civil Engineers," shall be a body corporate by the name aforesaid, having perpetual succession and a common seal, with power to acquire, hold and dispose of real and personal property for the purposes of its constitution, and to sue and to be sued in the manner usual with such corporations.

3. All persons who, on the day this Act comes into force, are members of the said existing Canadian Society of Civil Engineers, and all persons who shall hereafter be admitted as members of the Society hereby incorporated, and who shall be registered under the provisions of this Act, shall be members of the said Society.

4. There shall be a Council of Management of the said Society, to be appointed in the manner provided for in this Act, and hereinafter referred to as "the Council."

5. The Council shall be composed of twenty-one persons, who shall, in the first instance, and as a Provisional Council, consist of the present Council of the existing Canadian Society of Civil Engineers, if British subjects and residing within the Dominion of Canada.

6. The members of the said Provisional Council shall meet in the City of Winnipeg for the purpose of organization, within two months after the passing of this Act, at such time and place as may be set forth in a notice in the Manitoba Gazette, and at such meeting any five members of the Council shall form a quorum.

7. A general meeting of the members of the Society shall be called by the Provisional Council, on or before the First day of February next after the passing of this Act, for the election of a permanent Council. The time and place for such meeting shall be determined by the Provisional Council, and at least two weeks' notice in writing shall be given by the Secretary to each member of the Society, and such meeting and any subsequent meeting of the Society may be held without this Province, but in the Dominion of Canada, as the Council may from time to time determine.

8. All members of the permanent Council shall be elected by ballot, each member having one vote, and the member or members obtaining the greatest number of votes shall be declared elected.

9. The members of the Council so elected shall hold office for the following terms respectively:

The seven names who have received the greatest number of votes shall hold office for the term of three years, the next seven names for the term of two years, and the third and last seven names for the term of one year.

10. No person shall be eligible for election to the Council, or qualified to fill any vacancy therein, or to vote for any member thereof at the first election, unless at such time he shall be a duly qualified member of the said existing Canadian Society of Civil Engineers; and no person shall be eligible for election to the Council, or qualified to fill any vacancy therein, or to vote for any member thereof at any subsequent election unless duly qualified under the provisions of this Act and the By-laws of the Society.

11. In the case of the death or resignation of any members of the Council, the other members of the Council shall have power to fill all vacancies so caused until the time of the holding of the next annual meeting.

12. Meetings of the Society and Council shall be held at such times and places as may be fixed by by-law of the Society, and at all meetings of the Society or Council the President or Chairman for the time being shall have a casting vote.

13. The Council shall have full power to enact by-laws for:

(a.) The qualification, election and registration of members of the Society.

(b.) The appointment and removal and defining the functions and duties of all officers and servants of the Society, and their remuneration, the time and place of holding meetings of the Society and Council, and the notice to be given therefor.

(c.) The calling of all meetings, the quorum and the procedure in all things at such meetings.

(d.) The suspension, expulsion, disciplining and readmission of members.

(e.) The appointment of examiners for the purpose of ascertaining and reporting upon the qualifications of persons who shall present themselves for admission and enrolment as students at any examination.

(f.) The admission and regulation of students, the periods and conditions of study, and all matters relating to the discipline and honor of the profession.

(g.) The regulating and fixing of the admission and annual fees payable by members and students. And to deal with and regulate all other matters necessary for the government of the Society, and to effectually carry out its objects, and generally to administer the affairs of the Society.

14. The Council may from time to time repeal, amend and re-enact the by-laws of the Society; but every such by-law and every repeal, amendment and re-enactment thereof, unless in the meantime confirmed at a General Meeting of the Society, duly called for that purpose, shall only have force until the next Annual Meeting of the Society, and in default of confirmation thereat, shall, at and from that time only, cease to have force, and in that case no new by-law to the same or like effect shall have any force until confirmation at a General Meeting of the Society.

15. The Council shall cause to be kept by an officer appointed by it, to be called the Registrar, a book or register, in which shall be entered the name of every person registered as a member of the Society, according to the provisions of this Act, and those persons only whose names are inscribed in the book or register above mentioned shall be deemed to be members of the Society, and such book or register shall at all reasonable times be open for inspection by any member of the Society of by any other person.

16. If the Registrar shall wilfully make or cause to be made any falsification in any matter relating to the register, or shall refuse to allow the register to be inspected, he shall be deemed to be guilty of a misdemeanor, and shall on conviction thereof be imprisoned for any term not exceeding twelve months.

17. On and after the 1st day of July, 1896, no person shall be entitled within this Province to take or use the name and title of "Civil Engineer" or any abbreviation thereof, either alone or in combination with any other word or words, or any name, title or description implying that he is a member of the said Society of Civil Engineers, or act as Engineer in laying out, advising on, constructing or superintending the construction of any railway or public work, or any work upon which public money is expended, the cost of which shall exceed $500, unless such person is a member of the Society hereby incorporated and registered as such under the provisions of this Act, or unless he is a duly qualified Civil Engineer, and entitled to use the title of Civil Engineer by virtue of some statute in force in this Province, or by the authority of some institution of learning in this Province having authority to confer degrees in Civil Engineering, or unless he has been practising as a Civil Engineer in this Province at the time of the passing of this Act, or unless he is a member in good standing of some institution of Civil Engineers in Great Britain and Ireland, or of some National Society of Civil Engineers of good standing in any foreign country.

18. This Act shall be deemed a Public Act.

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THE PUBLIC AND PRIVATE DEBT OF THE UNITED STATES.

Among the publications of the Department of Labor at Washington is a bi-monthly "Bulletin," containing current facts relating to the condition of labor in this and in other countries, and other information deemed of value to the industrial interests of the United States. It is edited by Labor Commissioner Carroll D. Wright and by his Chief Clerk, Mr. Oren W. Weaver.

A recent number of this bulletin treats of the public and private debt of the United States; a subject that is being discussed a good deal of late. The compiler of the bulletin explains by way of preface that it is practically impossible to show the private debts of the people, and even if it could be ascertained the result would be meaningless. A man may owe a large sum and yet have no burden of debt if an equal sum of money is owed to him. What is of interest is to know the debt that must be paid, not by payments of other debtors, but by the fruits of industry and economy. The following statistics, therefore, show these debts, which are offset little, if any, by credits. All except 12.14% of the items used are taken from the census returns of 1890 and are supposed to represent the minimum debt at that time.

Somewhat condensed from the tables given the statement stands as follows:

Steam railways, funded and unfunded debt.		$5,669,431,114
Street railways, funded and unfunded debt.		*182,240,754
Quasi public corporations:		
Telephone companies	$4,992,565	
Telegraph companies	20,000,000	
Public water companies,**	80,127,489	
Gas companies	75,000,000	
Electric light and power	45,000,000	
Transportation companies, not otherwise specified, canals, turnpikes, bridges, etc.	114,208,078	
		348,328,132
Total		$6,200,000,000
Real estate mortgages		$6,019,679,985
Crop liens (estimated)		650,000,000
National banks, loans and overdrafts		1,904,167,351
Other banks, loans and overdrafts		1,172,918,415
National, State and local taxes		1,040,473,013
Other private debts (estimated)		1,212,761,236
Aggregate private debt		$18,200,000,000
Public debt, less sinking fund:		
United States	$891,960,104	
States	228,997,389	
Counties	145,048,045	
Municipalities	724,463,060	
School districts	36,701,948	
		2,027,170,546
Aggregate private and public debt		$20,227,170,546

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*By table published in our issue of July 6, this item is now about $600,000,000.

**Not owned by cities.

In the above the debts of individuals and private corporations amount to 59.33% of the total, and quasi-public corporations form 30.65%. The real estate mortgage debt alone is 29.76% of the total, and the railway companies follow with 28.03%. The public debt of the United States forms 4.41% of the total as compared with 3.58% for municipalities. The author places the wealth of the United States, in 1890, at $65,037,091,197; so that the total private and public debt represents 31.10% of the total wealth of the country. The per capita private debt, in 1890, was $291, and public debt $32, an aggregate of $323, or $15.94 per family of 4.93 persons. The real estate mortgage debt is $6,019,679,985; while the estimated value of taxed real estate and untaxed mines was $36,025,071,490.

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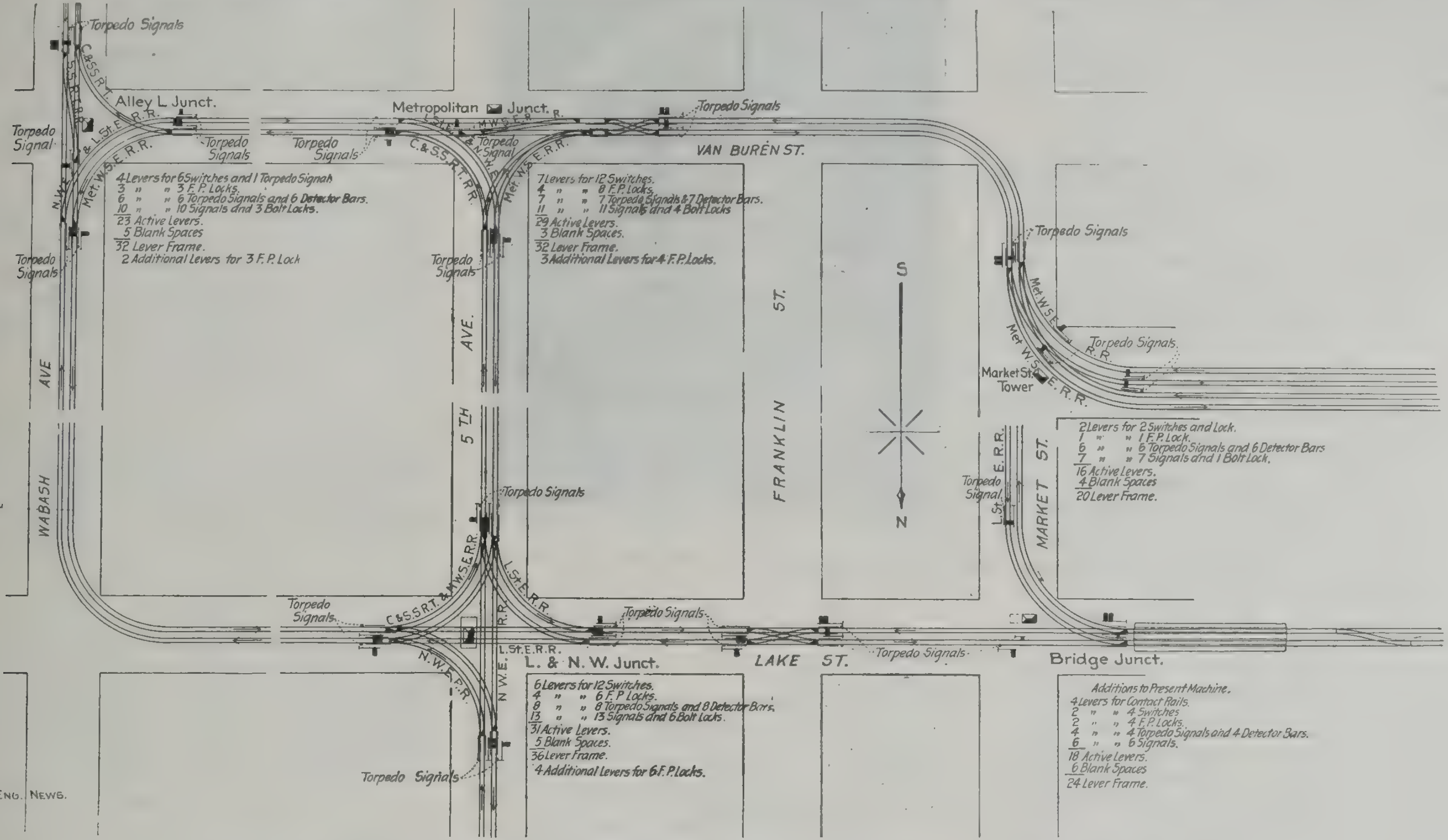
SIGNAL AND INTERLOCKING PLANT FOR A LOOP TERMINAL AT CHICAGO; UNION ELEVATED RAILWAY.

The city of Chicago has now a number of elevated railways extending in all directions from the central part of the city, and work is now in progress on a loop terminal system which will connect the several lines, and enable them to land passengers in the heart of the business district, as described and illustrated in our issue of July 16. This line is being built by the Union Elevated Ry. Co., which has been formed by representatives of the Chicago & South Side Elevated Ry. Co. (Alley Line), the Metropolitan West Side Elevated Ry. Co., the Lake Street Elevated Ry. Co., and the North Side Elevated Ry. Co. The first three lines are in operation, and the fourth is preparing to build a line northward from Lake St. This loop line will be a double-track line, with junctions at Wabash Ave. and Van Buren St., Fifth Ave. and Van Buren St., and Lake and Van Buren Sts., together with the necessary connecting tracks, crossovers, etc. In addition to these three junctions, the four-track line of the Metropolitan Elevated Ry., which now ends at Franklin St., will be changed so as to carry traffic south on Market St. to Van Buren St., and the present interlocking plant at Bridge Junction will be enlarged so as to operate the double crossover at Franklin and Lake Sts. These junctions are indicated in the accompanying plan, which also shows the location of all switches and signals.

The volume of traffic which will be put upon the loop line will, it is said, probably exceed that of any railway now operated. The number of trains now on the three railways in operation is not less than 1,000 per day, and with the addition of trains from the North Side railway this traffic will probably not be less than 1,500 trains per day. On the three lines now in operation the trains are run on the right hand track, and in order that the traffic may be divided on the loop it has been decided to operate this loop left handed, the outer track being used by the North Side and the Lake St. lines, and the inner track by the Metropolitan and South Side lines. By following the current of traffic on the several lines, as indicated by the arrows on the plan, it will be seen that the crossings at the several points will necessitate the installation of a very complete system of signaling and interlocking in order that the maximum of safety may be secured with the minimum of delay in the manipulation of traffic.

All switches will be considered as facing point switches and will be equipped accordingly, and since it is not feasible on an elevated structure to provide any physical protection in the shape of a derail or scotch block, the torpedo machine will be installed and operated in the same manner as a derail and each signal will be operated in conjunction with this torpedo signal, all torpedo signals having separate levers, and connections from them operating the signal. The introduction of this audible signal will undoubtedly prove of great value in the operation of traffic over this complicated system of tracks, as it gives immediate notice not only to the engineman but to all train hands when the first pair of wheels has passed a home signal set at danger. Each torpedo machine is equipped with a certain number of detonators, and since the operator in charge of the plant is required to keep a complete record of the detonators delivered to him it is not likely that he will allow an engineman to pass a signal at danger and explode a detonator without making a full report to the proper officer. At the same time, as the engineman knows that such a report will be filed against him for disobeyance of signals, he will not be likely to pass a signal at danger.



SIGNAL AND INTERLOCKING PLANT FOR THE LOOP TERMINAL OF THE UNION ELEVATED RY. CO., CHICAGO.
National Switch & Signal Co., Easton, Pa., Engineers and Contractors.

The machine at Fifth Ave. and Lake St. will be located in a tower spanning the tracks and will have 40 levers; the machine at Wabash and Van Buren Sts. will be placed in a tower on the deck of the bridge and will contain 32 levers; the machine at Van Buren St. and Fifth Ave. will be located in a tower south of the south track and will contain 36 levers; the machine at Market and Franklin Sts. will be located in a tower between the lines of Franklin St. and will contain 20 levers; the additions to the present plant at Bridge Junction will involve 24 levers. All the signal towers will be of fireproof construction, and completely equipped with modern plumbing, heating and telephone connections. The machines will be carried on steel frames.

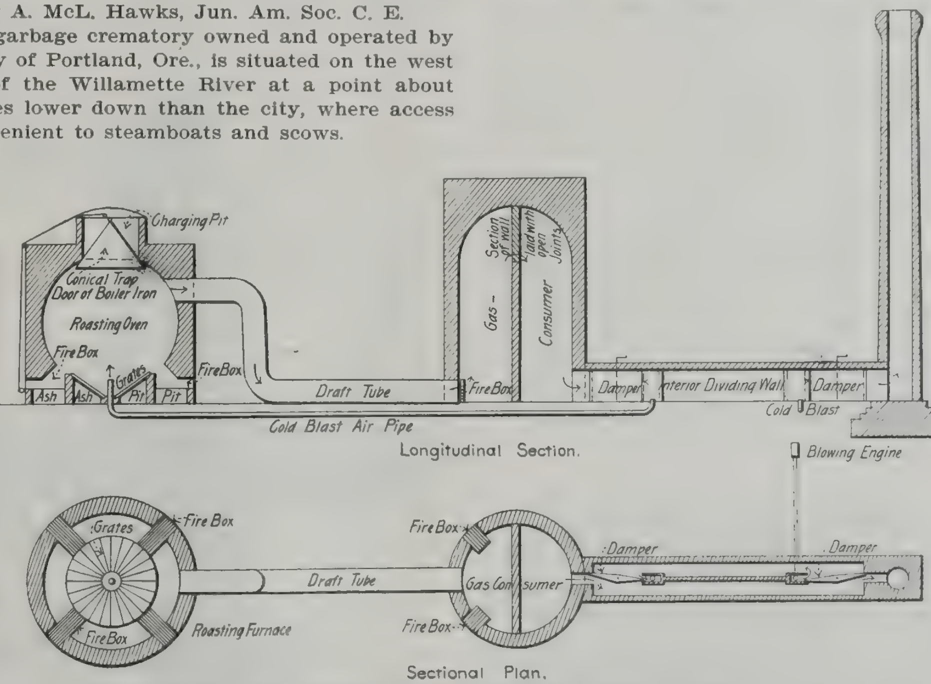
The operation of traffic around the loop will be entirely in the hands of the Union Elevated Ry., and as soon as a train from either of the four lines operated on the loop enters the limits of interlocking all trainmen will be under the orders of the officers of the loop. It is expected that work will be commenced at once at Bridge Junction and Van Buren St. and Fifth Ave., and be pushed to completion as soon as the structure is built on Van Buren St. The motive power to be used on the loop will be electricity, operated in the same way as on the Metropolitan West Side Ry., there being a third rail carrying the current which is supplied to the motor through a contact shoe which runs on this rail.

The contract for planning the entire system, and for designing and installing all the work, has been given to the National Switch & Signal Co., of Easton, Pa.; and the company was instructed by Mr. D. H. Louderbach, General Manager of the Union Elevated Ry., to present the most complete plans necessary for the safe and convenient handling of the traffic, without regard to cost of installation.

THE GARBAGE CREMATORY AT PORTLAND, ORE.*

By A. McL. Hawks, Jun. Am. Soc. C. E.

The garbage crematory owned and operated by the city of Portland, Ore., is situated on the west bank of the Willamette River at a point about 15 miles lower down than the city, where access is convenient to steamboats and scows.



SKETCH PLAN AND SECTION OF GARBAGE CREMATORY AT PORTLAND, ORE.

The building is a shed-like structure covering the furnaces, which are shown by the accompanying sketch, with a square stack 70 ft. high at the rear. The wharf, or landing, is two stories high, the lower story at the level of the furnaces and the upper at the level of the top of the main or roasting furnace.

The plant consists of a brick roasting furnace, circular in form, the oven of which is nearly the shape of a perfect sphere. At the four quadrants are fire-boxes penetrating to the oven. At the top is a large circular opening leading down to the oven; and to close this aperture is a conical bell of boiler iron hung by a chain over a pulley. At the bottom is a tuyere whereby a strong blast is brought into the oven at a point directly below the opening and between the four fire-boxes. On the side of the oven, well up towards the opening, is a 4-ft. circular draft tube of steel leading to the second or "gas consuming" furnace.

This secondary furnace is also of brick and circular in form, and is of a little greater height than the first or roasting furnace. The interior is cylindrical with a hemispherical dome at the top, and is divided in halves by a brick wall, the part included in the dome being laid with joints open very wide. On the side of the partition wall nearest the roasting furnace are two auxiliary fireboxes, one on each side of the draft tube for the purpose of assisting in burning the gases as they come over from the roaster. Later on the upper part of the partition wall was entirely removed, as it hindered the draft almost to the point of entirely stopping it.

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*Information collected by Mr. Hawks for Mr. Rudolph Hering, M. Am. Soc. C. E., and published with the consent of Mr. Hering.

From the secondary furnace, or gas consumer, a long chamber leads to the stack, divided by a fire brick partition wall and dampers so the draft may be turned to either side of the chamber.

There is a small blowing engine for the purpose of furnishing a forced draft to the roasting oven.

The plant was constructed in March, 1894. The first change made was in the conical bell trapdoor of the roaster. Subjected to the great heat of the roasting oven, with the draft from the blast directly against it, it soon overheated and warped badly. It was replaced with a heavier one having a cast rim at the lower edge, which seems to stand well.

The next change was the removal of the upper part of the partition wall in the gas consumer. Although the joints had been laid dry and very wide open, the soot and grease soon began to collect in the narrow crevices, hindering the draft to such an extent that finally the capacity of the furnace fell below the requirements, and the top of the wall was taken down. Before that time the plant had been entirely successful in the attainment of the objects sought. No odor from the furnace could be detected at that time.

When I visited the plant recently, it was in full operation. The garbage is dumped at the dock in Portland into boxes about the size and shape of the body of a large dump cart. These boxes are taken, on a scow, to the wharf of the crematory, where they are hoisted to the upper landing directly beside the charging pit. At intervals determined by the condition of the furnace, this pit is filled and then the bell is lowered, permitting the load to slide off evenly distributed all over the oven. The size of the charging pit is great enough to permit whole animals to be passed through.

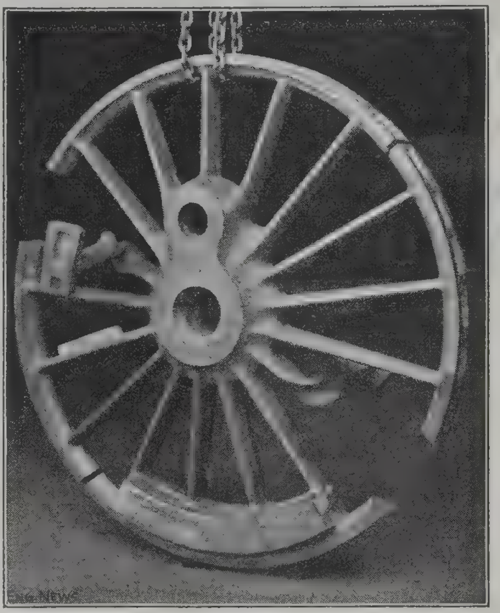
On the leeward side of the furnace there was a distinct odor which could be observed over a fan-like area having the stack for a centre and being 200 to 300 ft. wide at a distance of 500 or 600 ft. Beyond that distance it was so faint that it could not be determined. On breezy days it is said to be observable at 1,000 ft. distant. As the crematory is removed from any settlement, and no houses are near, there has been no complaint. The fires in the furnaces are continuous and the plant consumed 35 tons of garbage per day, using two to three cords of wood in the fire-boxes for aiding in the cremation. Five men are employed.

The ash from the roasting oven is perfectly odorless and inert. It can be sold as a fertilizer, bringing $10 per ton. The garbage is not sorted, so this is the only source of revenue. No account has been kept whereby the reduction of weights can be ascertained; the opinion seems to be that it takes about ten tons of garbage to make one of ash. The odor from the stack in its present operation is not exceedingly offensive, somewhat resembling cooking ham. If the city makes no other change it is probable that the partition wall will be again built up in a modified form.

A CAST-STEEL DRIVING WHEEL CENTER.

It is not so very long ago that cast iron was deemed a good enough material for driving wheel centers. The last dozen years, however, have brought increased train speeds, greater loads per wheel, more powerful locomotives, and driving wheels of larger diameter. Under these conditions it is found that the best metal available is none too good for driving wheel centers, and the best quality of cast steel is now extensively used for this purpose.

The accompanying cut shows what remarkably tough and ductile material is now obtainable in cast steel, and also that the steel founder does not hesitate nowadays to undertake castings of complicated form. The casting shown is a driving wheel center 72 ins. in diameter for a 78-in. driving wheel. The axle is 8½ ins. in diameter and the crank-pin is 5½ ins.. The total weight of the casting is 2,795 lbs., which is, we understand, about 500 to 700 lbs. less than the weights of cast-iron centers of the same diameter.



Cast-Steel Driving Wheel Center for 78-in. Wheel. Made by the American Steel Casting Co., Thurlow, Pa.

The casting was made from open-hearth steel with the following physical characteristics:

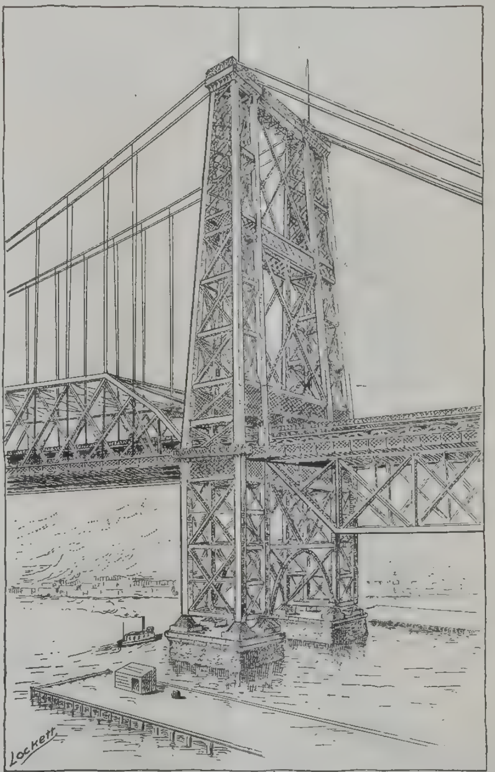
Ultimate tensile strength, 68,500 lbs.
Elongation, 28.50%.
Reduction of area, 47%.

It was cast by the American Steel Casting Co., of Thurlow, Pa., and the managers of that company inform us that about 2,500 to 3,000 wheels equipped with these centers are in service and are giving entire satisfaction.

The casting from which our photograph is taken was exhibited at the recent Saratoga convention of the Master Mechanics' Association.

THE TOWERS FOR THE NEW EAST RIVER BRIDGE.

As the result of some criticism upon the general design of the New East River Bridge, from an aesthetical point of view, and of an effort to associate a competent architect with the civil engineer in this design, Chief Engineer L. L. Buck submits the accompanying perspective view of the tower as designed by him.



Perspective View of Towers Designed for the New East River Bridge.

From a purely structural standpoint this design doubtless answers every requirement; and in criticising the design the elements of mass and height must not be neglected. We are utterly opposed to false ornamentation in similar structures and to any attempt to disguise the real materials of construction or the chief lines of stress. But in a monumental work of this character, in the center of a great city, good taste in design and proper ornamentation must be considered; and if a more pleasing effect can be secured without sacrificing the elements above referred to, the effort should certainly be made and is worth the added cost.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

When Municipal Consent is Necessary for Operation of City Railway

Municipal consent is requisite to enable any railroad company, whether incorporated by special act of assembly or under general railway laws of a state, to enter upon and occupy the public highway of the city, unless its charter contains authority for same in express terms or by necessary implication.—Philadelphia v. River Front Ry. Co. (Supr. Ct. of Penn.) 34 At. Rep., 60.

Injunction Against Water Company.

Where the water furnished by a water company, incorporated under the laws of Pennsylvania, for the use of the inhabitants of a town in that state, is utterly unfit for domestic use, or use by domestic animals, and is so destructive to pipes and boiler flues as to be unsafe for steam purposes, it is proper to enjoin such company from collecting water rents for other purposes than for extinguishing fires and flushing sewers.—Brymer v. Butler Water Co. (Supr. Ct. of Penn.), 33 At. Rep., 707.

City Liable for Damage to Property in Grading Streets.

Under a constitutional provision that no person's property shall be taken, "damaged" or destroyed for or applied to a public use without adequate compensation being made, where a city in grading streets, leaves large and dangerous holes in the streets, and also in the abutting lots, it is liable to the owners of such lots for damages, if any, to the lots; and the measure of damages is the market value of the lots immediately before and immediately after the excavations were made.—San Antonio v. Mullaly (Ct. Civ. App. of Tex.), 33 S. W. Rep., 256.

Forfeiture of Charter of Water Companies.

The failure of a water company to elect directors or officers, or to hold any meetings, or to perform any corporate act, for many years, and an attempt to sell and surrender all its property to another corporation, is a wilful violation of corporate duties, entitling the state to demand a forfeiture of its charter. The fact that another company is furnishing the people with water, as the pretended successor to such company, will not deprive the state of the right to demand a forfeiture.—City Water Co. v. State (Ct. Civ. App. of Tex.), 33 S. W. Rep., 250.

Street Railway Liable for Entire Street Paving.

The charter of a street-car company provided that it should be compelled to keep in constant repair that portion of the street which it uses and occupies and be subject to such ordinances of the city council as relate thereto; and the city ordinances provided that all street car companies should be at the entire cost and expense of maintaining, paving and repairing that may be necessary on any street occupied by them. The Supreme Court of Pennsylvania held that such company was bound to keep in repair not only the portion of the street occupied by them, but the whole street from curb to curb.—Philadelphia v. Passenger Ry. Co., 33 At. Rep., 126.

Liability of Director of Mining Corporation.

The law of California declares it the duty of the mine superintendent to file weekly and monthly accounts and reports, verified under oath, showing receipts, disbursements, number of employees, and wages paid, reports to be kept in the office of the company, open to inspection of the stockholders. It further provides that in case of the failure of the directors to have the reports and accounts made and posted as provided, an action shall be liable by any stockholder, who, on proof of the failure, shall recover judgment for $1,000 liquidated damages. The Supreme Court of that state held that, the statute being remedial, and there being no ambiguity in it, recovery could be had of the directors for failure to have the accounts and reports of the superintendent verified by him, though they were full, true and correct, and there was no one within many miles of the mine who could administer oaths, and the directors acted in good faith, and had been advised by counsel that it was not necessary to have them verified. Under such statute, it is not necessary to prove damages. They will be implied from its violation.—Shanklin v. Gray, 43 Pac. Rep., 399.

Elevated Railways and Damages to Abutting Property.

The New York Court of Appeals recently said: The elevated railroad companies are entitled to receive from the courts ample protection in view of the numerous actions they are called upon to defend, and the vast amounts involved in their determination, and judgments against them ought not to be upheld resting upon mere speculation unsupported by evidence; but, on the other hand, parties whose property may have experienced a small advance in fee and rental values since the completion of the elevated road ought not to be remediless when all the facts render it clear that property along the line of such road has been damaged by the interference with the easements of light, air and access, and has for that reason failed to share the advance in values of adjacent property, manifestly due not only to the construction of the elevated system, but to that natural growth which the neighborhood would have experienced by reason of the increase of population and business in a great city, even if the railroad had never been constructed.—Malcolm v. New York El. Ry. Co., 41 N. E. Rep., 793.

Payments to Contractors for Public Buildings.

Where the legislature required that a contract for the erection of a public building should be let to the lowest bidder, but limited the cost, and the contract was let to one who bid less than the amount of appropriation, but afterwards contracted with the commissioners having charge to make some alterations for which he was to look to the state for the additional cost, the difference between the sum bid and the amount of the appropriation cannot be recovered, as such additional contract was not binding on the state, because not let in manner prescribed by law. —Nichols v. State (Ct. Civ. App. of Tex.) 32 S. W. Rep., 452.

Admissibility of Record of Surveys.

The record of a survey by a county surveyor in subdividing a section which neither shows for whom the survey was made, nor the variation of the magnetic needle from the true meridian, as required by the laws of Michigan, and which does not purport to fix definitely the center of the section, is not admissible in evidence.

And though the laws of that state provide that the certificate of the county surveyor of any survey made by him shall be presumptive evidence of the facts therein stated, yet when other surveys made by competent surveyors are introduced in evidence the survey of the county surveyor is of no more binding force than the others.—Van Der Groef v. Jones (Supr. Ct. of Mich.) 65 N. W. Rep., 602.

Civil Engineer Has a Lien.

A civil engineer who makes field notes, maps, charts and drawings, while employed by a corporation in and about the construction of an irrigating canal, on books and papers furnished by the corporation, is entitled to a lien on such field notes, maps, charts and drawings, and has a right to retain possession of the same until he is paid for making them. It does not make any difference whether he was employed by the day or the month, or whether he was employed to make the field notes, etc. —Amazon Irrigating Co. v. Briesen, 41 Pac. Rep., 1119.

Appliances on Electric Street Railways.

An electric street railway is not required to have in use the latest improvements which have been devised to prevent collision with vehicles and pedestrians, but only to use reasonable care to avail itself of new inventions and improvements known to it.—Richmond Ry. & Elec. Co. v. Gartright (Sup. Ct. App. of Va.) 24 S. E. Rep., 267.

Recovery of Excessive Charge from Gas Company.

Where an ordinance provides that a gas company shall not charge consumers more than a certain rate, payment by a private consumer of a charge in excess of such rate may be recovered, though no right of action in his favor is given by the ordinance.—Pingree v. Mutual Gas Co. (Supr. Ct. of Mich.) N. W. Rep., 61.

Construction Company Liable for Neglect of Foreman.

Whenever the nature and magnitude of an undertaking, whether it be of construction or otherwise, are such that it is necessary that orders be given regulating the conduct of employees, and directing them where to work, it is not only the right, but the absolute duty of the employer of such men to give the orders; and in obeying such orders the employees have a right to assume that he has exercised due care for their safety; and where the orders are given by a foreman, who has authority to employ and discharge such men, the foreman is a vice principal, and the employer himself is liable for the negligence of the foreman.—Carlson v. N. W. Tel. Exch. Co. (Supr. Ct. of Minn.), 65 N. W. Rep., 915.

Injunction Will Not Lie Against Sewer Construction.

Where a village constructs a sewer that empties the village sewage into a natural water course outside of the village limits, the owner of the lands across which such water course runs cannot enjoin the construction and use of such drain, unless it is proved to be a nuisance. The dismissal of such a bill should be without prejudice, as the sewer may become a nuisance afterwards.—Robb v. Village of La Grange (Supr. Ct. of Ill.) 42 N. E. Rep., 77.

Railway Ownership of Surveyed Routes.

The Supreme Court of the United States holds that a company which surveys a line over public lands beyond the termini fixed by its charter, and afterwards files supplemental articles of incorporation authorizing an extension covering the survey, acquires no right of way beyond such termini, under the laws of the United States, as against another company which, having full powers, makes a survey over the same land after the other company's survey, but before the filing of its supplemental articles.—Washington & I. Ry. Co. v. Coeur D'Alene Ry. & Nav. Co., 16 U. S. Rep., 232.

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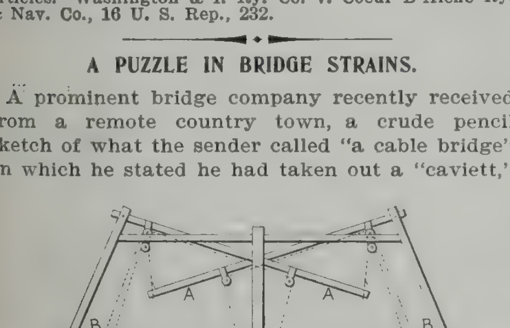
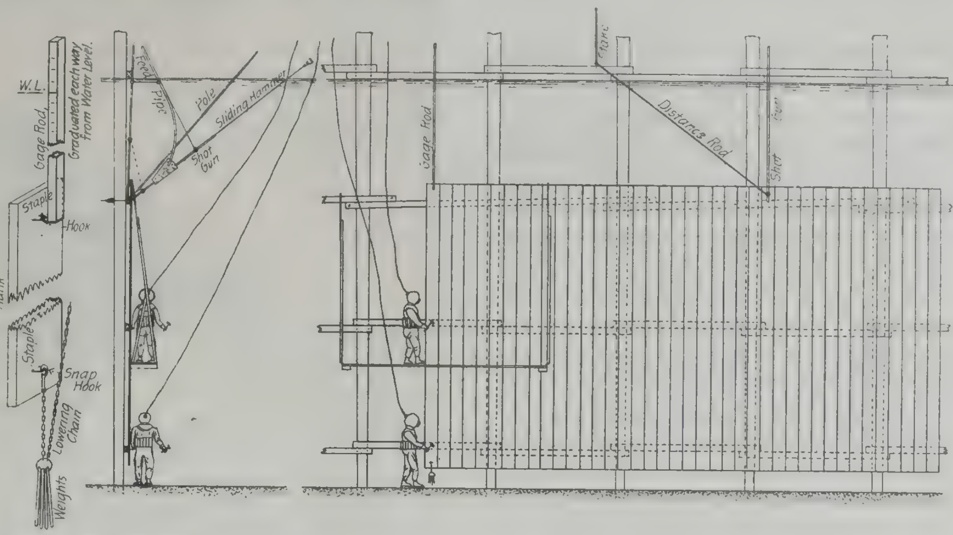
A PUZZLE IN BRIDGE STRAINS.

A prominent bridge company recently received from a remote country town, a crude pencil sketch of what the sender called "a cable bridge" on which he stated he had taken out a "caviett," and was desirous of selling his rights. The pencil sketch has come into our hands, and it is so curious an affair that we have thought it worth while to resketch it, so as to put it into a shape that may be understood, and submit it to our readers. The task of computing the strains in the various members of this funicular absurdity may prove an agreeable pastime to while away an hour in some of these hot summer days. The only legends attached to the sketch to aid in understanding the construction are one to the effect that "butman (abutment!) lever B works on pivot" and lever A "lifts and distributes strain." We are indebted to Mr. Geo. E. Gifford, M. Am. Soc. C. E., for the original sketch, from which our own is prepared.



"A Cable Bridge."



Cross Section. Side Elevation.

FIG. 1.—METHOD OF ATTACHING PLANKING TO STRINGERS IN CONSTRUCTING UNDER WATER MOLDS FOR CONCRETE WALLS OF HERR ISLAND DAM.

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THE FOUNDATIONS OF THE HERR ISLAND LOCK AND DAM, NEAR PITTSBURG, PA.

In the Annual Report of the Chief of Engineers, for 1895, Major R. L. Hoxie, Corps of Engineers, U. S. A., describes the preliminary work for the foundation of the movable dam at Herr Island, near Pittsburg, Pa. This dam is to be a part of a system of slackwater navigation on the Allegheny River, and is also intended to enlarge the harbor room at Pittsburg by forming a pool. The dam is to be of the movable type, and the estimated cost, on the plans approved July 10, 1894, is $600,000.

It was originally planned to enclose the side of the lock and dam within a coffer dam, and work was commenced upon that basis. But on attempting to pump out the enclosure it was found that water came in in large quantities, not only under the dam, but from springs in the bottom, and all attempts to close these by dumping clay and gravel were a failure. The area enclosed by the dam was about 600 by 200 ft., or about three acres of river bottom. The deposit of sand and gravel overlying the rock was about 35 ft. thick, the rock being 45 ft. below the water level, while the plans required an excavation 20 ft. deep below this water surface. The bottom deposit had been worked over for years by sand-diggers who threw back the large stones and coarse gravel after removing the fine sand; this work resulting in a very permeable bottom, with possible channels of comparatively large dimensions extending to unknown distances beyond the limits of the coffer dam.

Under these conditions Major Hoxie deemed the further trial of a coffer dam impracticable, and concluded that the foundation must be laid under water. He now proposed to dredge out the site of the lock to a point 30 ft. below the pool level, and to then drive piles and to these attach plank formers for confining a thick bed of concrete deposited under water and covering the entire area. Upon this concrete foundation walls of the same material would be built up until the weight of these walls and the redeposited sand and gravel between them would be sufficient to balance the head of water to be dealt with in completing the work from this point within coffer dams. All rupturing strains on the floor of the pumped-out lock-chamber would be met by the thickness given to the concrete bed.

This modified plan was approved on Sept. 6, 1894, and a contract for dredging was awarded to the Drake & Stratton Co., of Pittsburg, Pa. At the date of the report, June 30, 1895, the dredging was completed, the encircling piles were driven and divers were putting the concrete forms in place. In connection with this latter work, various somewhat novel appliances were used, and these are here described and illustrated, as taken from the report of Mr. J. W. Arras, one of the assistant engineers in immediate charge:

The piles were 40 ft. long and driven in 30 ft. of water; they were weighted at the lower end and hung from a staple in the upper end from the leads of the pile-driver; then lowered, accurately fixed in position by intersecting transit lines and driven, with 2 ft. of each pile extending above the surface after driving. They were afterwards spaced and approximately aligned by spiking temporary wale pieces upon them at the water surface. The bottom stringers, each 4 × 6 ins., and 12 ft. long, were attached to the inside of the piles by three 9-in. spikes in each pile; the upper stringer was in two pieces, one inside and the other outside, each piece 4 × 6 ins., and 20 ft. long, with the 6-in. dimensions horizontal, and they were bolted together with three ¾-in. iron bolts. These top stringers were framed together at the surface of the water, then lowered to position and the nuts on the bolts were finally tightened up by divers working from a platform suspended from the divers' boat. Each pair of stringers covered three piles, and the series overlapped one another at each third pile. A middle stringer was then put in place by divers working from a platform swung from the top stringers.

The 2 × 12-in. hemlock planks were placed vertically. Each plank, 20 ft. long, was put in position by divers, one stationed at the bottom and the other at the middle stringer. Workmen in a boat lowered each plank, with a gage-rod attached to its upper end weighted at the bottom, as shown in Fig. 1. When at the proper height the two divers nailed the plank to the two stringers, and the upper end of the plank, at a point 9 ft. below the surface, was nailed by means of a "shot-gun," which consisted of a hollow tube and sliding hammer, attached to a spike-pole for holding it in position. The spikes were fed down a second pipe when the hammer was partially withdrawn.

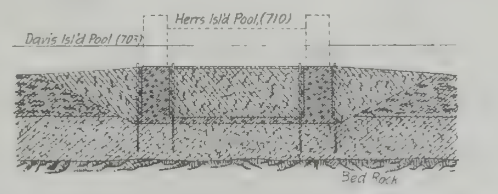

Fig. 2.—Concrete Foundation for Locks at Herr's Island Dam Completed and Ready for Supplemental Coffer Dam.

In this manner two parallel sets of piles and planking were placed in positions, at a sufficient distance apart to contain within them the concrete foundations for the lock-walls. The floor between these walls being first concreted, as shown in Fig. 2, and when the walls are carried up to a certain height the space between them and the outside of the foundations will be weighted with sand and gravel. Upon this filling coffer dams will be built and the remaining part of the lock-walls will be constructed within this dam.

EFFECT OF ENGINEERING WORKS ON WATER CURRENTS.

At a late meeting of the Canadian Society of Civil Engineers, Mr. Cyrus Carroll, C. E., read a paper upon the above subject, citing examples and cautioning engineers against designing structures without a previous careful study of existing conditions of water currents and prevailing winds.

As showing the effect of combined wind and current action he submitted maps of the several typical river-mouths here reproduced; and said that these maps fairly illustrate the existing conditions at the mouths of the Rivers Saugeen, North Sables, Penetangore, Pine, Maitland, Bayfield and nearly a dozen others named. These maps show sand-bars formed across the ends of the valley, as the result of opposing currents of river and lake meeting, sometimes fairly and squarely, but generally at an angle. These opposing currents join and form a new direction of current with an angle determined by their relative forces.

The sand-bar begins at the windward side of the valley and in time extends across it, crowding the river towards the leeward bank. As a consequence the channel is often narrow and deep when it crosses the bar, and the bar itself grows on the windward side by lake silt washed against it. The lake bank, below the river, is usually cut away.

Fig. 2 shows the utilization of one of these rivers as a harbor, by building out piers or jetties to deep water. They cannot always be entered in a storm; but vessels can seek the shelter of the lee side of the longer piers. Mr. Carroll strongly advises against attempts to form a new channel through the bar and cites Fig. 3 as an illustration of the effect of such a change in channel.

Lakes Burwell and Smith were once portions of Lake Huron; but in comparatively recent times they were cut off from the greater lake by sand dunes now extending out about four miles from the old shore of Lake Huron. Through these dunes the Aux Sables River reached the lakes by a very circuitous route. When the small lakes were first cut off by the dunes the river flowed northerly, as the dunes were extended in this direction by the action of the lake, and this continued until the nature of the shore at Grand Bend turned the river nearly due west. There the lake current opposed it from the northwest and a bar was formed which gradually forced the river close up along the foot of the sand dunes, and it took a general southwest direction, as shown. Had the river not been interfered with it would probably have reached Kettle Point, where the dunes ceased.

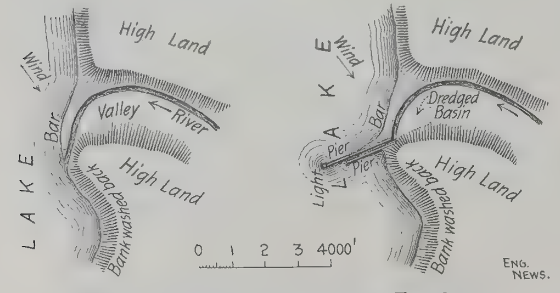

Fig. 1. Fig. 2.

Figs. 1 and 2.—Typical River Outlets on Lake Huron.

In 1872 a contract was let for the excavation of the Burwell Canal, which was intended to act as a drain to reclaim about 16,000 acres of land covered by these lakes. The canal cost about $80,000, and the result was disappointing. Lake Burwell lies about 4 ft. above Lake Huron, and as soon as a trench was made the water rushed out with such force as to excavate a channel about ⅛ mile wide. The great quantity of sand carried down stopped up the old mouth of the river and a new outlet was formed further north. New mouths were being continually formed as the old ones choked up from sand, and each one to the north of that preceding it. The general result was that only 1,000 acres of land was sold as reclaimed, and the regimen of the river was completely destroyed, spoiling it entirely for navigation purposes. Every freshet brings a new lot of sand for the river to work through as it may, and while Lake Burwell is dry in summer, Lake Smith still covers two-thirds of its former area. The old channel, between Grand Bend and Port Franks is filled up for considerable distances, and the lands near Grand Bend are subjected to more floods than ever before.

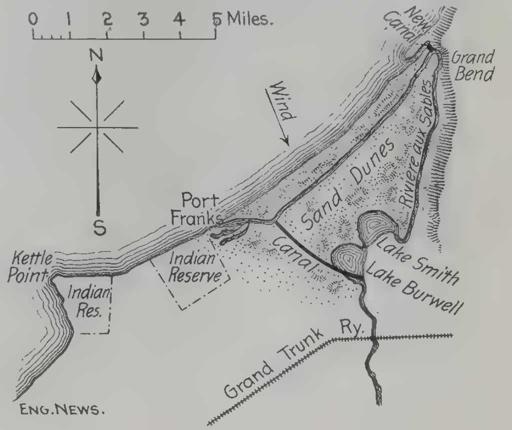

Fig. 3.—An Unwise Attempt at River Regulation.

In 1892 a new channel was cut through the beach at Grand Bend, at a cost of $21,500; but as soon as it was completed a beach began to form across the mouth and is now extending southward again along the base of the old dunes and parallel to the old channel, as shown in Fig. 3.

BOOK REVIEWS.

MODERN METHODS OF SEWAGE DISPOSAL for Towns, Public Institutions and Isolated Houses.—By Geo. E. Waring, Jr., M. Inst. C. E. Second Edition, Revised. New York: D. Van Nostrand Co. London: Sampson Low, Marston & Co. 12mo.; cloth; pp. 253; 22 illustrations; $2.

The first edition of this book was favorably noticed in our issue of Oct. 11, 1894. The only change which we can discover in the present edition is the re-writing of Chap. XIII., "Filtration with Aeration," so as to exclude all reference to other investigations of the subject and deal wholly with the author's experiments along this line at Newport. A footnote to p. 147 states that a report describing these experiments in detail "will be sent, without cost, to readers who desire it, upon application to the author at Newport, R. I.," so, obviously, no one who has the first edition need buy the second on account of the changes noted. The original edition, having been published before the Newport experiments were made, contained no reference to them, but interesting as they are it seems a pity to have sacrificed all the matter relating to other researches on the subject in order to have more space for the Newport studies, especially when the report named is available for all interested in the matter.

ELECTRIC LIGHTING.—A Practical Exposition of the Art, for the Use of Engineers, Students and others interested in the Installation or Operation of Electrical Plants. Vol. I, The Generating Plant. By Francis B. Crocker, E. M., Ph. D., Professor of Electrical Engineering in Columbia University. New York: D. Van Nostrand Co.; London: E. & F. N. Spon. 8vo.; pp. 444. $3.00.

The development of electric lighting until quite recently has been so rapid that any complete treatise on the subject would become out of date while it was being printed. At the present time, however, in the opinion of the author of the work before us, electric lighting has reached a sufficiently perfected and established state to allow of its being treated in a fairly satisfactory and permanent manner. The apparatus and methods employed are almost as well standardized as in other arts. The dynamo is one of the most perfect machines in existence. Arc and incandescent lamps, overhead and underground wires, transformers, and almost all the other parts of electric lighting plants have also become sufficiently stereotyped. The plan adopted in this work is to follow the sequence in which the electric current is generated, transmitted and utilized. The present volume treats of the generation of electric current, including location of plant, buildings, steam boilers and engines; gas, oil and hot-air engines; water-wheels and windmills; direct coupling, belting and shafting; principles, construction and management of dynamos; accumulators, switchboards, electrical measuring apparatus and lightning arresters. The transmission and utilization of the current for lighting purposes, together with descriptions of typical electric lighting plants, are reserved for the second volume. The first two chapters treat very briefly of the advantages of electric lighting and of its history, then follows a short chapter on general units and measures, in which are given the definitions of the "international" volt, ampere, etc., as given in an act of Congress in 1894, and now universally adopted, together with the specifications prescribed by the National Academy of Sciences for the practical determination of the ampere and volt. The present work differs from nearly all other works on electrical subjects in not devoting any space to discusion of the elementary principles of electricity, the reader being recommended to acquire a general knowledge of these principles from other works before undertaking the study of a special branch, such as electric lighting. The location and general arrangement of electric lighting plants, buildings, foundations, etc., are treated in his brief, but well written chapters. A discussion of the possible sources of electrical energy follows, in which the author states that the possibility of generating electricity directly from the combustion of coal more cheaply than by present methods is not encouraging. The hope of a new method by which electricity can be gotten directly from fuel-energy is very indefinite at present. It may be realized in one year, or perhaps not for a hundred, or even a thousand years. The steam-engine, history and general principles, is the heading of a chapter of only six pages. The book might be improved by leaving out this chapter altogether, or by considerably enlarging it and making it more clear to the general reader. We do not see why the formula $p\ v = R\ T$ is given on p. 92, when it is not stated what R means, nor why the differential formulas for isothermal and adiabatic expansion are given on p. 93, when the much more useful, practical formulas for calculating the work done in an engine cylinder are omitted. The chapter on steam-boilers covers 32 pages, and is fairly good. In the table of heating powers of coal, p. 94, bituminous is given as 8,000 centigrade heat units. A more correct statement would be from 5,000 to 7,500 heat units, as there is probably no bituminous coal in this country (semi-bituminous coals excepted) which have a heat value of 8,000 heat units. Writers of text books should make a clear distinction between the semi-bituminous coals, such as Cumberland and Pocahontas, which have a heating value higher than anthracite, and bituminous coals containing 30% and upwards of volatile matter, which have a much lower heating value. The author's statements that the use of a poor quality of coal on account of cheapness is usually bad economy, and that a larger boiler is required with poor coal to produce a given amount of steam, are far from being generally true. A poor quality of coal is often found in some markets to have a price much lower than that due to its quality, and in such cases great economy is often effected by its use. A poor coal usually requires a larger grate surface than a good coal, the use of shaking grates instead of plain grates, or the use of forced instead of natural draft, but not necessarily a larger boiler. The size of boiler required depends upon the amount of water to be evaporated, and not upon the quality of coal. The chapters on steam-engine construction, typical forms, selection, installation and management, on gas, oil and hot-air engines, and on water-wheels and windmills, occupy 100 pages of the book, and contain much information which may be useful to electrical engineers and others interested in electric lighting plants. The chapters on mechanical connections between engines and dynamos, and on toothed, friction and other gearing, are also excellent.

The strictly electrical portion of the work begins on p. 265 with a chapter on principles and construction of dynamos, which occupies 56 pages. In it is condensed a great quantity of useful information, although it is neither sufficiently elementary in its method of treatment to be read with satisfaction by those not already possessed of a considerable knowledge of the subject, nor complete enough to take the place of other treatises. Typical forms of dynamos for electric lighting are described in a brief chapter of 19 pages, which properly includes only the well-known modern forms. The practical management of dynamos occupies another short chapter, the reader being referred to another work for more complete treatment. Two chapters, covering 40 pages, are devoted to accumulators, their principles, construction, management and applications. The treatment of these subjects is quite satisfactory. Three brief chapters on switchboards, including switches, fuses and circuit-breakers, electrical measuring instruments, and lightning arresters, conclude the volume.

On the whole the book is about as satisfactory a one as can be expected, when its necessary limitations of space and price are considered; in other words, the field attempted to be covered is so vast and has such a variety of detail in every part of it that it is scarcely possible to do it justice in the narrow compass of a $3 book of 444 pages. Prof. Crocker has done as well, within the prescribed limitations, as could be done probably by any writer on electrical subjects.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

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THE AWARDS FOR THE MONTREAL BRIDGE PLANS called for by the Montreal Bridge Co., have at last been made. The first prize has been awarded to Mr. E. S. Shaw, of Boston, Mass., and the second prize to Mr. A. L. Bowman, of Roanoke, Va. The awards were made by Mr. Walter Shanley, and he called special attention to a plan submitted by Mr. J. W. Balet, of New York, which, though possessing peculiar merit did not comply with all the conditions of the advertisement, and could not be considered in awarding the prizes. The company has, however, awarded a special prize to Mr. Balet. The call for competitive plans for this bridge were made early in 1895, and the general plan was shown in our issue of Feb. 14, 1895, Mr. C. N. Armstrong, of Montreal, is the Managing Director of the bridge company.

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A TRACK ELEVATION ORDINANCE covering a portion of the lines of the Chicago & Western Indiana and the Pittsburg, Fort Wayne & Chicago railways in Chicago, is benig prepared by the Aldermanic Committee on Track Elevation, and will be submitted to those companies for action at an early date. The elevation will begin at 71st St., and extend north to 22d St. From 47th St. north the tracks of the two companies run side by side, and all work will be done in common. Altogether about 40 subways for crossing streets will be required. This is the latest of several attempts which have been made to secure action on the part of the Chicago & Western Indiana Co., and it is stated that it will be forced if the company does not come to an early voluntary agreement. The policy of this road toward the track elevation movement and the controlling position which it occupies were explained in Engineering News, Jan. 23, 1896. The city authorities are awaiting also the decision of the Supreme Court this fall in regard to the order compelling the Union Stock Yards Co. to tear up its tracks on 40th St. If the city loses in this fight the tracks will be ordered elevated from Halstead St. to the Illinois Central R. R. tracks at once. The Aldermanic Committee has prepared plans for this change which provides that the tracks be elevated 15½ ft. on a steel structure. No street will be closed, but a number of thoroughfares will be slightly depressed, as follows: Lake Ave., 3 ft.; Wentworth Ave., 2 ft.; Bissell St., 3 ft.; Wallace St., 3 ft.; Sherman St., 4 ft.; Union Ave., 6.5 ft. At Emerald Ave. the roadway is raised 2 ft., and at Halstead St. the tracks come down to grade again.

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BIDS FOR A NEW WATER SUPPLY FOR JERSEY City were received on Aug. 24 from the East Jersey Water Co. and the Rockaway & Hudson Water Co. The bids were for constructing new supply works and delivering water to the present distributing reservoirs by the million gallons, with an option of purchase of the works by the city. As was to be expected from the character of the specifications, no formal bids for filtering the present Passaic River supply were received. The bids for the gravity supply are given in the accompanying table, not including those from the East Jersey Water Co. for a supply through one 50,000,000-gallon pipe line, which was not in accordance with the specifications, which called for two or more when the full supply of 50,000,000 should be developed. Although informal, the one bid made for a filtered supply is given as of interest, but it must be remembered that it does not comply with the specifications. The United States Filtering & Purifying Co., of Philadelphia, offered to deliver filtered water to the present reservoirs at $20 for each 1,000,000 gallons up to 20; $23 for each between 20 and 30; $21 for each between 30 and 40; and $18 for each 1,000,000 gallons between 40,000,000 and 50,000,000. It would sell a 30,000,000-gallon plant, with pumps, boilers and conduits, for $1,300,000, and a 50,000,000-gallon plant for 1,918,000.

Bids for a New Water Supply for Jersey City.

Bidder.	Source of supply.	Prices for each 1,000,000 gallons.				Purchase price for works to supply.	
		1 to 20	20 to 30	30 to 40	40 to 50	35,000,000 galls. per day.	50,000,000 galls. per day.
Plan A, gravity to low service, 127 ft. elevation.							
Rockaway & Hudson Water Co........	Rockaway River..	$35.50	$34.50	$33.50	$32.50	$6,050,000	$7,100,000
Plan B, gravity to high service, 210 ft. elevation.							
Rockaway & Hudson Water Co........	Rockaway River..	37.00	36.00	35.00	34.00	6,375,000	7,400,000
East Jersey Water Co................	Rockaway River*.	37.00	38.00	36.00	35.00	7,990,000	7,990,000
East Jersey Water Co................	Rockaway River*.	35.00	36.00	35.00	34.00	6,945,000	6,945,000
Plan C, at least one-third to high, and balance to low service.							
Rockaway & Hudson Water Co........	Rockaway River..	36.50	35.50	34.50	33.50	6,250,000	7,250,000
East Jersey Water Co................	Neennock Lake & Wynockie River	37.00	38.00	37.00	36.00	7,950,000	7,950,000

*From different points of intake.

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THE CAISSON FOR THE INTAKE CRIB of the northwest water supply tunnel at Chicago, Ill., was launched Aug. 19 by Fitzsimons & Connel, the contractors for the submarine section of the tunnel. This caisson is 112 ft. in diameter, with walls 20 ft. high. Altogether 750,000 ft. B. M. of timber and 93 tons of steel and iron will be used in its construction by the time it is ready for sinking. The location of the crib will be three miles from shore and it is expected that the sinking of the caisson and the masonry for the crib will be completed this year. The structure was designed by Mr. John Ericsson, Assistant City Engineer, under the direction of City Engineer L. B. Jackson.

◆

WATER FROM THE HARBOR for increasing the fire protection of Boston has been proposed from time to time. It is reported that the question is now to be investigated by a joint committee of aldermen and councilmen, who will visit a number of cities to study this and other matters related to fire departments. The Boston "Journal" comments editorially on the trip under the heading "Eight to One," or eight politicians and one expert," and asks, "could not eight experts and one politician learn more to the advantage of the Boston Fire Department?"

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THE CONSTRUCTION OF A SANITARY AND DRAINage Canal west from the Calumet district, at South Chicago, Ill., is again rumored. It is stated that the intention is to follow the survey made by the U. S. Engineers, some years ago, which is practically the route of the present "Sny" feeder to the Illinois & Michigan Canal. The cost is estimated at from $10,000,000 to $15,000,000, and the method of procedure will be to organize a sanitary district similar to that organized to construct the Chicago Drainage Canal and raise the money by tax levies and bond issues as provided by the sanitary district law of the state of Illinois. The large land owners in the Calumet district are said to be at the head of the project, and the opinion is expressed that the scheme is simply an attempt to boom land values and will never get beyond the paper stage. Furthermore, it is charged that the assessed valuation of the district cannot possibly provide the necessary money from bonds and taxes at the rates of issue allowed by the state laws.

◆

A COMBINED OUTLET SEWER AND GARBAGE chute has been built at Niagara Falls, N. Y. The sewer is of steel, about 30 ins. in diameter, and 220 ft. long, extending from a 24-in. sewer at Bath Ave., over and down the bluff, which is here nearly 200 ft. high, to the water's edge. The sewage and garbage was formerly discharged over the bank, but the construction of the Gorge Electric Ry., near the water line, made this practice undesirable, to say the least. Mr. W. W. Reed is city engineer of Niagara Falls and gave us the above information. Mr. John Mahar, of Tonawanda, was contractor for the work, which was done last May. Mr. Reed says the new outlet is giving satisfaction.

◆

GAS-ENGINE STREET CARS on the Luehrig system (Eng. News, Jan. 24, 1895) have been put in operation on the new Blackpool, St. Ann's & Lytham Tramway, of England, and are said to be the first cars to be operated by gas in that country. Each car has a two-cylinder Otto gas engine of 15 HP., and reservoirs holding a supply of gas for a run of eight miles. The gas is obtained from the town mains and compressed at the company's station, and the charging is done by means of an india-rubber pipe, occupying but about one minute. The track from Blackpool to St. Anne's is for the most part along a country road, and some rather steep grades are easily mounted, the cars running at a speed of eight miles an hour, though they are said to be capable of running 12 or 14 miles per hour. Each car carries 40 passengers. Cars on this system are in operation at Berlin, Dresden and Dessau, in Germany.

◆

THE HOLLAND SUBMARINE TORPEDO-BOAT, now being built for the U. S. Government at Baltimore, is nearly completed and her builders expect that she will be ready for her trial trip in September next. If she succeeds in meeting the requirements of the contract this boat may work as great a revolution in naval warfare as did the "Monitor."

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment, on Aug. 22, of a westbound freight train, near Horse Plains, Mont., on the Northern Pacific R. R. As the train was passing over a high embankment the bank settled and slid out, throwing the train into the Clark's Fork River. Four trainmen were killed. It is supposed that an underlying quicksand bed caused the accident.——A rear collision of westbound freight trains, at Valencia, Pa., on the Pittsburg & Western Division of the Baltimore & Ohio R. R., Aug. 24, caused the fouling of the eastbound track by wreckage, and the limited express ran into the obstruction, the engine and two cars going over the bank and most of the cars being wrecked. About 20 persons were injured, four being fatally injured.

◆

A BOILER EXPLOSION occurred Aug. 19 on the works of the sewer in Rockland Park, Rochester, N. Y.; one man was fatally injured and several others more or less injured. ——The boiler of the steamer "Manitou," on Clark's Lake, at Jackson, Mich., exploded Aug. 20, but nobody was killed.——A boiler in the car shops of the Pennsylvania R. R., at Pavonia, N. J., exploded Aug. 21, and one man was badly hurt.

◆

A LOCOMOTIVE BOILER EXPLOSION occurred Aug. 16, on the Colorado Midland R. R., at Basalt, Colo. A switch engine was standing at the station when its boiler burst and two men were injured.

◆

AN EXPLOSION OF GUNPOWDER occurred at the works of the Tomnicken Powder Mfg. Co., at Derringer, Pa., Aug. 20, killing one man and injuring three others.

◆

A COLLISION WITH AN ICEBERG on the Atlantic Ocean, Aug. 19, caused the loss of the tramp steamer "Moldava," carrying coal from Cardiff, Wales, to Halifax, Nova Scotia. The ship struck about 4.30 p. m., during a heavy fog, and in a few hours the vessel went down. The crew took to the boats and were picked up by the "Circassia," of the Anchor Line.

◆

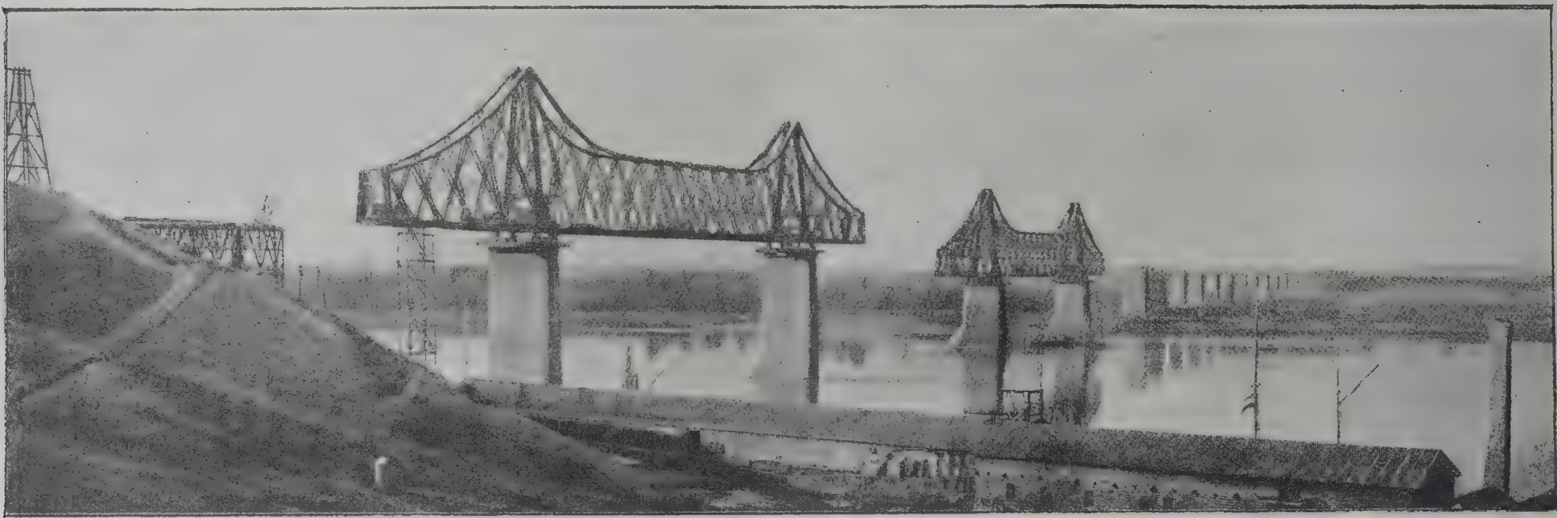
TWO MORE CASES OF RUNAWAY ELECTRIC CARS are reported: On Aug. 22 a car on the Bergen St. line of the Nassau Electric Co., Brooklyn, N. Y., got beyond control on the grade and left the track at the curve at the corner of Bergen and Hoyt Sts., running onto the sidewalk. Four of the eight persons in the car were slightly injured. The motorman said the brakes were out of order.——A car on the new line up the Catoctin Mountain, from Frederick, Md., to Braddock Height, got beyond control while coming down the grade, Aug. 23. The car crossed a high trestle and then jumped the track at a curve and fell over on its side. The car had seats for 45 persons but carried about 120 persons at the time, and about five persons were badly hurt, while some 30 more were cut and bruised. Passengers tried to put on the brakes but it is said they would not work.

◆

THE COLLAPSE OF A NEW FREIGHT SHED being built by the New York, New Haven & Hartford R. R., on Congress St., South Boston, Mass., occurred Aug. 19, by which one man was killed and ten were injured. The building was to be 1,000 × 60 ft., and about 600 ft. of its length had been built, and the wooden roof trusses were being put up at the time of the accident.

THE CERNAVODA BRIDGE OVER THE DANUBE RIVER.

The recent formal opening to traffic of the great bridge over the Danube in Roumania, after 5½ years spent in construction, has recalled the attention of engineers to a work possessing many features of unusual interest. It was in 1890 that the Roumanian government determined to undertake the bridging of the Danube, at Cernavoda, its purpose being to provide a direct route from the interior to the Black Sea. The Fetesti-Cernavoda Ry., whose track crosses the new structure, now gives an almost direct outlet to the ports on the Black Sea, and it is thought that the advantage thus gained will be felt especially in the transportation of agricultural products. At the point on the river where Cernavoda is located, and where it was determined to place the bridge, the Danube is divided into two branches by the island Balta. The river flows in a northerly direction at this point and it is the easterly channel that retains the name of Danube, the westerly being called the Borcea River. The island is swampy, and at certain times is entirely covered with water. It is between seven and eight miles in width. Two bridges are thus necessitated, and on the island a long stretch of embankment with an open viaduct about half way across. The total length of iron structure is about 13,460 ft., or 2.6 miles, this being divided as follows: Cernavoda bridge, 2,460 ft.; approaches to Cernavoda bridge, 3,000 ft.; viaduct on Balta island, 4,770 ft.; Borcea bridge, 1,380 ft.; and approaches to last named, 1,840 ft. The first two mentioned portions may be seen in the accompanying engraving, showing the Danube bridge in course of construction. The piers for the 15 spans of the approach lead away westward to the end of the embankment in the distance.



CANTILEVER BRIDGE OVER THE DANUBE RIVER AT CERNAVODA, AUSTRIA. VIEW SHOWING TWO MAIN SPANS COMPLETED AND THE PIERS SUPPORTING THEM UNDER CONSTRUCTION.

The contract for the construction of the Cernavoda bridge, not including approaches, was awarded to the Societe de Fives-Lille, of France, for $1,570,000. This estimate was based on a rate for the superstructure of $135.40 per ton weight, including erecting and painting. The estimated weight was 5,150 tons; the actual is about 5,500. The construction of the river piers was attended with unusual difficulties. It was required that they be built on bed-rock, and to accomplish this it was necessary to sink the caissons to a depth of 101 ft. below water level. Much difficulty was experienced in working at this great depth, the extreme pressure proving fatal to a number of laborers. The total height of the pier is 207 ft., giving the floor of the bridge an elevation of 121 ft. above high water level. The dimensions of the various portions of the piers and the materials used in their construction are indicated in Fig. 3.

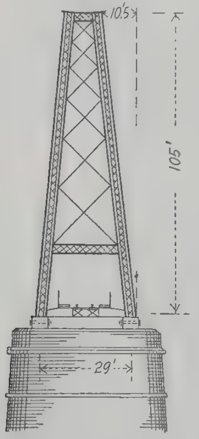


Fig. 2.—End Elevation of Pier, showing Inclination of Trusses.

There are four river piers, each two supporting a span 790 ft. long, consisting of two end cantilevers, each 164 ft. in length, and a central truss construction. The spaces remaining are filled with three 295-ft. truss spans, having half parabolic top chords. An elevation of the bridge, showing length of various parts, is given in Fig. 1. The width of the bridge at the floor level varies from 29 ft. at the piers to 21 ft. at the ends of the cantilevers. These widths are maintained throughout the 467 ft. and the 295 ft. portions. Fig. 2 is the end elevation of the superstructure at a pier. One of the most noticeable features of the construction, the rapid narrowing from bottom to top chords, is here shown. The slope of the trusses is 1 : 10 with the vertical. Basic open hearth steel of a tensile strength of from 59,000 to 68,000 lbs. per sq. in. is used on the main bridge. The elongation at failure in tests of this steel was about 20%, and the elastic limit was about 34,000 lbs. per sq. in. On the approaches a milder grade of steel was used.

The two main spans of the superstructure, as shown in the photograph of the bridge, were erected at the same time with the piers themselves. They were first lifted by trestles to high water level. From that point they were raised by hydraulic jacks on the piers. The jacks were supported on pipes imbedded in the masonry of the piers, there being four pipes in each pier, used in pairs. While one pair was being extended, the other supported the weight on the jacks. In this way ample space for working at the top of the piers was obtained. Fig. 4 shows the floor construction, with the method of imbedding the ties in cement, the whole being underlaid with iron. The bridge is crossed by but a single track.

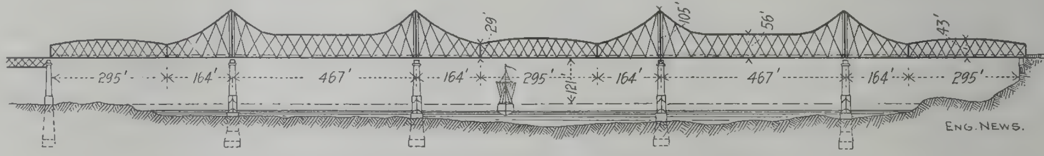


Fig. 1.—ELEVATION OF THE CERNAVODA BRIDGE.

The approaches and viaduct present no features of particular interest, except, perhaps, the solidity and permanency of construction prevailing throughout. The masonry piers are surmounted by trusses of ordinary type. The embankment is built in a substantial manner, with a generous use of rip-rap. The Borcea bridge is similar in appearance to the larger structure. It has but two river piers, which support a 790-ft. span like the central spans of the Cernavoda bridge, and connection to shore is made by two 295-ft. half parabolic spans, as before. The bridge floor is 62 ft. above high water level.

The total cost of the work, including both bridges and all approaches, was, in round numbers, $6,000,000.

STANDARD SPECIFICATIONS FOR STEEL; ASSOCIATION OF AMERICAN STEEL MANUFACTURERS.

The Association of American Steel Manufacturers has recently revised its standard specifications, and we are indebted to Mr. H. H. Campbell, Secretary of the Association, for an official copy of the specifications as now adopted. After the adoption of certain changes it was deemed advisable to reword the entire matter, the revised specifications being then submitted to three members of the association, and after their criticisms the corrected specifications were sent to all the members. We print below the final form of the specifications in full; and this form has been approved by quite a number of the members and will, without doubt, be the final one. As will be noted by comparing these with the specifications first adopted, the consideration of the chemical, as well as the physical properties of structural steel in the later specifications constitute the chief points of difference and a marked step in advance, as pointed out in a letter from a correspondent in another column.

Standard Specifications Governing the Chemical and Physical Properties of Structural and Special Open Hearth Plate and Rivet Steel as Adopted by the Association of American Steel Manufacturers on Aug. 9, 1895; Revised July 17, 1896.

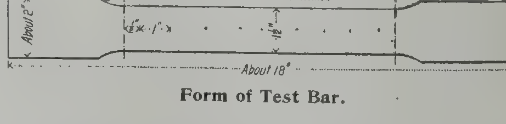
Structural Steel.

Process of Manufacture.—(1). Steel may be made by either the Open Hearth or Bessemer process.

Test Pieces.—(2). All tests and inspections shall be made at places of manufacture prior to shipment.

(3). The tensile strength, limit of elasticity and ductility shall be determined from a standard test piece cut from the finished material. The standard shape of the test piece for sheared plates shall be as shown by the following sketch:

On tests cut from other material, the test piece may be either the same as for plates or it may be planed or turned parallel throughout its entire length. The elongation shall be measured on an original length of 8 ins., except when the thickness of the finished material is 5-16-in. or less, in which case the elongation shall be measured in a length equal to sixteen times the thickness; and except in rounds of ⅝-in. or less in diameter, in which case the elongation shall be measured in a length equal to eight times the diameter of section tested. Two test pieces shall be taken from each melt or blow of finished material, one for tension and one for bending.



Form of Test Bar.

(3a). Material which is to be used without annealing or

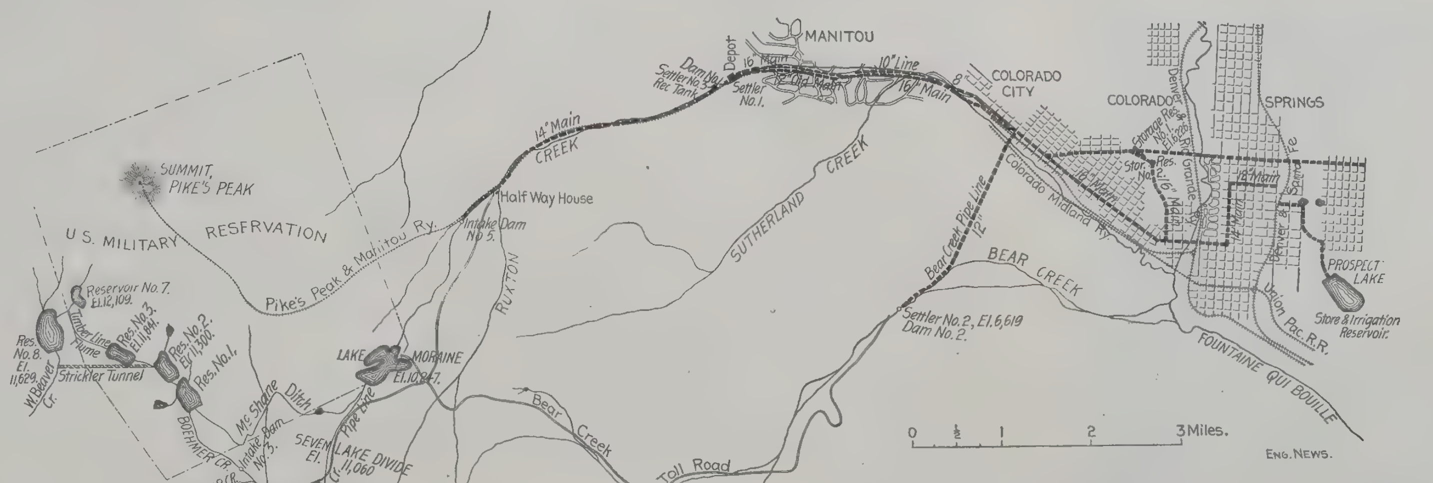


FIG. 1. MAP OF WATER-WORKS SYSTEM SHOWING RESERVOIRS, PIPE LINES AND STRICKLER TUNNEL.

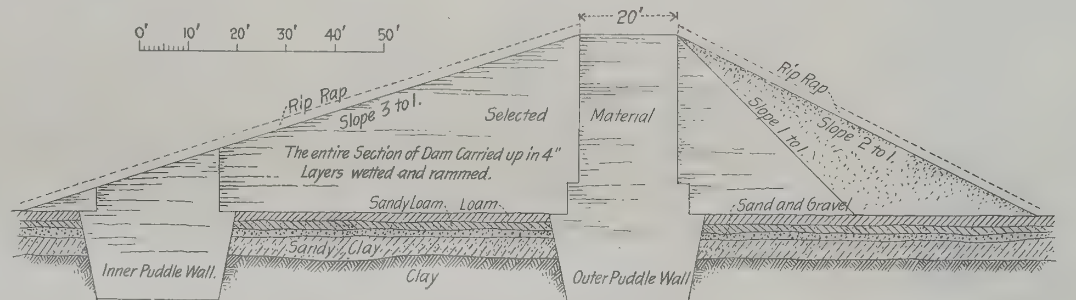


FIG. 3. CROSS SECTION OF LAKE MORAINE RESERVOIR DAM.

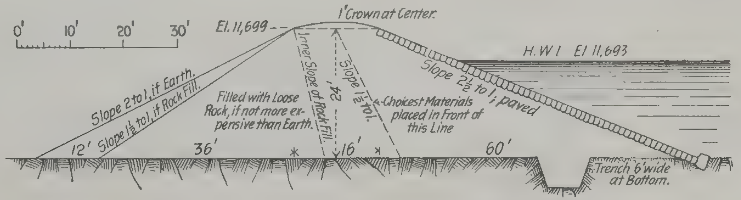

0' 10' 20' 30'
El. 11,699
1' Crown at Center.
H.W.L. El. 11,693
Slope 2 to 1, if Earth.
12' Slope 1½ to 1, if Rock Fill.
Filled with Loose Rock, if not more expensive than Earth.
Inner Slope of Rock Fill.
24'
Slope 1½ to 1.
Choicest Materials placed in Front of this Line
Slope 2½ to 1, paved
36'
16'
60'
Trench 6' wide at Bottom.

FIG. 9. CROSS SECTION OF DAM, STORAGE RESERVOIR No. 8.

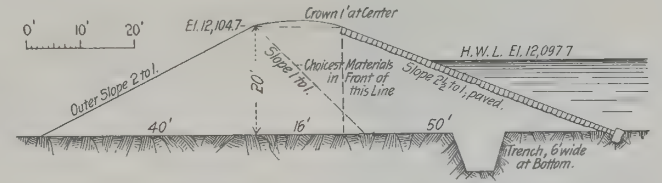
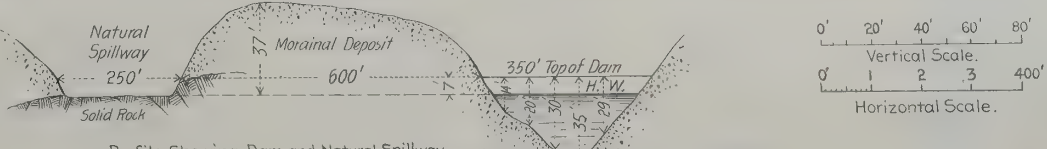
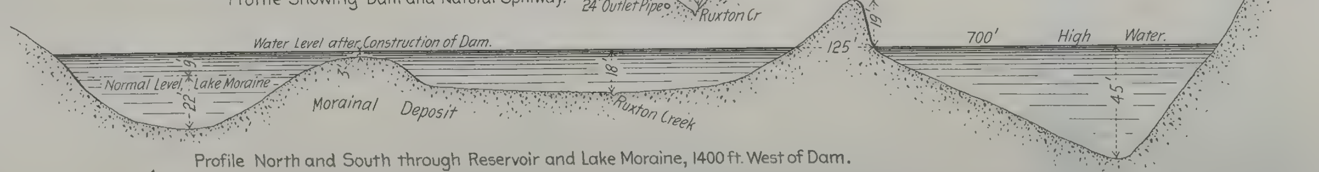


FIG. 10. CROSS SECTION OF DAM, STORAGE RESERVOIR No. 7.



Profile Showing Dam and Natural Spillway.

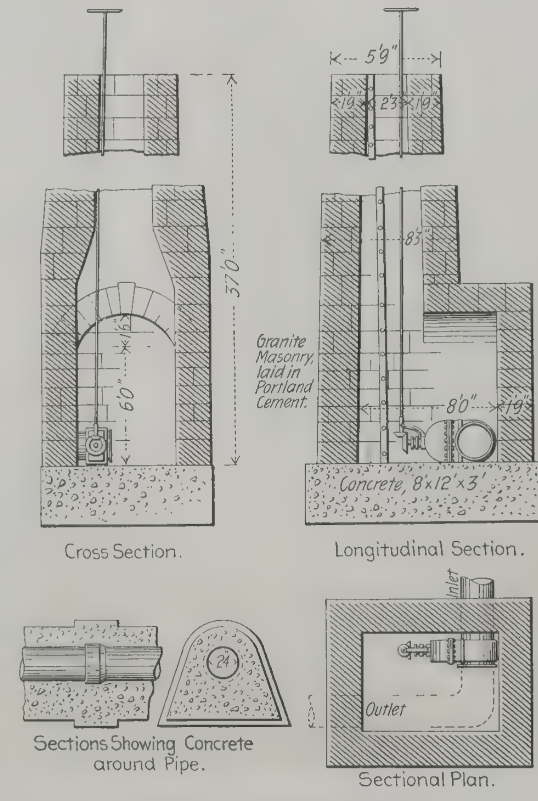


Profile North and South through Reservoir and Lake Moraine, 1400 ft. West of Dam.

FIG. 2. TRANSVERSE SECTIONS OF LAKE MORAINE RESERVOIR BASINS.

THE WATER SUPPLY SYSTEM OF COLORADO SPRINGS, COL.

H. I. Reid, City Engineer.



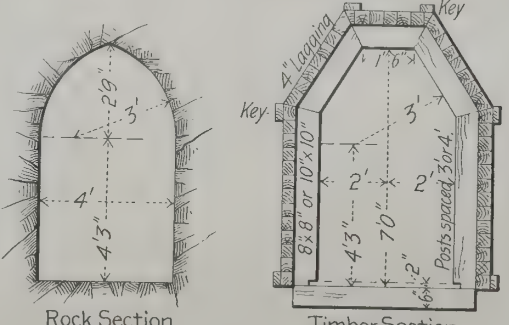
Cross Section.

Longitudinal Section.

Sections Showing Concrete around Pipe.

Sectional Plan.

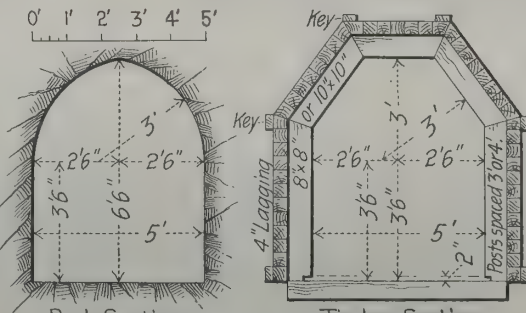
FIG. 4. DETAILS OF VALVE CHAMBER, LAKE MORAINE RESERVOIR.



Rock Section.

Timber Section.

FIG. 7. ADOPTED CROSS SECTIONS OF STRICKLER TUNNEL.



Rock Section.

Timber Section.

FIG. 8. ALTERNATIVE CROSS SECTIONS OF STRICKLER TUNNEL.

further treatment is to be tested in the condition in which it comes from the rolls. When material is to be annealed or otherwise treated before use, the specimen representing such material is to be similarly treated before tested.

(4). Every finished piece of steel shall be stamped with the blow or melt number, and steel for pins shall have the blow or melt numbers stamped on the ends. Rivet and lacing steel, and small pieces for pin plates and stiffeners, may be shipped in bundles securely wired together with a blow or melt number on a metal tag attached.

Finish.—(5). Finished bars must be free from injurious seams, flaws or cracks, and have a workmanlike finish.

Chemical Properties.—(6). Steel for buildings, train sheds, highway bridges and similar structures shall not contain more than 10% of phosphorus.

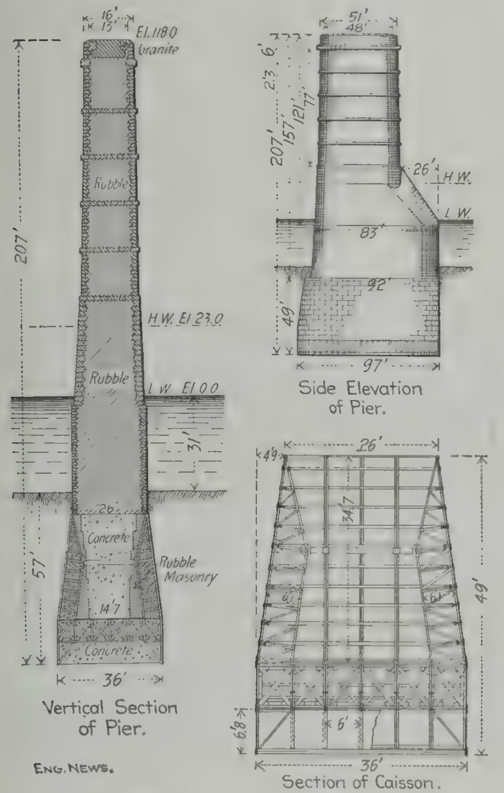


Fig. 3.—Elevation and Sectional Views of Pier and Caisson.

(7). Steel for railway bridges shall not contain more than .08% of phosphorus.

Physical Properties.—(8). Structural steel shall be of three grades: rivet, soft and medium.

Rivet Steel.—(9). Ultimate strength, 48,000 to 58,000 lbs. per sq. in. Elastic limit, not less than one-half the ultimate strength. Elongation, 26%. Bending test, 180° flat on itself, without fracture on outside of bent portion.

Soft Steel.—(10). Ultimate strength, 52,000 to 62,000 lbs. per sq. in. Elastic limit, not less than one-half the ultimate strength. Elongation, 25%. Bending test, 180° flat on itself, without fracture on outside of bent portion.

Medium Steel.—(11). Ultimate strength, 60,000 to 70,000 lbs. per sq. in. Elastic limit, not less than one-half the ultimate strength. Elongation, 22%. Bending test, 180° to a diameter equal to thickness of piece tested, without fracture on outside of bent portion.

Pin Steel.—(12). Pins made from either of the above-mentioned grades of steel shall, on specimen test pieces cut at a depth of 1 in. from surface of finished material, fill the physical requirements of the grade of steel from which they are rolled, for ultimate strength, elastic limit and bending, but the required elongation shall be decreased 5%.

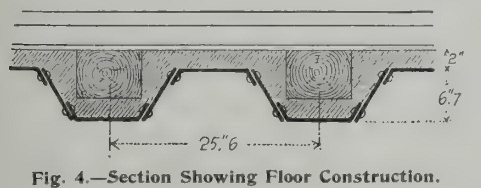


Fig. 4.—Section Showing Floor Construction.

Eye-Bar Steel.—(13). Eye-bar material, 1½ ins. and less in thickness, made of either of the above-mentioned grades of steel, shall, on test pieces cut from finished material, fill the requirements of the grade of steel from which it is rolled. For thicknesses greater than 1½ ins. there will be allowed a reduction in percentage of elongation of 1% for each ⅛-in. increase of thickness, to a minimum of 20% for medium steel and 22% for soft steel.

Full Size Test of Steel Eye-Bars.—(14). Full size test of steel eye-bars shall be required to show not less than 10% elongation in the body of the bar, and tensile strength not more than 5,000 lbs. below the minimum tensile strength required in specimen tests of the grade of steel from which they are rolled. The bars will be required to break in the body, but should a bar break in the head, but devolop 10% elongation and the ultimate strength specified, it shall not be cause for rejection, provided not more than one-third of the total number of bars tested break in the head; otherwise the entire lot will be rejected.

Variation in Weight.—(15). The variation in cross-section or weight of more than 2½% from that specified will be sufficient cause for rejection, except in the case of sheared plates, which will be covered by the following permissible variations, provided that no plate shall be rejected for light gage measuring 1-100-in. or less below the ordered thickness.

(15a). Plates 12½ lbs. per sq. ft. or heavier when ordered to weight shall not average more than 2½% variation above or 2½% below the theoretical weight.

(15b). Plates from 10 to 12½ lbs. per sq. ft. when ordered to weight shall not average a greater variation than the following: Up to 75 ins. wide, 2½% above, or 2½% below the theoretical weight; 75 ins. and over, 5% above or 5% below the theoretical weight.

(15c). Rectangular plates, ¼-in. thick and heavier, when ordered to gage, shall not average a greater variation than the following:

Table of Allowances for Overweight for Rectangular Plates.

(Note.—The weight of 1 cu. in. of rolled steel is taken at 0.2833 lbs.)

Plate	Width of plate		
	Up to 75 ins.	75 to 100 ins.	Over 100 ins.
¼-in. thickness	10 %	14 %	18 %
5-16-in. "	8 %	12 %	16 %
⅜-in. "	7 %	10 %	13 %
7-16-in. "	6 %	8 %	10 %
½-in. "	5 %	7 %	9 %
9-16-in. "	4½ %	6½ %	8½ %
⅝-in. "	4 %	6 %	8 %
Over ⅝-in. thickness..	3½ %	5 %	6½ %

(15d). Rectangular plates under ¼-in. in thickness when ordered to gage shall not average a greater variation than the following:

Thickness of plate.	Width of plate	
	Up to 50 ins.	50-in. and abv.
⅛-in. up to 5-32-in.	10 %	15
5-32-in. up to 3-16-in.........	8½	12½
3-16-in. up to ¼-in	7	10

Structural Cast Iron.

(1). Except when chilled iron is specified, all castings shall be tough gray iron, free from injurious cold-shuts or blow-holes true to pattern, and of a workmanlike finish. Sample pieces 1 in. square, cast from the same heat of metal in sand molds, shall be capable of sustaining, on a clear span of 4 ft. 8 ins., a central load of 500 lbs. when tested in the rough bar.

Special Open Hearth and Rivet Steel.

Test Pieces.—(1). All tests and inspections shall be made at place of manufacture prior to shipment.

(2). The tensile strength, limit of elasticity and ductility, shall be determined from a standard test piece cut from the finished material. The standard shape of the test piece for sheared plates shall be as shown by the sketch.

On tests cut from other material the test piece may be either the same as for plates, or it may be planed or turned parallel throughout its entire length. The elongation shall be measured on an original length of 8 ins., except when the thickness of the finished material is 5-16-in. or less, in which case the elongation shall be measured in a length equal to sixteen times the thickness; and except in rounds of ⅝-in. or less in diameter, in which case the elongation shall be measured in a length equal to eight times the diameter of section tested. Four test pieces shall be taken from each melt of finished material; two for tension and two for bending.

(3). Material which is to be used without annealing or further treatment is to be tested in the condition in which it comes from the rolls. When material is to be annealed or otherwise treated before use, the specimen representing such material is to be similarly treated before testing.

(4). Every finished piece of steel shall be stamped with the melt number. Rivet steel may be shipped in bundles securely wired together, with the melt number on a metal tag attached.

(5). All plates shall be free from surface defects and have a workmanlike finish.

Chemical Properties.—(6). The maximum allowable limits of phosphorus and sulphur shall be as follows:

(6a). On flange and boiler steels, .06% of phosphorus and .04% of sulphur.

(6b). On fire box and extra soft steels, .04% of phosphorus and .04% of sulphur.

(6c). On boiler rivet steel, .04% of phosphorus and .04% of sulphur.

Physical Properties.—Extra Soft Steel. (7). Ultimate strength, 45,000 to 55,000 lbs. per sq. in. Elastic limit, not less than one-half of the ultimate strength. Elongation, 28%. Cold and quench bends, 180° flat on itself, without fracture on outside of bent portion.

Fire Box Steel. (8). Ultimate strength, 52,000 to 62,000 lbs. per sq. in. Elastic limit not less than one-half the ultimate strength. Elongation, 26%. Cold and quench bends, 180° flat on itself, without fracture on outside of bent portion.

Flange and Boiler Steel. (9). Ultimate strength, 52,000 to 62,000 lbs. per sq. in. Elastic limit, not less than one-half the ultimate strength. Elongation, 25%. Cold and quench bends, 180° flat on itself, without fracture on outside of bent portion.

Boiler Rivet Steel. (10). Steel for boiler rivets shall be made of the extra soft quality specified in paragraph No 7.

Variation in Weight.—The allowances for overweight are to be the same as given in paragraph No. 15, under the head of Structural Steel.

THE WATER-WORKS OF COLORADO SPRINGS AND THE STRICKLER TUNNEL.

(With inset.)

The first water-works system for Colorado Springs, Colo., was completed in 1878, and since that time it has undergone a nearly continuous process of development and improvement until it has now reached a stage which is expected to render any further improvement unnecessary for many years. By the end of 1896 it is expected that the final construction of the plant as planned will be completed. Altogether the work of development has been an arduous one, beset with legal complications and engineering problems of annoying, if not of exceedingly difficult character. As an example of the variety of problems encountered by some of our American cities in securing a water supply, and likewise of the methods adopted to overcome these problems, the work is unusually instructive, but further than this it comprises reservoir, pipe line and tunnel constructions of unusual character. The tunnel work particularly is a task worthy of extended mention, and in the accompanying illustrations and this description, the salient features of the work are given in such detail as their importance seems to warrant. For the information from which this article has been prepared we are indebted to Mr. H. I. Reid, City Engineer, Colorado Springs, Colo., who has planned and carried out the work in all its details. The character of his task and the efficiency with which it has been accomplished is testified by the matter which follows.

The accompanying map, Fig. 1, shows the water-works system of Colorado Springs as planned and constructed. All the various pipe lines, reservoirs and other constructions are shown as far as their general location is concerned.

Original System.

The first system of water-works constructed in 1878 consisted of six miles of 6-in. main, from Ruxton Creek in the town of Manitou to storage reservoir No. 1, and a 12-in. distributing main from the reservoir into town. The reservoir was located 200 ft. above City Hall datum and held 1,250,000 gallons. The main being laid with but a slight covering of earth and the intake, according to reports, being improperly designed, it froze solid the first winter. To correct the error a new main of 10 ins. and 8 ins. diameter was laid in 1880. Altogether this experiment cost the city $40,000.

New System.

In 1884, Mr. H. I. Reid was employed by the city to investigate the different sources of water supply preparatory to preparing a general plan for future operations. Careful study of all details regarding supply, drainage area, precipitation, freedom from pollution, and comparative cost led to but one conclusion, and this was that the Pike's Peak region was the proper source of supply. The city which was to be supplied, Colorado Springs, is a health and tourists' resort, and consequently few restrictions are placed upon the use of water. Lawn sprinkling is permitted free of charge and no meters are used. Naturally the citizens were not slow to take advantage of this freedom, and the consumption of water exceeds 300 gallons per capita per day. In view of these facts it was assumed that it was desirable to plan the system for a population of 25,000 people using 200 gallons per day each, and this was done.

Storage Reservoir No. 2.—The first work done was to build a second storage reservoir about 400 ft. from the reservoir of the old system. This site was the Mesa, having a slope of 4% to the south and was the only one available for a reservoir unless a new supply main was to be constructed, which was not at once possible. At the location selected the reservoir could be supplied by a bypass around reservoir No. 1 from the original 8-in. pipe. Besides this by-pass a new pipe was laid connecting the two reservoirs at high water line, and a 16-in. distributing main was carried into the city. Briefly described the new reservoir has a capacity of 14,500,000 gallons and being excavated in the side hill has embankments on three sides only. The cross-section of these embankments is 20 ft. wide on top, with an inside slope of 3 to 1 and an outside slope of 2½ to 1. All pipes through the embankment are incased in concrete masonry and have projecting collars at each joint. In regard to the construction of this reservoir the engineer, Mr. H. I. Reid, writes:

> In constructing these embankments the writer learned from actual experience two important facts, relating to safe construction: (1) A large percentage of clay is not desirable, and (2) too great a quantity of water used in wetting the embankment is worse than no water. More especially is this true if a large amount of clay is used.

New Supply Mains.—As stated above, the new storage reservoir No. 2 took its water from the old 8-in. supply main. This provided for temporary demands, but it was necessary to construct an additional supply main to provide for the assumed demand of 5,000,000 gallons per day. Making due allowances for the original pipe it was found that a 16-in. supply main was needed, and after some opposition, on account of cost, its construction was begun in February, 1889, and completed in December of the same year. During this period several months' delay were caused by litigation for right of way through a neighboring town. Heavy cast-iron pipe was used and considerable time was spent to secure the best possible location and alinement. The pipe was laid on regular curve and tangent alinement, and all depressions and summits avoided. Where possible, without too great deflection, the line follows the streets and highways. The general profile of the pipe line is as follows: Elevation of intake, 6,619 ft.; elevation of reservoir, 6,226 ft.; elevation of City Hall, 6,026 ft.; length of line, 6.73 miles.

This 16-in. main does not enter the new storage reservoir, but connects with the 16-in. distributing main running from it as before described. Thus the new reservoir acts as a stand-pipe for the new supply main. When there is a heavy draft, water is drawn both from the supply main and the reservoir; but otherwise the water backs up from the main into the reservoir. Provisions are made for cutting off the reservoir supply so that if desired—in case of a large fire, for example—the water may be taken direct from the main with a pressure due to a head of 593 ft. Such use has never yet been made, however, and will not be until a pressure regulator has been placed so that the pressure cannot exceed 150 lbs. per sq. in.

All the work on the pipe line, and, indeed, all other work, except where especially mentioned, was done by day labor, and regarding it City Engineer Reid writes:

> The practical observations of the writer upon this work are that much time given to careful alinement and to minute details of construction is amply rewarded in the increased supply of water and the small cost of maintenance. This was practically demonstrated. We had parallel mains with the same intake point. Points were selected where the length and head were the same for both mains and the discharge of each was measured by a current meter. Making due allowance for the greater length of time the old pipe had been used, although this pipe is apparently as free from incrustation now as when laid, it was found that the old pipe had a measured capacity less than the calculated capacity for rough pipe, while the new pipe had a measured capacity somewhat greater than the calculated capacity for smooth pipe.

Bear and Cheyenne Creek Supplies.—As soon as the construction of the Ruxton Creek supply main was completed, work was begun on an additional main from Bear Creek, it having been previously determined that the water from this stream could be injected into the system by a pipe line 2½ miles long, and further, that at a point some eight miles up the stream Cheyenne Creek could be diverted, carried through a low pass, and emptied into Bear Creek, thus saving the cost of eight miles of pipe which would have been necessary had Cheyenne Creek been tapped at a lower point near the mouth of the canyon. A point was selected for intake purposes on Bear Creek at the same elevation as the Ruxton Creek intake. From this point a 12-in. main was constructed to the city. Some four miles above the intake the waters of Cheyenne Creek were let into Bear Creek by a ditch between the two streams. Subsequently, sewer pipe was laid in this ditch and it greatly diminished the loss of water. This work being completed, attention was turned toward constructing storage reservoirs in the Pike's Peak region. The first work was the Lake Moraine reservoir, which is described in the following excerpt from notes sent us by City Engineer Reid:

> Lake Moraine Reservoir.—This reservoir is located near the head waters of Ruxton Creek, about eleven miles west of Colorado Springs and at an elevation of 10,246.8 ft. Its capacity is 492,000,000 gallons and the total area covered is 96 acres, wholly within the original boundaries of the Pike's Peak Military Reservation. In speaking of this basin the eminent geologist, Prof. Arthur Lakes wrote: "At one time the whole valley was occupied first by a glacier and later by a lake over a mile in length, dammed back by a wide moraine thrown right across the valley; but at some time this principal moraine was broken through and the waters of the lake were discharged down a steep narrow ravine along the path of what is called Ruxton Creek, leaving only the small circular lake behind it."
>
> This little lake, 24 ft. deep and covering an area of about 15 acres, was formerly known as "Mystic Lake," probably from the fact that it has no visible inlet nor outlet yet is always full of pure and clear water. Later, however, it was called Lake Moraine. On the opposite side of the valley there is a basin which is almost the exact duplicate of Lake Moraine in form and capacity, yet holding no water until submerged, although its lowest point is lower than its counterpart and many feet below Ruxton Creek which flows between. The cross section profile, Fig. 2, illustrates this better than words can express. To construct the reservoir what we did was simply to repair the breach which caused the drainage of the ancient lake and to utilize the spill-way which nature had so kindly prepared and used in ages gone by. This spill-way is indeed a suggestion, which the engineer is wise in copying where possible. It is located 700 ft. distant from the dam. The water flows off from the side of the reservoir and, making a wide detour, comes back into the main stream one-half mile below the dam. Between the dam and spill-way is a morainal deposit 30 ft. higher than the dam.
>
> The dam, Fig. 3, is 422 ft. long on top; 150 ft. long on the bottom, and has a top width of 20 ft. The inner slope is 3 to 1 and the outer slope 2 to 1. Both slopes are covered to a depth of 2 ft. from toe to crest with broken granite. The crest of the dam is 8 ft. above high water level and the greatest height of the dam is 35 ft.
>
> The materials used were good for the purpose intended, being composed of coarse gravel, fine gravel, sand, and clay in about the proportions 4, 3, 1, and 2, respectively. The entire base of the dam was stripped to a depth below frost line and the puddle trenches carried down to a depth of 14 ft. below the surface or 4 ft. into the clay. Test pits dug 11 ft. deeper failed to define the depth of the clay stratum. It required a great deal of blasting to clear the borrow pits of granite boulders left by glacier drift, but these were utilized in slope paving and for the valve chamber, although for this latter use they were very poorly adapted. In fact we had to select such stone as somewhat resembled a cubical form, as dressing was out of the question.
>
> The valve chamber, Fig. 4, here, as in all of our mountain dams, is placed back free from the action of ice, but always in excavation in the natural earth at the end of the dam. In this case the outlet pipe parallels the inner toe of the slope to the valve chamber, on the high water line, thence turns nearly at right angles to center line of dam and passes to the outer toe. The pipe from chamber to inlet is under pressure, but we find this preferable to having the chamber in the water. The pipe thoughout is encased in concrete and a collar is placed at 12-ft. intervals. The winter weather at this altitude is severe, and from June 1 to Nov. 1 was the only time at which work could be carried on during the year. At the time construction was commenced there was no road nearer than four miles from the site, and all materials had to be carried in on burros over the old United States Pike's Peak trail. This was laborious and costly, and we immediately began constructing a road to connect with the Seven Lakes toll road four miles distant and in an opposite direction to Colorado Springs. This gave us a wagon road inlet, but the road mentioned is very steep and the length about 24 miles, or twice the distance to town over a direct line. There is now a wagon road completed direct down Bear Creek Canyon, also a road connecting with the Pike's Peak rack railway at Mountain View station.
>
> Proposals for this work were received and rejected because excessive; received a second time and again rejected for the same cause, and finally it was let by contract to furnish tools and all labor at so much per day. Mr. David McShaw, of this city, was the contractor. The lowest bid received for this work by yardage amounted to $28,000, and the cost of the work as carried out was $22,000. Mr. Delos Durfee, one of the present assistants in this office, was resident engineer in charge of the work.
>
> Provision was made for wetting the dam, but nature is very lavish with her down-pour of rain at this altitude during the summer months, so that it was a more difficult matter to keep the work sufficiently dry and not lose too much time.
>
> The dam is built up in parallel layers, 4 to 6 ins. thick, but the middle third was kept about 2 ft. higher than the outer thirds, which slope gently from the center in order to quickly shed the rain fall. We find it a wise precaution in all dams and absolutely necessary in the Mountain System, to lower the water 4 to 6 ft. below high water line every fall before the reservoir is frozen over. If this is not done the ice displaces the riprap and leaves the dam in a loosened condition for wave action at high water line, all of which is avoided by lowering in early fall and quickly covering the ice line by water in spring time.

Beaver Creek Pipe Line.—It was known that the waters from Middle Beaver Creek, on the west side of the ridge, could be diverted across Seven Lakes Divide and emptied into Ruxton Creek above Lake Moraine reservoir; also, that West Beaver Creek could be turned into Middle Beaver Creek above such a conduit either by means of a flume or a tunnel, and further, that the best available location for storage reservoirs was to be found on these streams. It was therefore deemed advisable to obtain water rights on Beaver Creek and to this end prices were obtained on several ranches having the oldest and best water rights of this stream. These ranches were located near the confluence of Beaver Creek with the Arkansas River, some 40 miles below the point where it was desired to divert the former stream. Two questions now arose: (1) Having purchased a water right on lower Beaver Creek, could the point of diverting this water be transferred 40 miles up the stream?, and (2), should this be legal, could this diverted water be turned into another stream having an entirely different watershed? To decide these questions a friendly suit was instituted between the city of Colorado Springs and Mr. Wm. Strickler and carried to the Supreme Court, where it was decided that the point of diversion could be changed without effecting priority. In the second case the state legislature enacted a law permitting the diversion from one watershed into a different one and also enacted the above court decision into a law. These questions being settled, the city purchased two ranches for $28,000, the combined capacities of whose water rights were 17.12 cu. ft. per sec.

Immediately work was begun on the necessary conduit from Beaver Creek to Ruxton Creek. The conditions were as follows: About 1¾ miles southwest of Lake Moraine dam is the lowest pass in the range known as Seven Lakes Divide. The elevation here is 11,070 ft., or 812 ft. higher than Lake Moraine. Less than one mile distant, and 120 ft. lower than this divide is the valley of Middle Beaver Creek. By constructing a pipe line 8,400 ft. long sufficient elevation is gained to carry the waters of this creek and its tributaries to Seven Lakes Divide whence it flows down the mountain side into Lake Moraine reservoir. A year previous to this construction a ditch was built for the same purpose and is still used to some extent in the summer time. This pipe is steel, 16 ins. in diameter and light weight in order to avoid excess weight in hauling to the works. Its capacity is 7½ cu. ft. per sec. and it carries the full capacity of the stream except during the two summer months when the ditch is also used if needed. This work was contracted but before half completed the contractor "threw up the job" and the work was completed by force account. It is proper to state here that while the greater portion of these water-works has been constructed by day labor, it was because the engineers were never able to secure a reasonable bid for any mountain work until the past year. The altitude, climate and difficulty in conveying materials, together with the uncertain character of the work, all made the bids excessive, as was afterwards proven by day labor construction.

Ruxton Creek Extension.—Hardly had the Beaver Creek pipe line been completed when a new problem arose. The Manitou & Pike's Peak Ry. is constructed very nearly along the water grade of Ruxton Creek, and this water formerly so clear and pure was rendered more or less muddy from grade washings and from the tourist travel and campers. The stream, it was thought, polluted the water to too great an extent for drinking purposes of a health resort, and it was deemed advisable to extend the supply main up stream a distance of three miles, where the road leaves the canyon. Previous to this time, however, Congress had given the city 700 acres of land surrounding Lake Moraine, so the city now purchased from private parties all the lands on either side of the canyon from the Lake Moraine grant to the rock road, thereby saving cost of constructing 2½ miles of pipe to reach the lake and also receiving the flow from the numerous branches and springs below the lake.

This construction was expensive, as is plainly indicated by the views, Figs. 5 and 6. A heavy wrought iron pipe with Mathewson joints was used, anticipating the early use of this water for power purposes, as well as domestic uses. This pipe line has a total fall of 2,428.8 ft. without a break, but has no dips or summits. The center line is parallel with and 8 ft. from the center of the railway, except at one point where it diverges for a distance of 700 ft. to avoid heavy blasting in the granite cut through which the road posses. On this diverging line huge masses of granite boulders were encountered and at two points the line passed under them by tunnels.

All material for this work was hauled by the rack-road, and the city was not allowed to begin construction, could not in fact, until the road had ceased operations for the summer. The contract with the company owning the road compelled the city to fully protect the track at all times, and, as a precautionary measure, the pipe was laid between the track and the creek, which made it necessary to cross under the rack-road at three points. The weather was very cold, but this proved to be a great help and saving in cost of construction, where the road was on embankment. At such places the pipe line came on embankment slopes, which were about 1 to 1, and were composed of disintegrated granite or gravel. To excavate a bench on this slope of sufficient width for the pipe and at the same time preserve intact the track, was no easy work. In some places sheet piling was driven by hand to support the track side, a bench shoveled off, the pipe laid and the original surface restored with materials borrowed from the opposite side of the track. Generally, however, the track side of the trench was sprinkled with water from the creek near by and in freezing it supported the track in perfect shape.

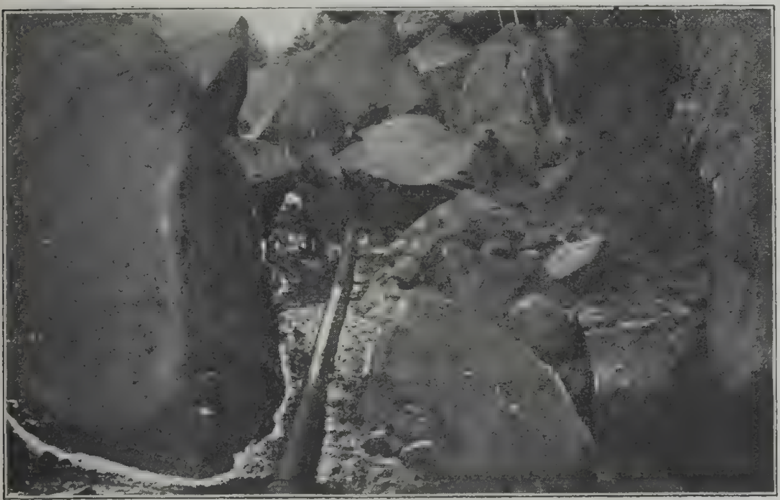


FIG. 5.—VIEW ON RUXTON CREEK PIPE LINE SHOWING TUNNEL UNDER BOULDERS.

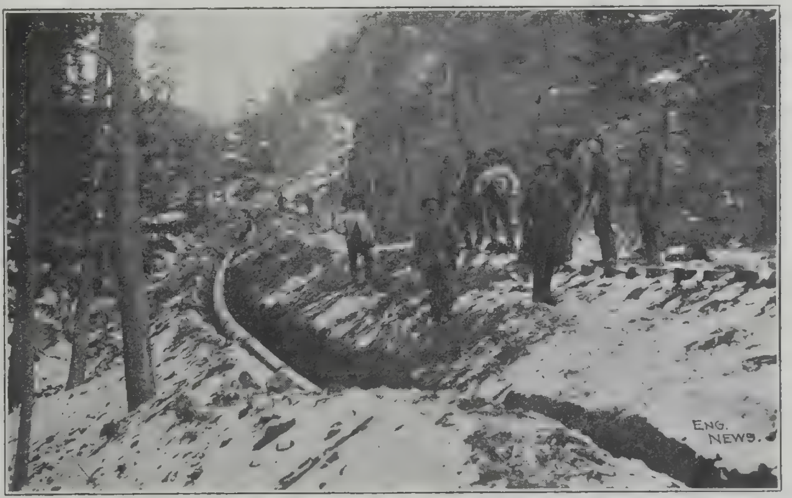


FIG. 6.—VIEW ON RUXTON CREEK PIPE LINE SHOWING CURVE AT HALF-WAY HOUSE.

A considerable portion of the roadbed was in excavation and here the pipe trenching was in solid granite and to excavate a trench at the end of the ties, of sufficient depth and preserve the track, was a more difficult task than the embankment work. This was done, though, and the crossings under the track blasted out without unbolting the rail joints, but it was tedious and costly.

At frequent intervals along the line and at all points where the pipe was on embankment and on the outer side of the curve of roadway, anchors were placed. These were made of steel, a draw band with two bolts around the pipe and a steel rod; one end having a forged eye to receive the bolt of draw band. the other turned at a right angle and placed in hole drilled in the granite walls where most convenient, and the remaining cavity filled with lead. The city blacksmiths made all these anchors and they were found to be cheap, simple and efficient.

Reservoir No. 2 (Beaver Creek system).—The next step was to complete the storage system of which reservoir No. 2 was the first work. It is located on Middle Beaver Creek one mile above the intake of the Beaver Creek pipe line already mentioned. The dam is 725 ft. long; maximum fill 30 ft., with top width and slopes of the standard dimensions previously given. The construction, however, differs from the other dams alluded to in some respects. Earth was a very scarce article, while granite boulders were plentiful, so the outer third was constructed entirely of granite boulders laid in by hand and faced with such earthy materials as were available.

Timber Line Flume.—To divert the waters of West Beaver Creek into Middle Beaver Creek it was necessary to resort to one of three methods: (1) A flume seven miles long; (2) a tunnel 6,400 ft. long, or (3) a pumping plant. For this last method the head in the pipe line could be utilized for generating electricity as a motor power. The tunnel was finally adopted, but for temporary supply a branch of West Beaver Creek was diverted by means of a flume 4,000 ft. long and carried over the divide through which the tunnel is now being driven, At that time it was not expected that the tunnel would be constructed for several years, but being suddenly confronted with a formidable rival in Cripple Creek, Victor and several other towns of this mining district which have a combined population of 30,000 people and are rapidly increasing in size, and further, the only practicable source from which they may receive a water supply being this same Beaver Creek, it was thought wise and proper to push forward as rapidly as possible the construction of Strickler Tunnel. The lumber used in this flume is Southern pine and the cost of transportation from Colorado Springs to the location (17 miles) exceeded the price paid for the lumber plus the freight from Texas.

Strickler Tunnel.—From the foregoing it will be seen that the construction of the Strickler Tunnel is simply to divert the waters from the western to the eastern slope of Pike's Peak. Fig. 1 shows the location of the tunnel in relation to other parts of the system. The total length of excavation is 6,427 ft., of which about 150 ft. at west end and 35 ft. at east end will be open cuts, leaving a net tunnel length between portals of 6,242 ft. The west portal and intake is located at the confluence of two branches of West Beaver Creek and the east portal at a point on Middle Beaver Creek, 1,200 ft. from and 500 ft. higher than reservoir No. 2 of the city's system. The grade elevation of the west end of tunnel is 11,540 ft. above sea level, and the gradient used is 0.50 ft. per 100 ft.

The line of the tunnel is a tangent, course N. 88° 40′ E., and passes through the ridge or "hogback" connecting Pike's Peak and Big Horn Mountain. From the west portal, for a distance of 5,300 ft. the surface is a gradual ascent to the top of the ridge, which point is 424 ft. above grade, then dropping rapidly to the east portal which is on the face of a very nearly vertical cliff of red granite coarse and porphyritic. So far as surface indications determine the east 4,200 ft. is through this same formation, but the west 2,000 ft. shows morainal debris, and this portion of the tunnel will probably require timbering. Geologically speaking this ridge is the seat of an ancient glacier which divided at this point. One portion flowed westward and ploughed out the canyon through which West Beaver Creek now flows, another portion flowed southward, forming the valley of Middle Beaver Creek, and ending in a cul de sac near Seven Lakes, two miles below reservoir No. 2. The west portal is 1½ miles west from the summit of Pike's Peak and about four miles east from "Bull Hill" of Cripple Creek fame. The tunnel site is reached via the Manitou & Pike's Peak Ry. to Saddle House Station, from which point a wagon road has been constructed by the city for use in hauling materials for construction of the timber line flume and reservoirs Nos. 7 and 8. The site may also be reached via the Bear Creek Canyon Toll Road, a distance of 20 miles.

In calling for bids it was stated that it was desirable that the cross-section of the tunnel should be the smallest possible for economical construction. Two cross-sections were designed and bids received separately on each. Figs. 7 and 8 show these cross-sections, both in solid rock and where a timber lining is required. Proposals for the work were received from eight different firms, the prices ranging from $7.99 to $21.75 per ft. for tunnel excavation (Eng. News, Jan. 16). The price of Wilson & Jackson, Chicago, Ill., being $12.90 for tunnel excavation, and $4.76 for timbering, and also being for the cross-section 4 ft. × 7 ft. the least price it was adopted. The total cost, as figured from estimated quantities for comparison, is $99,916. The greater number of bids were the same for each cross-section, one firm, however, bid a less price for section Fig. 8 than for section Fig. 7, and this was undoubtedly correct. The cross-section 5 ft. × 6.5 ft. is the more economical one for the contractor. The amounts of excavation per lineal foot for the two sections are 0.94 cu. yd. in solid rock, and 1.9 cu. yd. in timbered excavation for Fig. 7, and 1 cu. yd. and 2.11 cu. yds., respectively, for Fig. 8.

As stated above, when deemed necessary by the engineer the tunnel will be timbered with red or yellow fir or yellow pine, which may be sawed or hewed as most desirable. The inside lines of any timbers must not fall within the prescribed limits of rock section. The sets of timber will be of 8 × 8 ins. or 10 × 10 ins. and placed 3 to 4 ft. apart as the character of materials supported require. Outside of the posts and arch blocks a 4-in. lagging will be placed and the whole set brought to a firm bearing by wedge-shaped keys. Any cavity existing between lagging and sides of tunnel will be filled with stone or timber as contractor may choose.

The foregoing gives the character of the tunnel work sufficiently well. The method of construction was left to the discretion of the contractor with the usual restrictions as to responsibility, safety, etc., and we have secured from the contractors, Wilson & Jackson, of Chicago, Ill., a brief description of their plant and of the system of excavation to be followed. Briefly stated, electricity, generated by water power, will operate an air compressor plant to furnish power for the work.

The Ruxton Creek main, as already noted, extends from Manitou to a point ½ mile above the Half Way House on Pike's Peak. This pipe line has a fall of over 2,400 ft. without dips or summits and a section of the line will be used for power purposes, the primary plant being erected at Minnehaha Station. This plant consists of a 36-in., 220-HP. Pelton wheel which operates a 150-K-W. three-phase generator built by the General Electric Co. From this generator a 3,500 volt current is sent to the east portal of the tunnel, where a step-down transformer supplies a 220-volt current to the motor, which will be described further on. The transmission line consists of three No. 5 wires carried on cross-arm poles, and is provided with lightning arresters at intervals. Altogether the transmission line is nine miles long.

The plant at the east portal of the tunnel consists of a 75-HP. motor, driving a 75-HP. air-compressor, and smaller motors to drive a Sturtevant blower for ventilation, to run the blacksmith shop machinery and to light the tunnel, shop and yards. From the compressor, air will be piped into the tunnel from the east portal and also over the mountain by a 1½-mile 3-in. pipe to the west portal. Two drills will be worked at each end and the air will be also used for derricks and other power machinery.

For taking out the spoil, a trolley carrier system similar to the ones so much used in Chicago packing houses will be employed. A longitudinal timber will be fastened to the tunnel roof directly in the apex of the roof arch, and this timber will carry by means of hangers a steel bar trolley rail on which carriages or trolleys will run. Outside the portal this rail will form a loop so that the carriages can pass around and be taken back to the working face. Each trolley carries a steel pan of 1½ cu. ft. capacity so suspended that by means of a trip it is automatically dumped when it reaches the proper point. At the east end of the tunnel this dump is emptied directly into a deep gorge only a few feet away, and the dump at the west end is almost as favorable.

The contract for the tunnel was awarded Dec. 27, 1895, and shortly thereafter the contractors began erecting the necessary plant, which has only recently been put in operation. Work on the approaches to the tunnel is about completed.

Reservoirs Nos. 7 and 8.—The water from these two reservoirs, which are located on the west slope of the range, will pass through the Strickler tunnel. Both reservoirs are under construction and will be completed this year. The contractors are Ord & Swipe, of Colorado Springs, Colo. Fig. 9 is a cross-section of the dam for reservoir No. 8. This dam is 1,200 ft. long. Owing to scarcity of earth the outer portion of this dam is built of rock, as previously described for reservoir No. 2. Fig. 10 shows the cross-sections of the two dams for reservoir No. 7, which is the highest reservoir of the system, being at an elevation of 12,109 ft. above sea level.

Prospect Lake Reservoir.—There remains to be described only one other reservoir of the domestic supply system of Colorado Springs, viz., the Prospect Lake reservoir, located east of the city. This reservoir was built during the winter of 1890-'91. It is used principally for irrigation and resort purposes, but can be utilized for domestic supply for a considerable portion of the city if necessary. It is located on the opposite side of the town from the Mesa reservoirs already mentioned. The town lies between and on lower ground than either of the reservoirs, Mesa reservoir being 200 ft. and Prospect Lake 80 ft. above City Hall datum. This reservoir basin is a peculiar one. Located on the very summit of a sand mesa, the wind action has gradually ploughed out along the line of prevailing winds, northwest to southeast, a basin 2,800 ft. long, 1,200 ft. wide and 23 ft. maximum depth, leaving natural dams at either end, so that without any work at all it gave a capacity equal to the above dimensions. The engineers simply enlarged this piece of nature's handiwork by increasing the height of the dams, thus submerging the entire basin.

The northwest dam is 1,250 ft. long and 14 ft. deep. The southeast dam is 1,320 ft. long and 12 ft. deep. The slopes in each case are 3 to 1 and 2 to 1 for inner and outer slope, respectively, and the top width is 20 ft. The inner slopes are heavily riprapped with cobblestone. The northwest dam is built up of fine sand and probably 15% of sandy loam, which was moist from melting snow. The southeast dam was composed of fine sand only and was neither moist nor sprinkled. Each dam was constructed by the same parties and in the same manner, but the northwest dam was completed before the other was commenced. The northwest dam seeped considerably the first year, while the dry sand dam has not leaked at all. In order to drain the water from the bottom of this natural basin it was necessary to make an excavation 1,000 ft. long and 23 ft. deep at the greatest cut. A 12-in. supply main from the city system carries the overflow water into this reservoir, which pipe was laid on a slightly ascending grade from a point in the city to the reservoir, so that the pressure from the Mesa reservoir forces the water into Prospect Lake, but when the valve is closed, cutting off Mesa reservoir pressure, then the pressure due to the elevation of Prospect Lake forces the water back through the same main into town for irrigation purposes.

In the foregoing no mention has been made of irrigation reservoirs and pipe lines developed in connection with the domestic water supply system, nor have many of the details shown by the drawings been described. Several minor details to further improve the system will doubtless be developed later and it is quite possible that work may be begun in the near future to develop the water power, which has been made available by the various constructions. At present careful measurements are being made of the rain and snow fall, and all streams are being gaged with the intention of determining very closely just what can be expected in the way of precipitation and runoff of the available watershed.

As stated above the entire work has been designed and carried out by Mr. H. I. Reid, City Engineer, Colorado Springs, Colo. His assistants in all the work have been Messrs. Delos Durfee, E. W. Chase, and E. S. Gandy.

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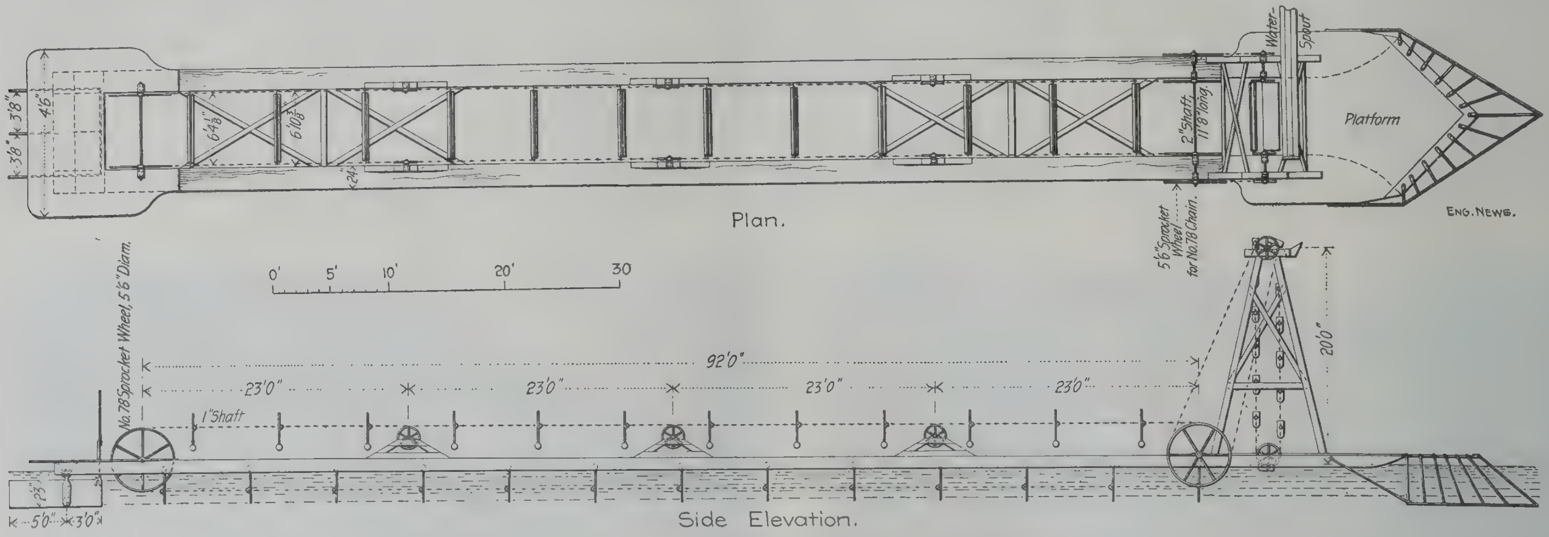
A CURRENT MOTOR FOR PUMPING WATER.

The accompanying illustration shows an interesting machine which has recently been developed specially for the purpose of raising water for irrigating purposes, though it promises to be applicable in a variety of situations. It consists simply of a long narrow float or pontoon, carrying an endless chain to which are attached floats at intervals of about 8 ft., which receive the force of the current. The chain, or rather chains, for there are two which run side by side, carrying the floats between them, run over sprocket wheels at each end of the pontoon, and the wheels at the head transmit the power thus gained to an overhead shaft which lifts the water by an endless chain pump.



PLAN AND ELEVATION OF A CURRENT MOTOR FOR PUMPING WATER.
Designed and Built by the F. C. Austin Mfg. Co., Chicago, Ill.

It will be evident that in a stream with a swift current a very considerable amount of power can be developed by this simple mechanism at very small expense. The system is especially applicable to the streams of the Far West where an unstable bed, or sudden and great floods makes the erection of permanent dams for the development of water-power almost impossible, and where the water often carries silt which would make the operation of almost any type of cylinder pump expensive.

Further, the apparatus is especially adapted to locations where the machinery must be as simple and light as possible on account of difficulties of transportation, and must be susceptible of repair with the crudest of tools. It will be seen that it can be made of any size desired to suit the location in which it is to be placed, the quantity of water desired, the height to which it is to be raised, etc. The apparatus is manufactured by the F. C. Austin Mfg. Co., of Chicago, Ill., a firm which has given special attention to the development of irrigation machinery, and to which we are indebted for the blue-print from which our cut is prepared.

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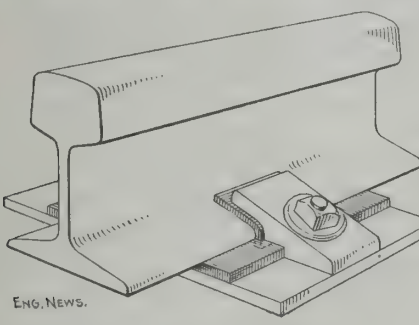
THE SEWALL DYKE FOR LEVEE PROTECTION is being endorsed by the Sugar Planters' Association of Louisiana, and other citizens of that state. The system is that of H. F. and N. H. Sewall, and has been tested for about three years at New Orleans, Bayou Goula and the South Pass. The plan, says the New Orleans "Picayune," is to construct pile spur-dykes, at intervals along a caving bank, projecting up stream "at an angle of about 25°," with the piles driven 30 to 35 ft. into the river bottom. The conditions require piles up to 150 ft. in length and to meet this condition Messrs. Sewall have devised a special form of spliced or continuous pile. At New Orleans the river is 50 ft. deep and the dykes run out about 135 ft., but they have stood the high water of three years. The dyke at Bayou Goula was built in 1894 and terminates in water 115 ft. deep; but has well answered its purpose. The Planters' Association will ask that Congress take this matter in hand directly.

INSULATING RAILS FROM METAL TIES AND BRIDGE FLOORS.

On roads using a track circuit for signal operations and having the rails laid upon metal ties or upon the metal floors of solid floor bridges, it is necessary to provide some efficient means for insulating the rail from its metal supports. We illustrate herewith a method of insulation which is in use on the new Park Ave. viaduct and Harlem River drawbridge of the New York Central R. R., where (as has been described in our columns) the rails are bolted directly to the rectangular transverse troughs which form the floor. The construction was shown in our issue of May 7, 1896, in an article on "Short Span Bridges." There are three pieces of indurated fiber. One forms a bed plate, and has slots for the edges of the two shorter pieces which fit between the rail and the bolted clamps by which the rail is secured to the metal structure or tie. The same device may be applied to wooden ties when desired, substituting two screw spikes for the bolts in the clamps. The patents are owned by the New York Rail Insulation & Equipment Co., 200 Market St., Newark, N. J.



Device for Insulating Rails.

BASIC STEEL RAILS.

The use of basic steel rails having a year or two ago been prohibited on the Austrian State Railways, Prof. Tetmajer, of the Polytechnic School of Zurich, Switzerland, published a paper in which he defended the use of such rails. The action of the Austrian government was due largely to two lots of inferior rails having been furnished by a German company. On the representation of the officers of a large basic Bessemer steel plant the government appointed a commission to investigate the matter (the firm referred to selecting two members), and as a result of this investigation the order was reversed, although basic rails are still required to show a tensile strength of 71,100 lbs. per sq. in., while for ordinary Bessemer rails a tensile strength of only 66,800 lbs. is required.

The defective basic steel rails above referred to were accepted in spite of a low tensile strength, as the rails were needed at once, but after some time defects appeared in the shape of longitudinal splits in the rail heads, sometimes extending nearly the entire length of the rail, a little to one side of the center line, and in some places this split was large and gaping. As the splits did not extend to within a few millimeters of the surface of the head they only became evident after the rails had been worn to some extent. Out of 1,540 tons of these rails furnished and laid in 1890, 122 rails, or nearly 8%, had been removed by the end of 1893. These same defects appeared to a still greater extent in the second lot of rails furnished by the same company, and careful examination showed that the defect existed originally in the steel. The split was not vertical, but followed irregularly the contour of the rail, and its walls showed plain signs of oxidation. In some exceptional cases the ends of the rails were crushed, owing to the softness of the material, but no cross fractures occurred, though such fractures are not uncommon in ordinary Bessemer steel. Defective rails that were tested showed a tensile strength of 62,000 lbs., with 28.3% elongation for the base, and 68,000 lbs., with 24.8% elongation for the web. The specifications required not more than 0.6% manganese and 0.1% each of phosphorus and sulphur, but analyses showed 0.415 to 0.695% manganese and 0,128 to 0,221% phosphorus.

That the rails successfully passed the drop and bending tests is explained by the low percentage of carbon and the absence of silicon, as such rails, even with too much phosphorus, may give good results in these tests and show no transverse fracture. The presence of the longitudinal split following more or less regularly the contour of the section on one side of the rail is due to careless work with the ingots. Blowholes are naturally found disposed symmetrically at a certain distance below the surface of the ingot, and if such an ingot is removed from the mold before the metal has thoroughly set, and is laid on its side on the floor or on a car, the soft interior metal will settle down to the lower side, filling the blowholes on that side, but enlarging those on the upper side, and these latter will form the splits when the ingot is rolled. Unsatisfactory and unreliable results may occur through carelessness in the blowing of the steel, as well as in the casting and handling of the ingots, but Prof. Tetmajer pointed out that it does not follow that the basic Bessemer process should, therefore, be condemned. In well managed works the heats are blown regularly, the phosphorus is brought down below the specified limit and the ingots are not removed until the metal has thoroughly set.

Since 1878 the basic process has developed rapidly. In 1880 only 50,000 tons were made, while in 1893 the output was 3,638,556 metric tons, of which about 20 to 25% was made by the basic open-hearth process. The metal is said to meet with a steadily increasing application in the construction of bridges and railways all over the continent of Europe and in England. As one of the principal objections made to basic steel has been the alleged irregularity of its composition, Prof. Tetmajer gave in his paper a number of analyses showing that great regularity is actually obtained in the output of many large works and referred to the value of the Darby and Meyer recarburization process in this connection, and also states that the basic Bessemer boiler plates of the Peine works compete successfully with the best brands of Siemens-Martin steel.

In Switzerland the principal railways use from 19 to 44% of basic rails, while some secondary railways use basic rails exclusively and others use acid Bessemer rails only. No restrictions are made as to manufacture, but the specifications require that the rails shall be faultless, made from perfectly sound ingots, whose cross sectional area is 20 times that of the rail, and that they must stand cold bending, tensile and chemical tests. Crop ends are usually chosen for the drop and bending tests, while test bars 1 in. diameter are cut from the rail heads for tensile tests. The tensile strength is required by the new Swiss specifications to be 5.5 tons per sq. cm. (about 81,000 lbs. per sq. in.) and the product of this figure and the elongation must be at least 90, which is called the "coefficient of quality." For cold bending a 4-ft. piece of rail is laid on supports 3 ft. 3⅜ ins. apart and must carry for ten minutes without permanent deflection a center load in tons of 0.15 W (W being the moment of resistance of the piece in centimeters), and must also carry a load of 0.25 W without breaking, the permanent deflection in this case being carefully noted. The average chemical composition required is not less than 0.3% carbon, not more than 0.3% silicon, and not more than 0.1% each of phosphorus and sulphur, the proportion of manganese being left to the discretion of the manufacturer. On the Northeastern Railway, of Switzerland, 27,044 basic Bessemer rails were laid between 1885 and 1893, of which 14 were removed (5 for being split, 5 for being crushed, 2 for being broken and 2 for ordinary wear and damage), giving a proportion of 0.518%. Between 1875 and 1893 the same road had laid 134,902 acid Bessemer rails, of which 431 had to be removed (216 broken, 83 split, 54 crushed and 78 worn and damaged), or 0.3195%. It is stated, however, that in the earlier years the rail flanges were notched in some places, which may have increased the percentage of removals of the acid Bessemer rails.

In dealing with the manufacture of basic rails in Germany it was pointed out that the rails from the only two works using the basic Bessemer process show the greatest resistance to wear. Thus the decrease in height of rail per million tons of traffic was 0.005 and 0.018 mm. (or 0.0002 and 0.007-in.) respectively, while the Krupp acid Bessemer rails come third with 0.025 mm. (or 0.00098-in.). This wear is obtained by dividing the decrease in height of the rail by the amount of tonnage in million tons passed over it during the period of observation. Returns from the state railways of Finland and Hungary showed that the wearing quality of basic Bessemer rails is above the general average, in some cases showing a decided superiority. The renewals of defective rails are also less than with acid rails. From the information collected, Prof. Tetmajer concluded that basic Bessemer rail steel can be made with great regularity in its composition and free from oxygen and red shortness, and also that by the application of the Darby and Meyer recarburization processes any grade of hardness can be easily and regularly obtained.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

When Punitive Damages Will Not be Allowed.

In the absence of evidence, in a personal damage suit against a coal company, of malice or reckless conduct on the part of the company indicating a purpose to have the employee injured, or of a reckless disregard of the safety of the person of the employee the injury should be confined, in case it returns, a verdict against the company, to compensatory damages only.—McHenry Coal Co. v. Sneddon (Ct. App. of Ky.) 34 S. W. Rep., 228.

Assessment Lien, Contract Must Comply with Statute.

A contract reciting that a party would construct curbing and gutter ways in accordance with the specifications thereto annexed, but to which no specifications were annexed, is not a sufficient compliance with a statute requiring all contracts to be in writing and signed by the contractor; and under it no lien can be fixed, against the will of the owner, upon abutting property. A proceeding to charge one with improvements for which he has not contracted must show a strict compliance with the law. —Schwiesau v. Mahon (Supr. Ct. of Cal.) 42 Pac. Rep., 1065.

Railway Bridge and Drainage Construction.

A railroad company's property may be benefited by the drainage afforded its right of way, and at the same time may be damaged by a requirement to remove or alter the construction of its bridge across the proposed drain. If the cost of temporary changes in a railroad bridge to admit of improvements to a stream for drainage purposes do not arise from the railroad company's continuing duty to so maintain its bridge as to admit public rights accruing subsequent to the construction of the bridge, such changes are proper subjects of consideration in the ditch proceedings, and the costs of such changes should be deducted from the assessment of benefits to the company.—Lake Erie & Western Ry. Co. v. Cluggish, drainage comr. (Supr. Ct. of Ind.) 42 N. E. Rep., 743.

Engineer's Estimate, When Not Conclusive.

The provision in a construction contract that, when the work is completed, there shall be a final estimate made by the engineer of the quantity, character and value of the work, agreeably to the terms of the contract, and the balance, after deducting monthly payments, and on the contractor giving a release, will be paid in full, is not an agreement that the engineer's estimate shall be conclusive.—Central Trust Co. v. L., St. L. & T. Ry. Co. (U. S. Cir. Ct. of Ky.) 70 Fed. Rep., 282.

Discretion of Court as to Admission of Engineer's Opinion.

The refusal of the lower court to permit a witness who has testified that he is a professor of civil engineering, and has made the law of moving bodies a study, and can tell how far a train will move by its momentum, to testify as an expert as to the distance such train would travel, in order to contravene the testimony of other witnesses testifying from practical experience, will not be disturbed on appeal.—Blue v. Aberdeen & West End Ry. Co. (Supr. Ct. of N. C.), 23 S. E. Rep., 275.

Liability of Trolley Company for Injuries.

In an action against a street railway company it appeared that in passing a switch at the top of an incline, the trolley had to be adjusted from the rear of the car; that there was but one person in charge of the car, whose position was in front, and that he, without stopping the car, went to the rear end, adjusted the trolley, and got off to run ahead to the front end; and that while running he fell, and was unable to overtake the car, which finally jumped the track and killed a passenger. The Supreme Court of California held that the company was liable. —Redfield v. Oakland Consol. St. Ry. Co., 42 Pac. Rep., 822.

Use of Streets by Gas Company.

A gas company was granted by ordinance the privilege of laying pipes in the streets of a city, subject to the conditions of a prior general ordinance fixing the conditions generally on which corporations could lay pipes, and requiring any such corporation to file with the comptroller a certified copy of a resolution of its board of directors accepting all such conditions. A company filed with such officer a resolution of its directors agreeing to comply with the general ordinance "excepting so far as any of its terms may be held or adjudged illegal or unreasonable by the courts." The court held that the council of said city never having consented to such modification of the acceptance, and the company having enjoyed the privileges of the ordinance under its acceptance, it could not refuse to comply with certain conditions of the ordinance on the ground that after its acceptance they were decided to be illegal.—Allegheny v. Peoples' Nat Gas & Pipage Co. (Supr. Ct. of Penn.) 33 At. Rep., 704.

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We illustrate and describe on another page of this issue a structure recently completed which is entitled to rank as one of the great bridges of the world, a cantilever structure over the Danube at Cernavoda, Austria, with a central span of 623 ft. The bridge is of more interest to American engineers, however, by reason of some interesting features in its design. The main trusses at the piers have a total height of 105 ft., and they are inclined toward each other, so that while they are 29 ft. apart at the base they are only 10 ft. 6 ins. apart at the top. Of course previous cantilever bridges have made use of inclined trusses; but it is worth considering whether the idea might not be adopted to advantage in the design of curved chord trusses of every long span.

A still more curious and, so far as we recall an entirely novel feature, is that the width of the cantilevers is greater at the piers than at their ends. The distance between the truss centers at the floor level being 29 ft. at the piers and only 21 ft. at the ends of the cantilevers.

Another notable feature in connection with the Cernavoda bridge is the fact that the main cantilevers were completed before their supporting piers were built, and were raised by hydraulic jacks as the piers were built up. While this may seem an awkward way to carry on work, its advantages in the saving of false-work and risk in erection are evident; and it will be remembered that European engineers have not had the experience in bridge erection over great rivers that we have had in this country, and are presumably willing to go to greater lengths to avoid difficulties in such work.

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Our recent comments (in connection with the Atlantic City collision) on the need of installing derailing switches interlocked with the signals at every grade crossing of steam railway lines, have additional force furnished them by a recent accident, unimportant, so far as casualties are concerned, at Danville, Ill. The particulars, as furnished by a correspondent, were as follows: At Danville Junction the Peoria Division of the Cleveland, Cincinnati, Chicago & St. Louis Ry. (better known as the "Big Four") crosses the Wabash R. R. at grade. On Aug. 3 a caboose and four cars of a freight train on the former road were left east of the crossing and ran back down the grade and struck a Wabash freight train which was passing over the crossing, striking about four cars back of the engine. Nine cars were wrecked, but as no trainmen were on them no one was injured. Here is an occurrence which admirably illustrates the fact that a signal system for the protection of a grade crossing cannot be called safe unless some mechanical means of protecting a train using the crossing from trains on the other track is provided. Runaway cars do not obey danger signals, and the much-vaunted appliances for automatically setting the brakes of trains running past a danger signal would have no effect on them. In the case of this Danville accident, it was pure chance that it was not a crowded excursion train which these runaway cars struck instead of a freight train. Had that occurred there would have been a repetition of the Atlantic City horror, and a new demand on the part of the public for the abolition or better protection of grade crossings. Because no one was hurt in this Danville accident the public pays no attention to it, but to a railway officer it should be as instructive as if the dead and injured resulting from it had been numbered by scores.

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What may be termed the itinerary investigating committee, especially in connection with the development of public works, is a subject which might be discussed to advantage by students of municipal government and one which directly concerns many engineers and contractors. To come directly to the point with a concrete illustration, a supplementary water supply for the fire protection of Boston, consisting of independent fire mains supplied by powerful engines with water from the harbor, has been under discussion for some years. It is now proposed to have three aldermen and five councilmen, composing the Joint Standing Committee on Fire Department, make a trip to New York, Brooklyn, Philadelphia, Baltimore, Washington, Richmond, Pittsburg, Cincinnati, Cleveland, Buffalo, Detroit, Chicago, Milwaukee and Niagara Falls to study this question, together, it is said, with training schools and veterinary hospitals for fire department horses. It is proposed to invite a representative of the city engineering department to join the expedition. The Boston "Herald," in a brief editorial headed "Eight to One," calls attention to the fact that the investigation will be made by "eight politicians and one expert," as it terms those who are to take part in it, and asks if it might not be well to reverse the numbers.

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We know nothing whatever of the character or qualifications of either the "eight" or the "one." We are sure that one capable engineer is all that is needed, ordinarily, for a trip of this sort. Whether eight city fathers are necessary depends altogether upon the point of view from which the matter is considered. Looked at technically, we have no hesitation in saying that one engineer without the other members of the party could learn all that was valuable on the subject in hand, weigh the evidence and recommend a plan best suited to the needs of the city. On the other hand, the practical aspects of city legislation, as now conducted, show that it is one thing to scientifically determine the best mode of procedure and quite another to secure the passage of the necessary legislation. "Seeing is believing," and in the case of the proposed introduction of some public works new to the locality, like brick or asphalt paving, or a garbage disposal plant, the committee having the matter in charge may come back satisfied from an inspection of successful works of the same character in other cities and ready to recommend the adoption of what some or all of them might otherwise think a doubtful experiment, at best, while the confidence of the committee will carry its recommendation through the city council. With good engineering advisers, and proper confidence in them, in many cases where investigating committees have gone out all this would be unnecessary. Often the engineering department possesses all the information needed to decide on the best plan and to carry it out, and where it does not the department could obtain it at much less expense than would be incurred by three or five or a dozen men in their journeyings over the country. As human nature stands, however, it is far easier to secure a large appropriation for such a trip than a small one to conduct engineering investigations. There is much more that might be said on all the various phases of this subject, especially regarding the educative values of these itineraries on the one hand, and on the other hand their superficial character in many cases, their cost, and their occasional dark and devious ways. But it is gratifying to note that there seems to be an increasing tendency to at least take an engineer along, thus profiting by his knowledge and experience as he points out salient features, and sometimes gaining through him for the city valuable information which would otherwise be overlooked.

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The decision of Justice Edwards, in the case of the Hilton Bridge Company, New York, vs. the State Superintendent of Public Works, George W. Aldridge, has in it elements of interest to bridge companies and to state officials. The company named applied for a writ of mandamus to compel Mr. Aldridge to award to it the contract for two lift-bridges over the Erie Canal, in Utica. The bridge company claimed that the work was awarded to a lower bidder owing to the fact that certain alterations were made in the successful company's proposal after the bids were opened. This action, the attorney of the bridge company claimed, was illegal and contrary to Section 132, Chapter 338, of the Laws of 1895, which requires that all bids shall be definite and certain, and that no bid which is not definitely certain "shall be received or acted upon." The attorney claims that two items were uncertain in the bid of the successful company and the proposal was only made definite after communicating with this company after the bids were opened. In a short opinion issued, Justice Edwards practically says that the provision of the constitution quoted does not apply to contracts let by the Superintendent of Public Works. He holds that that official is vested with great discretionary powers in awarding contracts and that his action in this matter was perfectly just.

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Without knowing more than we do of the actual facts of the case the opinion of Justice Edwards can not be criticised. But it is interesting to know that the State Superintendent of Public Works, of New York, is vested with this unusual power and is not bound by the Constitution of the State. In his hands an award under similar conditions is doubtless safe; but the practice is not a safe one to extend to every official who is to pass judgment upon the character and status of a proposal. To permit any alterations in proposals once unsealed is to at once remove about the only safeguard remaining to the bidder; and while it might sometimes work an injustice to reject all explanation of unintentional blunders in a proposal, that amounts to a change in item prices, this seems to be the only just course to pursue. The law of the state is a wise one and should apply to all alike. The remedy is always left of rejecting all bids and readvertising, thus throwing all bidders back upon a common level.

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For the last twenty years the engineers and manufacturers of Europe have been attempting to unite upon uniform methods of testing structural materials with regard to their mechanical properties, and conventions have been already held for this purpose at Munich, Dresden, Berlin and Vienna, attended by representatives of the technical professions. As might be expected in gatherings of this character, opinions differed widely, and while some agreement has been reached, many of the more important problems have yet to be solved, or present solutions revised. Under the existing conditions of trade intercourse any unification of testing methods will have little value unless it be adopted by all manufacturing countries, and hence every effort is, and should be made to secure the views and experience of the greatest number of delegates possible from technical associations and societies. At the last conference delegates attended from Germany, Austria-Hungary, Switzerland, Russia, France, America, Norway, Holland, Italy and Spain, but England was conspicuous by her absence. France, in 1891, created a government commission, having for its object the same as that of the permanent committees appointed at the later conventions, with the added advantage of more readily obtaining the funds needed for experimental research. The promoters of this unification in testing methods rely mainly, however, upon the international character of these conventions and believe that ultimate success can only result from all manufacturing nations uniting upon common standards and methods in the tests of structural materials. To this end they invite the technical representatives of all countries, and that new delegates may better understand the scope of the work proposed and that performed, Prof. J. Bauschinger, of Munich, has published the resolutions passed at the conventions held at Munich, Dresden, Berlin and Vienna, together with a short statement of the reasons for their adoption. This publication has been translated into English by Capt. O. M. Carter, Corps of Engineers, U. S. A., and by E. A. Gieseler, U. S. Assistant Engineer. This translation is issued from the Government Printing Office, at Washington, and can be secured by application. The resolutions referred to cover, in part, the tests of wrought iron and steel, copper, bronze and other metals, tests of wood, stone, paving and ballast materials and hydraulic binding materials. Aside from the great importance of a unification in the methods of tests, the text of this little book is valuable to all engineers as indicating the direction and scope of modern research in this connection.

With a full appreciation of the value of the work proposed at these conventions, it must be admitted that the task set is one difficult of performance, and some time will yet undoubtedly elapse before a thoroughly acceptable and international system of tests of structural materials can be adopted. This end will only come when the best and most experienced engineers of every country can meet in convention, discuss experiences and methods and, aided by special experimental research under standing committees, arrive at a common and intelligent agreement upon the problems presented. The difficulty lies in gathering men of this character together and enlisting them in the common cause. The views of isolated experts have little weight in a crusade of this type; what these conventions aim at is a concensus of the opinions of the technical professions and trades everywhere, and by this means alone can the nations unite upon any common methods of tests. Hence, it is important that every man who has valuable experience in these matters should be represented by communication or in person; and the wider the interest taken in the aims of these conventions the sooner will thoroughly valuable results be given out to all industries and to the technical professions.

AN OPPORTUNITY FOR AN AMERICAN STEEL RAIL PLANT IN AUSTRALIA.

In recent issues we have discussed at some length the prospects for the extension of the export trade of the United States, which is a matter now receiving considerable attention, and bids fair to lead to very considerable changes in our commercial system, but an opening now offered for American business is in a somewhat different line. There is at this present time an opportunity open for some enterprising American capitalists and rail manufacturers to establish themselves in Australia, this opportunity being afforded by the invitation to bid for the contract to manufacture 150,000 tons of steel rails and other track material in the colony of New South Wales, as has been advertised and briefly commented upon in our columns. So far, all the track material for the railways of that colony (which are owned and operated by the colonial government) has been obtained from Europe, and mainly, if not entirely, from England, but the government is desirous of establishing home industries and developing native resources, and for this reason it has taken the initiatory steps toward securing the installation of a complete rail manufacturing plant. In extending this opportunity to American investors and manufacturers the railway authorities have, no doubt, been influenced by the excellent results which have followed the adoption of certain American details of railway practice, and the introduction of American types of locomotives, cars, brakes, etc.

Some considerable time will probably be required for the perfecting of negotiations and financial arrangements among men here who may contemplate entering the competition for the contract, and it will also be necessary to collect a large amount of information upon which to base the preparation of a safe proposal, especially as the bids are to state the prices per ton for rails delivered. The advertisements were first published in July, and the proposals will be received until Dec. 30 by the Secretary for Public Works, at Sydney, and by the Agent-General for New South Wales, in London. There should, therefore, be ample time to make all preliminary arrangements and to send engineers out to make personal investigations as to questions of character, cost and supply of ore, fuel, etc.; available sites, and their distance from the mines and railways; transportation facilities; extent of present iron working industries, cost of machinery, labor conditions, etc. The probability of further contracts for rails, the prospect for undertaking the rolling of structural iron work, etc., and the possibility of securing orders from the other Australian colonies, are also points to be considered.

The contract stipulates that the rails and other materials are to be manufactured in the colony, using native iron ore and other necessary minerals, and native coal, coke or other fuel, all raised and smelted in the colony. The delivery of rails is to commence within 18 months after the contract is signed, and is to be at the rate of 15,000 tons per annum for ten years, reckoned from the date of the first delivery. The other materials are to be delivered in quantities corresponding with the requirements of the track for which the rails are supplied. The total amount of material contracted for will be as follows: Steel rails, 150,000 tons; steel splice bars, 7 per cent. of the total weight of rails supplied (10,500 tons); steel track bolts, 7 per cent. of the total weight of rails supplied (10,500 tons); steel spikes, 6,000 tons.

The bids submitted must state the prices per ton for rails and other material delivered at the railway station most convenient to the works, and must be accompanied by a deposit of £5,000 ($25,000), the deposit of the successful bidder being retained by the government until the works have been completed and the delivery of rails commenced, and being forfeited if the bidder does not execute the contract within 30 days of his bid being accepted by the Minister of Public Works. All the work is to be done under the supervision of the Engineer-in-Chief for Railway Construction, and in accordance with drawings and specifications prepared by him, which accompany the contract, but are subject to change as to dimensions and weights required. The men are to be paid their wages at least once a month in current coin of the colony, the truck system or any other such system of payment by tickets for provisions, etc., being strictly forbidden. It is also provided that in the event of any failure on the part of the contractor to pay the claims of any tradesmen, workmen or laborers in full in current coin of the colony, the Minister of Public Works or the Engineer may pay the amount of the claim and deduct the same from any money due or becoming due to the contractor. The labor element has become very prominent and powerful in the colony, and it will be seen that ample care has been taken by the government to protect the men employed in the proposed rail works. The contract must not be assigned or sublet by the successful bidder. Progress payments may be made to the contractor monthly, in the proportion of 85 per cent. of the value of the material turned out.

In the early days of the New South Wales Government Railways, the English type of track was largely used, with 75-lb. double-head rails supported in heavy cast-iron chairs. The American type of track, however, with T-rails laid directly upon the ties, has been found far more satisfactory, and the contract above noted includes only T-rails of 60 and 80-lbs. per yd., but it is stated that the length is to be 30 or 40 ft., as required. The designs of the rails and angle bars show the influence of American practice, but the rail heads are open to criticism in the roundness of the tops (10-ins. top radius and ⅜-in. corner radius), while the splice bars are thick in the web but have a very narrow edge to the flange, and are evidently designed after the Pennsylvania R. R. section. In English practice, joints with short splice bars and four bolts are practically universal, but for this Australian track six-bolt joints are to be used, and will be an innovation. The bolts will be spaced uniformly 5 ins. c. to c. in angle bars 31 ins. long, this arrangement being in accordance with the tendency of the best modern American practice to use six bolts in short bars. It would seem from the specifications that the rails are to be secured to the ties simply by round spikes, ¾ and ⅞-in. diameter and 4¼ and 5 ins. long under the head. No other form of fastening is referred to, and we are inclined to look upon this as a weak point in the track construction, although the arrangement will be superior to the average American practice in that the spikes are round and driven into holes bored in the ties, while the heads are much heavier than those of our spikes. For the 60-lb. rails the bolts are ¾-in. diameter, and the bolt holes are 1 in. diameter in the rail and 13-16 × 1 1-16-in. in the splice bars. For the 80-lb. rails the bolts are ⅞-in. diameter, and the bolt holes are 1⅛ in. diameter in the rail and 15-16 × 1 3-16-in. in the splice bars. The bolts have the Whitworth thread and are fitted with hexagon nuts, no washers or nutlocks being used, or, at least, not shown on the drawings.

Some notes from the specifications may be of interest in this connection. The ingots from which the rails are to be rolled must be cast from a mixture of the best New South Wales hematite and charcoal spiegeleisen, and the chemical composition of the ingots is to be limited as follows: Silicon, 0.1 to 0.15 per cent.; manganese, 0.8 to 1 per cent.; sulphur not to exceed 0.069 per cent.: phosphorus not to exceed 0.06 per cent.; carbon to be from 0.43 to 0.57 per cent. in 60-lb. rails and 0.55 to 0.65 per cent. in 80-lb. rails. The carbon percentage is higher than has been usual in English practice, and the ores would seem to be low in phosphorus. The proportions may be varied by the engineer in accordance with the results of the inspection of the blooms and rails during manufacture and the tests of the finished rails, so as to secure the most suitable chemical composition. According to the specifications the engineer is given considerable power to harass the contractor in this matter of chemical composition, but unless he is an expert in rail manufacture we imagine that he will be slow to interfere to any great extent if the contractor shows that he understands his business and turns out good rails. Rails that require much cold straightening will not be accepted, and all straightening must be done without hammering. Each rail must be stamped at the end to show from which cast of metal it was made. Certain rails from each day's output will be selected for test, and from each of these will be cut a piece 4 ft. 6 ins. long; this piece being placed head upwards upon iron supports 3 ft. 6 ins. apart. The test piece must withstand two blows from a weight of 1 ton falling 6 ft., the deflection to be not less than 3¾ ins. or more than 4¼ ins.; it must then sustain one blow of the weight falling 12 ft. without fracture. The engineer may change the tests, the main object being to get rails of the highest quality in regard to strength and toughness.

The splice bars call for a higher grade of steel than is common in this country, being required to be made from steel of the same mixture and same chemical composition as the rails, while in this country the bars are usually of a softer steel (with lower carbon percentage) than that of the rails. In this particular detail American practice is mainly inferior to foreign practice. The bars are to be sheared or sawed to length, pressed between dies while hot to take out any bulge, annealed and punched. The splice bolts and the spikes are to be of mild steel, and the bars from which they are made are to stand doubling cold without fracture.

One point of particular importance to the colony will be the relation of the prices for rails as submitted by the bidders for this contract, to those now paid for imported rails, including the cost of freight for the latter. It was stated in the colonial legislature, however, in answer to a question on this point, that there was every reason to believe that bids would be submitted showing that rails could be manufactured at as low a rate as they could be imported. The present price of rails in England is £4 10s. to £4 15s. (say $22.50 to $23.75) per ton, and the freight rates from London to Sydney are 12s. 6d. to 15s. (say $3 to $3.75) per ton. The cost of English rails delivered would, therefore, be about $23.50 to $27.50 per ton. As to wages, we are informed that laborers are paid 18 to 25 cts. per hour, and mechanics about 30 cts. per hour. New South Wales, it may be noted, is practically a free trade colony. The iron deposits have not been worked very extensively, but coal mining is an important industry for home consumption and for export (some of the coal being exported to the United States), and there are large coking plants in operation. There are, we understand, no iron works of any extent now in operation, the field being practically open for the new works to get a good hold of the general iron and steel manufacture.

This is the first time, we believe, that a public invitation has been given for competitive bids for the establishment of manufacturing plants in foreign countries by American capital, but such plants have in some cases been established as the result of private negotiations, the latest and most notable example of this being the new locomotive works for the Russian government at Nijni-Novgorod, which, as noted in a recent issue, are to be designed, equipped and managed by American engineers and American manufacturers. This has undoubtedly resulted from the great success which has attended the extensive introduction of American locomotives into that country. The same reasons have probably had an influence in leading the government of New South Wales to offer to American investors and manufacturers the present opportunity to establish a steel plant and rail mill, and we trust that the matter will be taken up here, and that it may prove to be practicable and mutually profitable for American capital to undertake this enterprise.

LETTERS TO THE EDITOR.

Steel Makers and Chemistry.

Sir: The voluntary introduction of chemical limitations in the revised specification of the Association of American Steel Manufacturers, marks an advance that should not be passed without notice, and the argument that such limitations are valuable and necessary is doubtless nearing a close.

Arguments as to what the chemical limitations should be will now, as heretofore, be in order, and it is to be hoped that engineers will give the matter the attention which it deserves.

The eminent authority on steel, Mr. Wm. Metcalf, in his new book, "Steel," calls the impurities of steel "elements of disintegration," and brings out clearly how, when in sufficient amount, these elements will cause the final failure of a structure. Explanations for the failure of iron and of iron structures, in the past, have been sought for in theories of vibration and shock; had these theories included an investigation of the "elements of disintegration" in the iron, they would have had more satisfactory results.

During the days of iron structures, but little attention was given to its impurities by manufacturers and practically none by engineers, so that we may say that iron has passed without our really having known it.

Phosphorus and sulphur are the most common, the most dangerous, and the most readily controlled of the "elements of disintegration," and it is these two elements on which the A. A. S. M. specification has placed limits. For boiler and fire-box steel this specification limits both phosphorus and sulphur; for structural steel the phosphorus only is limited.

The question naturally occurs, if a sulphur limit is good for boiler plate, is it not also good for bridge steel?

A much used but now threadbare argument has been advanced, that if the engineer took care of the phosphorus the manufacturer could be trusted to take care of the sulphur. This argument was doubtless made in good faith at first, but increased knowledge has shown that the neglect of sulphur sometimes leads to disastrous consequences.

No manufacturer will let the sulphur run so high in his steel that it will break up when he is rolling it, but between this point and safety there is a zone of sulphur in which steel will apparently roll and finish all right, without visible defects, but be filled with invisible cracks which Mr. Thos. Andrews, F. R. S., M. Inst. C. E., calls micro-sulphur flaws.

As sulphur is a hot-shortener it is but natural to assume that when steel is cold, sulphur is no longer to be feared; well and good, if it has not done its treacherous work beforehand. Many failures of steel which have been credited to phosphorus, a thorough investigation would doubtless have shown to be due to "micro-sulphur flaws" alone, or as an able assistant to phosphorus.

Let us thank the American Association of Steel Manufacturers for having given us phosphorus and sulphur limits; not so much for the limits themselves, as for the official recognition that limits are good.

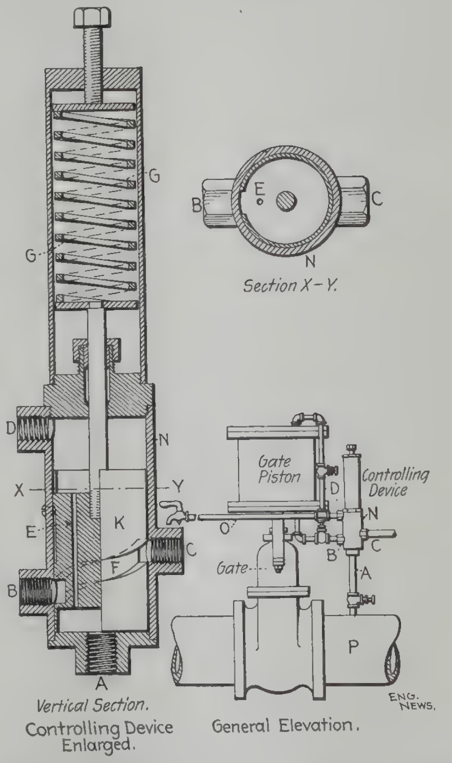
To be sure we must still take, under this specification, for railway bridges, acid open hearth, basic open hearth, acid bessemer, or basic bessemer, straight or mixed, as it may come to us, but in this respect the specifications is no worse than many individual specifications, and in the fact of having chemical limits, it is far in advance of them. A. C. Cunningham, M. Am. Soc. C. E.

Albany, N. Y., Aug. 14, 1896.

(We reprint the revised standard specifications of the Association of American Steel Manufacturers on another page.—Ed.)

A Device for Operating a Gate from a Distance by Hydraulic Power.

Sir: In designing the new gravity system of waterworks recently completed at Astoria, Ore., it was desirable to use a small reservoir, already constructed, for the supply of the low service distribution, although the elevation of this reservoir was insufficient for a first-class fire protection directly from the hydrants, and to construct the new reservoir at such an elevation as to properly supply a higher service, while when connected direct with the low service a suitable fire pressure would be secured. This plan presented the advantages of a moderate pressure for ordinary domestic consumption, and an increased fire pressure when required. The necessity at once arose for a means of readily operating the gates between the high and low services in case of fire; and it was desirable that these gates, two in number, should be both opened and closed from the central fire station. To meet this requirement the writer, in preparing the plans for the works, devised a governor for a piston lift gate, a print of which is enclosed, and which it is believed, will be of interest to many of your readers; inasmuch as this question of operating gates from a distance is one which has attracted some attention, and is often desirable of accomplishment, especially in connection with the use of stand-pipes and direct pressure for fire protection, and to accomplish the speedy closing of large supply mains in case of disastrous breaks.



A Device for Operating a Gate From a Distance by Hydraulic Pressure.

The manner of operation and general arrangement of the parts is as follows: In the cylinder, N, is a close-fitting piston, K, which moves in opposition to the spring, G. The cylinder, N, has provision for four pipe connections, A, B, C and D. Connections B and C freely communicate together by way of the inclined port, F, cut around the piston, when the piston is at the lower end of the cylinder. When the piston is raised the opening, C, is closed, and the opening, B, has free communication with the opening A. The opening D is always unobstructed whatever the position of the piston. A small hole is drilled through the piston longitudinally as shown at E, which gives free communication between the two ends of the cylinder. This hole is drilled of such size as to have a less delivering capacity under the pressure at which the gate operates, than the small pipe extending from the governor to the point from which the gate is to be operated. In operating, A is connected with the pressure pipe in which the gate is placed, a screen being inserted between the main and the governor to prevent the passage of sediment; B is connected with the lower end of the gate cylinder; C with the waste; D with the upper end of the gate cylinder with a tee connection, in one branch of which is connected the line of small service pipe leading to the station from which the gate is to be operated. At the end of this pipe is placed a stop cock or other convenient means of opening and closing the pipe. Under normal conditions this cock is closed, the water has free access from the pipe P through A, E and D to the upper end of the gate cylinder, thus acting on the gate piston and keeping the gate closed. There being an equilibrium of pressure in the two ends of the governor cylinder, the piston remains at the lower end of the cylinder. When it is desirable to open the gate, the pipe at the controlling station is opened, releasing the pressure in D, causing the piston to be thrown to the upper end of the cylinder, which act closes C, and opens B to the passage of the fluid from A, which, acting on the lower end of the gate piston, causes the gate to open while the water from the other end of the gate cylinder passes off through the pipe, O, at the controlling station. By closing the pipe at the controlling station, equilibrium is again gradually restored in the two ends of the governor cylinder through the opening, E, when the spring, G, throws the piston to the lower end of the cylinder, releasing the water from the lower end of the gate cylinder through the openings and movable port B, C and F, while the pressure being again applied to the upper end of the gate piston, causes the gate to close. By reversing the connections between the governor and the gate cylinder, the gate can always be kept open instead of closed while the pipe at the controlling station is kept closed.

This governor has operated perfectly from the very first, and responds instantly to the opening and closing of the cock at the governing station, and the gate operates without production of appreciable ram in the pipes. A check valve placed in the supply pipe from the lower reservoir closes with the back pressure, cutting out the reservoir while the fire pressure is on.

Yours truly, A. L. Adams, M. Am. Soc. C. E.

Astoria, Ore., April 18, 1896.

The "Student" Grade of Membership in Engineering Societies.

Sir: Some time since I saw in an article in a technical journal a reference to "Students of the Institution of Civil Engineers." Would you kindly inform me and several other young engineers, whether these Students constitute men yet in college or young graduates out in life, and in what manner these Students pursue studies under the Institution. Please also let us know if the American Society of Civil Engineers has a Student grade, and if so, how admittance can be had to it. Very sincerely,

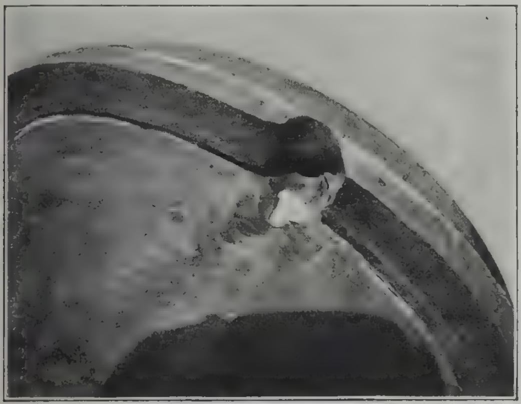
E. L. T.

Baton Rouge, La., Aug. 18, 1896.

[The Student of the Institution of Civil Engineers pursues no regular course of study under the Institution. He is simply entitled to attend the "Ordinary Meetings," to use the library, and to receive a copy of the published papers of the Institution; but he has no vote. He must be over 18 years of age, and be, or have been, a pupil under a Corporate Member of the Institution, under the English system of apprenticeship, or as an articled student of engineering under a practicing engineer. He must be recommended to the Council by the Corporate Member with whom he has served, and unless transferred to a higher grade he loses his connection with the Institution on reaching the age of 25 years. The annual dues are about $10 for a Resident and $5 for a Non-Resident Student. The American Society of Civil Engineers has a practically similar grade of member in its Juniors. This Junior must not be less than 18 years of age and have had at least two years active experience in the practice of some branch of engineering, or have graduated from an engineering school of recognized standing. He loses his connection with the Society upon reaching the age of 30 years, unless meanwhile transferred to a higher grade. His privileges are practically the same as those noted for the Student of the Institution, and both can have acceptable papers published in the proceedings of the societies. The entrance fee of a Junior is $10, with $10 annual dues for a Non-Resident and $15 for a Resident Junior, The purpose in establishing the grades of Student and Junior is to enlist the young men in the aims of these societies, to enable them to profit by the experiences of the elder members of the profession and to give them an opportunity of placing upon record any useful experiences they may have themselves. It is a valuable connection in both cases for the young engineer. By addressing the Secretary of the American Society of Civil Engineers at 127 East Twenty-third St., New York city, any applicant can obtain the constitution and full information on this head.—Ed.]

A Peculiar Break in a Water Main.

Sir: We mail you to-day a photograph showing a peculiar break in a 36-in pipe line. The point on the line where the break occurred is a sandy bottom along the edge of Stony Creek, and the leak was noticed for two months before we had an opportunity to work at it. Upon uncovering we discovered the state of affairs as shown by the photograph, which is unsatisfactory so far as showing the depth of the cutting of the metal is concerned. The pipe was laid in sand free from acids, so that the cutting was not due to chemical action. An attempt was made to cover the orifice with a patch, as will be noticed by the drilled holes, but was not successful, and pieces of two pipes were removed to make a complete repair. When first uncovered the surface of the orifice was brightly polished, and the edges were sharp, showing that the enlargement, at least, of the hole was caused by erosion. The water carried by this line is reasonably free from sand or mineral sediment. Yours truly,



Sand-Jet Effect Upon a Cast-Iron Waterpipe.

A. H. Walters, Secy.

Johnstown Water Company,
Johnstown, Pa., Aug. 20, 1896.

(This is doubtless a case of sand-blast action, the sandy soil furnishing the cutting material and a jet of water escaping from a leak in the joint supplying the power. In the "Transactions of the American Society of Civil Engineers," Vol. VII., page 14, will be found illustrated and described an almost similar case happening in the Philadelphia Water Department in 1878. In the Philadelphia case referred to the water-pressure was about 90 lbs. to the square inch, and a cast-iron pipe ⅜-in. thick was cut through in four days. Mr. Walters does not mention the pressure on the Johnstown pipe, but as the "blast" was in operation for at least two months the result is not remarkable. Judging from the photograph only and the vertical as well as lateral evidences of scour, there may have been several jets at work at the same time.—Ed.)

THE SEWERS AND SEWAGE FARMS OF BERLIN.

In August, 1894, the Prefect of the Seine sent a French government engineer, Mr. F. Launay, to Berlin to investigate the system of sewerage and sewage disposal of the German capital. The report of this engineer, published in the "Annales des Ponts et Chausees," of September, 1895, praises these works highly. The city has a population of about 1,600,000, including the suburbs, and an area of 15,586 acres; in 1874 it was without a sewerage system, while in 1894 the total length of sewers was 462 miles, and over 22,000 acres of land was embraced in the tracts used for purifying the sewage of the city. The construction of the works has been followed by a fall in the death rate from 32 to 20.2 per 1,000. "The most surprising feature in this great work," according to Mr. Launay, "is the rapidity with which it was planned; the methods, once studied out and adopted, have been followed without long or futile discussion with that force of will, that calm perseverance, that strong stubbornness, and, in a word, that spirit of discipline which is marked in the German character.

When the government became convinced that sewerage works were imperatively needed, it sent a commission to France and England to study the methods of sanitation practiced in those countries. Professor Virchow and Director Hobrecht, of the department of municipal works of Berlin, took an active part in this work and the latter was selected to prepare the plans and build the works. His report concluded with a statement to the effect that it was inadmissible to allow sewage to enter the Spree River, which passes through the city, but it should be pumped to irrigating fields in the suburbs; chemical treatment was said to be too costly as well as insufficient.

The city was divided into twelve independent districts, corresponding with slight differences in topography. Each of these basins was called a radial system and was provided in the plans with a system of sewers receiving both storm water and house sewage, and a pumping station for forcing the sewage to the irrigating fields. The part of the city south of the Spree as far as the Landwehr Canal comprises three systems: System I. is at the east, while at the west Systems II. and III. are separated by a line running from the Anhalt railway station to the Spittel market. North of the Spree are Systems IV. and V. To the south of the Landwehr Canal and separated by the Anhalt, Potsdam and Dresden railway stations, are Systems VI. and VII., at the east and west respectively; these also take in parts of Charlottenberg and Schoneberg, which are connected with the Berlin sewerage system by reason of a special agreement between the authorities of the cities. System VIII. comprises the Moabit district at the west of the city, and System IX. extends to the northwest. Finally, Systems X., XI. and XII. extend from the north to the east around the outskirts of the city. The island of Cologne is connected with System III. and the island of Berlin with System IV. The district adjoining the Zoological Gardens is connected with System VIII. by a syphon 282 ft. long, across the Spree. Systems I. to VIII., inclusive, and XII. are now in use; System XI., where the district is not yet built up, has not been begun, and the remaining two are incomplete.

The city is situated on a great sandy plain, with barely perceptible differences in elevation, and on this account the location of the pumping stations was a delicate problem. Wherever possible an attempt was made to select the lowest point in the system in order to give the sewers a grade corresponding with the natural slope of the surface. It was also necessary to keep near the public water ways in order to make as efficient as possible the interceptors which will be explained later. In the outskirts of the city, where the length of the force mains to the fields was reduced, it was possible to adopt less powerful pumps and to reduce in a corresponding measure the expenses of construction and operation. In some cases, the solution of a site for the stations was determined solely by the possession of suitable property for the purpose by the city.

When the location of the pumping station had been settled a system of channels was devised. In fixing upon the maximum of run-off per second from any surface the following assumptions were made: Maximum for household waste, 0.054 cu. ft.; for rainfall, 0.3; or, together, 0.354 cu. ft. per sec. per acre. The sections of the sewers were determined, according to the Eytelwein formula for full pipes. The pumps are all horizontal; and some of the engines are compound, controlling two pumps, and others are single, with one pump. But all the pumps in any one plant are alike in every part. The boilers are all tubular, and the buildings themselves are handsomely furnished and contain lodgings for the inspector and chief mechanic, dining-room, baths and places for drying the clothes of the workmen. The pumps are all of the piston type; excepting for a relay plant in System III., where a centrifugal pump is installed. The pumps in System IX., recently established, are compound machines, making 50 strokes per minute, on the Reidler system.

Each radial system is subdivided into basins, each of which has a collector leading to the lifting plant. The collectors, consequently, have the greatest length and the least fall and receive throughout their course either the direct drainage or the sewage from secondary collectors. The primary branches have the heaviest gradients and the least section. The depth of the water-line, at the head of any collector-system, varies from 4.8 to 8.2 ft. beneath the surface soil; at the pump-well the level is determined by the fall required in the system. At the lifting plant all the collectors unite in a common trunk, which empties into a sand-basin. This basin is essentially a sump, 39.36 ft. in diameter, divided on its diameter, into two equal parts, by a vertical grating of iron bars which leave an open mesh about 0.6-in. square. The velocity of flow in the sewage is checked by the sudden enlargement of the section of channel and by the sand, and the grating catches matter in suspension, which might otherwise clog the pumps. The foot-valve of the pump is placed in the sand-basin on the other side of the grating; or where the arrangement of the pump does not permit this a special channel leads from the sump to the suction pipe.

The sewers themselves, for three-quarters of their aggregate length, are made of vitrified clay pipes ranging from 8¼ to 19 ins. in diameter. The masonry sewers have an ovoid section varying from 2.95 to 6.56 ft. in vertical height. The following table of totals is taken from a full table showing each radial system in detail:

Masonry sewers, length	471,801 ft.
Pipe sewers, length	1,909,429 "
Waste-weirs, masonry	50,623 "
Waste-weirs, pipe	13,307 "
Manholes	2,005
Inspection shafts	8,874
Sewer inlets	14,204

The sewer-inlets or catch-basins, are built of brick masonry and are located about 200 ft. apart on each side of the street, near the curb. They are covered with gratings and admit to the drainage system all the rain falling upon the streets. These basins are cleaned out at regular and short intervals, and the connection between the basin and the sewer is made by a short section of pipe closed by a grating which arrests all floating matter.

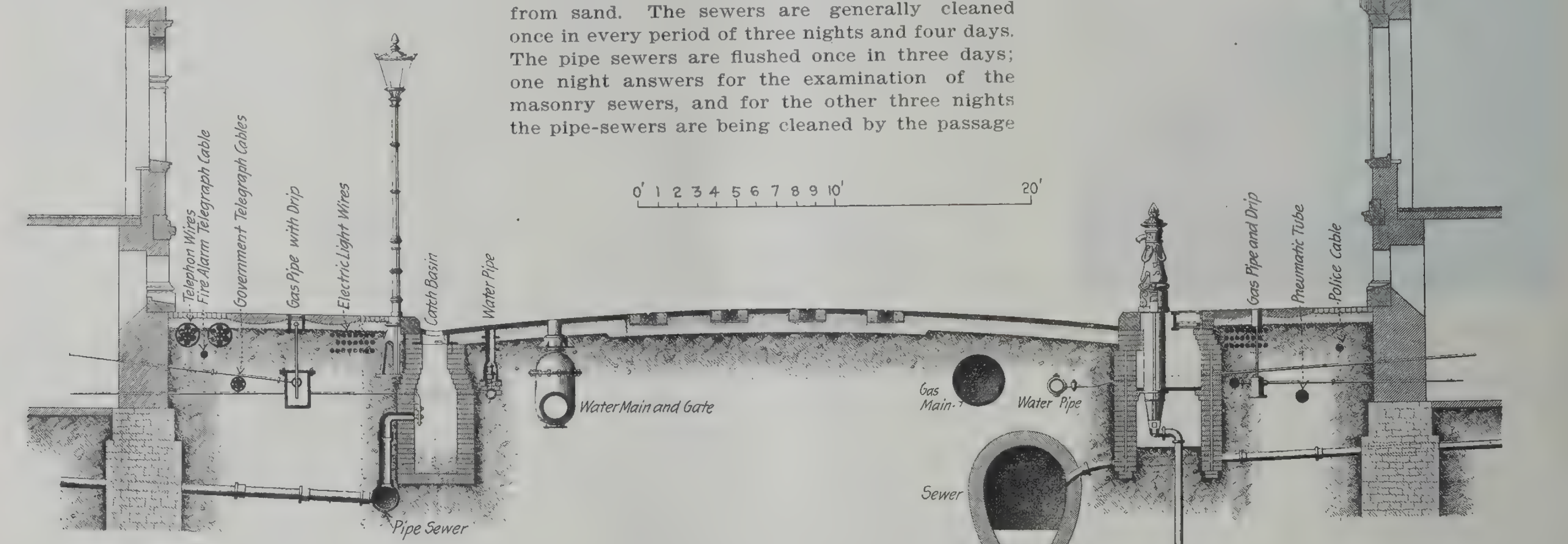
For the purpose of visiting and ventilating the system inspection shafts are placed every 200 or 260 ft. apart, or wherever the pipe sewers change in diameter or in horizontal or vertical direction. These openings are 3.1 ft. in interior diameter, and are so numerous that the whole system can be inspected, flushed and cleaned. The top of these openings is closed at the street surface by a perforated plate; the purpose being to assure air communication between the sewers and the streets. When it is considered that the total capacity of the Berlin drainage system is only 5,300,000 cu. ft. the importance of this arrangement can be better appreciated. During heavy rainfalls the sewers are completely filled and the air is forced out of the perforated plate with violence; but, on the other hand, the accumulation of compressed air at the higher points is prevented, and consequently the drainage back of the water and flooding of certain districts is avoided. The ventilation of the sewage system is also an important end gained.

The waste-weirs referred to connect the sewers with the nearest natural waterway and are used to relieve the sewers in the case of heavy rains. The bottom of these discharge pipes is established on a level with the tops of the pipe sewers, and at the springing line of the ovoid masonry sewers. To prevent a flow from the streams to the sewers this discharge channel is controlled by valves. But as heavy rains are rare in Berlin this relief system is seldom used.

One of the faults of the Berlin system is its small capacity, arranged only to perform mean duty. The Paris sewers, with their very large section, not only can care for all the water coming to them, but also provide a place for water pipes, telegraph and telephone cables and other underground furniture. In Berlin, considerations of economy of first establishment and a reduction in the cost of maintenance prevailed. When the waste-weirs commence to act in that city it is figured that the proportion of household waste to rainfall is 1 to 16; and with a water consumption of 60 litres (16 gallons) per head per day, the proportion of excremental matter is 1 to 100. This corresponds to a dilutation of 1 in 1,600; a rate which descends to 1 in 15,000 when the waste conduits are in full operation.

The pumping mains, leading to the sewage farms, have their upper side buried about 3.3 ft. below the normal street level, and they generally follow the undulations of the surface, having air-valves at all high points, which are opened daily. The diameter of the cast-iron pipe used varies from 2¼ to 3⅓ ft., and riveted iron pipe is employed in crossing streams and railways.

The house connections in Berlin are worthy of note. Building is regulated by a police ordinance of July 14, 1874, and by a municipal ordinance of Sept. 4, 1874. The police ordinance requires every owner of a house to make a connection with the sewers, either by a waste pipe or by a special connection to be used for the water-closets alone. All the old privy vaults have disappeared, and it is forbidden to build new ones. The house owner has six weeks from the date of notice to present to the city authorities for approval a complete plan of the contemplated sanitary appliances to be put in his house; and six weeks after the approval of these plans the installation must be completed.



STANDARD CROSS SECTION OF STREET; BERLIN, GERMANY.

This installation is controlled by the following rules: Every drain-pipe must be trapped and connected with a pipe carried above the roof or ventilated by communicating with a chimney; every sink must be provided with a grating; water-closets must have a water-seal and the pipe is limited to a diameter of 2¾ ins.; upon the direct house connections and directly back of the front wall of the house and between this wall and an automatic valve must be located a water-trap, which can be inspected. Rain-water pipes from the roof must be provided with a grating and a water-trap, so as to retain solid matter coming from the roofing And, finally, special authority is necessary to carry to the sewers any industrial waste or exhaust steam.

The municipal decree orders that the connections under the pavement are to be built by the city at the cost of the proprietors; only the interior work can be put in by the latter. The introduction of water and the sewer connection are obligatory, and each house bordering on a sewerage system pays a quarterly tax, according to its rental value, which is devoted to meeting the interest on the cost of construction and maintenance of the sewers. The amount of this tax is fixed annually by the administration, and in 1894 was 1% on the net revenue from the house.

The actual surface of the city drained by the present eleven radial systems is about 13,210 acres; the streets included represent a length of 314 miles, covering a superficial area of 3,366 acres. The total length of all the sewers, on April 1, 1894, was 450 miles, not including the relief sewers. The number of manholes and inspection shafts together was 10,879, and there were 14,204 catch-basins.

The entire service of maintenance, up to the limits of the sewage farms, is under an inspector having under him a number of special inspectors, the latter usually caring for two systems. The inspector has under his charge at each lifting-plant a chief-mechanic, 3 to 7 enginemen, 2 to 4 firemen, coal-handlers, etc. For the maintenance of the sewers of any system he has from 2 to 4 foremen with 6 or 12 workmen. Each foreman directs three laborers or more, according to the district assigned him. A district includes from 1,000 to 1,200 houses, and from 35,500 to 85,000 inhabitants; it also includes 15½ to 23½ miles of sewers, with 350 to 550 manholes, 450 to 680 catch-basins and from 1,500 to 2,000 house connections. The foreman is responsible for the care of tools, the inspection and cleaning of the sewers, and notes daily the amount of water used in cleaning the sewers and the quantity of sand taken from them. He examines all the house connections and ascertains that they are working properly; he supervises the regular flushing of the sewers and, at night, the cleaning of the same from sand. The sewers are generally cleaned once in every period of three nights and four days. The pipe sewers are flushed once in three days; one night answers for the examination of the masonry sewers, and for the other three nights the pipe-sewers are being cleaned by the passage of a special broom through them. In cleaning the larger sewers, two workmen, provided with boots, are employed; one of these pushes before him with a scraper all the mud, rags, paper, etc., and the second workman follows with a broom and cleans up the invert. These men usually enter at the head of a sewer at 7 a. m., and by 5 p. m. arrive at the sump of the pumping plant. During this time a third workman follows along the street and opens the manhole plates in advance of the two below, thus giving them pure air. It is also usual to have a man at the grating in the central sump to prevent it from being stopped by rags and paper.

The flushing is commenced at the highest point in any sub-system. The flushing tank is filled from the water mains, after the opening leading to the sewer has been closed by a stopper connected with the street by a chain. The tank is emptied at once by pulling out this stopper, and the flushing stream flows on down the system.

The broom-cleaning of the pipe-sewers referred to is done in the following manner: A float with an oiled cord attached to it is passed down one of the manholes into the pipe; to this cord is fastened a tarred cable fixed to a cylindrical broom of "piazzava" fiber which has another cable fixed to the other end, so that if one cable breaks the broom can be hauled out by the other. Two workmen and one foreman draw the broom forward by the aid of a reel; another takes away with a shovel the sand coming to a manhole, and a fourth man manages the rear cable and regulates the flow of distribution water for the cleaning of the sewer. Usually, three brushes of different diameters are used, one after the other, the last having the same diameter as the pipe. The sand is usually removed from the large sewers at night. For this service from 5 to 7 men are required, and the deposit is only removed when it acquires a depth of about 6 ins. One workman shovels the sand into buckets, which are carried by four men, two to each bucket, to the nearest manhole, where two other men lift them to the street.

This somewhat antiquated method of cleaning has of late years given way to an automatic flushing device. This is essentially a dam made of planks and cut to conform nearly to the section of the sewer. This dam is made in sections, united by bolts, for convenience in passing it into the sewer, and is provided with rollers above and below, and is kept in an upright position by a rear brace and guide rollers. It acts as a dam and permits the water to escape under a head through the opening at the bottom, cutting away and driving before it the sand in the sewer. This device is especially servicable in the sewers under 2½ ft. in height into which it would be difficult for workmen to enter. A new device, here illustrated, is also being used in clearing the pipe sewers on a similar principle. In this the plank dam is replaced by a cylindrical dam having a section equal to three-fourths of that of the pipe. To keep the open section down and to guide it, three heavy balls are made to roll in the bottom part.

The description of the sewage farms comes next. As showing the growth of the system of sewage irrigation, it is sufficient to say that in System I. the mean daily delivery was 150,000 cu. ft. in the year 1880-81; in 1893-94, the same system delivered 500,000 cu. ft. daily. In the same period the flow from System IV. increased from 230,000 to 1,253,856 cu. ft. per day. It is interesting to compare the quantity of water actually distributed in the city by the municipal service and the quantity sent by the pumps to the sewage farms. In the year 1893-94 the pumps delivered 2,240,000,000 cu. ft., or 16,800,000,000 gallons of sewage water; about 28 gallons per day per inhabitant. During the same period the average of water distributed from the city mains was 18 gallons per head per day. The extra 10 gallons came from the rainfall and water from industrial establishments originally obtained from wells or from natural streams; and included in this was the solids from the houses.

The natural conditions of the soil acquired by the city of Berlin for its sewage farms are far from presenting the most favorable qualities for purification purposes. The sandy dunes are less permeable than the gravels of the Valley of the Seine, and they rest upon an impervious bed, located at a light depth below them. In fact, the filtering bed is less than 3.3 ft. deep at some places and at no point exceeds 5 ft. The land acquired is in two groups; the first is to the northeast of Berlin and about 1.8 miles from the edge of the city; the second lies to the south and is about 7.2 miles distant. Of the whole 22,230 acres included in these fields, about 78% is represented by irrigation fields. The remainder is taken up by courts, gardens, parks, woods, roads and buildings. Of the total surface, about 70.3% is drained; or 96% of the irrigation area proper. This preliminary drainage is an absolute necessity, owing to the light depth of the filtering bed.

The distribution of sewage over these fields is controlled by a system of cast-iron mains with gates, and secondary conduits, some in pottery and most of them in the form of open drains, buried at least 1.6 ft. and having suitable fall. The principal conduit, leading from the pumping station, abuts at some point on the farm and terminates in a stand-pipe of the same diameter as the pipe. The branches of the distribution pipes terminate at high points and are closed with valves, the diameter of the pipe descending to 10 ins. There are about five of these valves to every 247 acres of irrigated land, and the pipes end in "swan-necks," with the escaping water falling into a circular basin or into trenches. At some places the pipes empty into a rectangular basin, 13 × 40 ft., 6½ ft. deep. These basins deposit the sand and the water in them is made to pass through facines which catch all matter held in suspension.

The beds for "running culture," or for cereals, carrots, potatoes, beans, fruit trees, etc., are arranged as at Gennevilliers (Paris sewage farm; see Engineering News, Aug. 25, 1895), in ridges and furrows. The furrows are from 65 to 98 ft. long; have a width of from 12 to 18 ins. and their depth is from 18 to 40 ins. The ridges thus formed are from 3 to 5 ft., c. to c.; they are generally united in great beds, 20 to 30 ft. on a side and in series of six, with a small dike around them. The prairie or grass beds are usually 200 ft. long by 130 to 160 ft. wide, and they are watered for three or four hours every three days. Certain other basins are set apart for winter use, or for filtration only, no kinds of cultivation being attempted. These basins receive the water in successive beds from 12 to 18 ins. deep, kept in place by dikes.

The experience with the Berlin sewage farms, as at Gennevilliers, proves that there is no burning out of the soil, no swamp-formations, and no necessity for reducing the doses of sewage water at the end of a certain time.

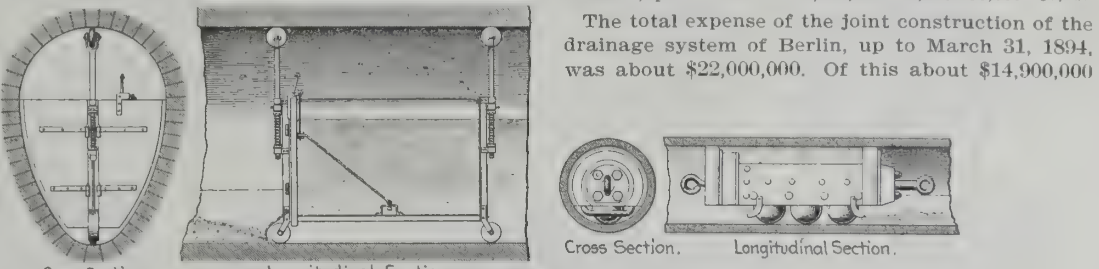
Periodical and methodical analysis will show the constancy of the effluent, or purified sewage, as being clear, pure, inodorous and free from micro-organisms. No epidemic has justified the sinister predictions of the adversaries of sewage farming. The health of the people living on these irrigated fields, carefully controlled by the administration, is always excellent, and the city of Berlin has not hesitated to establish homes for convalescents upon these fields; one at Blankenburg, for 40 women; another at Heinersdorf, for 40 men; a third at Malchon, and a fourth at Blankenfelds. These asylums are recommended by the physicians and are well filled.

As to cost, the following items are interesting: The mean daily wages paid to the workmen are 48 to 60 cts., with lodging, to the foremen of irrigation; 24 to 43 cts. to the workmen who instead of lodging receive 3,000 kilos. (6,600 lbs., or 110 bu.) of potatoes per year, or the land for cultivating them. The occasional laborers receive 36 to 60 cts.; the women, 19 to 24 cts.; and workmen caring for the fruit trees receive 60 to 72 cts. per day. Work is sometimes given as a task, and in this case the daily wages are increased 20 to 50%. At certain points the field work is done by vagrants taken from the houses of correction in Berlin, sent to the fields under guard and lodged in barracks.

The cost of managing the sewerage system in the city of Berlin, for the year 1893-94, was about $14,000; of which $12,900 was for the personnel and the remainder for sundries. In addition to this sum $820 were spent for gaging and $1,565 were set aside for the hospital for sick or injured workmen. The aggregate cost of operating the several radial systems, for the same year, was about $246,000. The average quantity of water taken from each house, etc., for the year 1893-94 is shown in the following summary of a detailed table for each radial system:

Total quantity sewage pumped pr year, gals.	16,343,000,000
Total houses connected with sewers.......	22,611
Sewage water per day per house, gallons ..	1,979
Total number of inhabitants	1,591,791
Sewage pumped per day per head, gallons..	280
Cost of operating, per head, cts.	14
Cost of pumping per 1,000 gallons, cts...	0.934
Total of sewer maintenance and pumping, 1,000 gallons, cts.	1.352

The total quantity of sand and refuse matter of all kinds taken from the drainage system in one year amounts to 130,000 cu. ft. taken from the sumps at the pumping station, and 299,000 cu. ft. taken from the masonry and pipe sewers; a total of 429,000 cu. ft. In relation to the total quantity of sewage water pumped and other solid matter taken from the sewers and the sumps at the pumping-station the dilutation is as about 1 to 5,000. The amount of solid matter still left in the sewage after passing the pumping-station is given in the table of analysis below, as 65 parts per 100,000.



DEVICE FOR CLEANING SEWERS AUTOMATICALLY.

Oval Sewers.

Pipe Sewers.

The improved drainage of Berlin has had an undoubted beneficial effect upon the health of the citizens; and while other factors have assisted in bringing about this better condition, the drainage system seemingly stands first in potency, as is shown by the following table:

Year.	No. houses connected with sewers.	Mortality per 1,000.
1873........	......	30.0
1874........	......	30.2
1875........	57	32.9
1876........	1,025	29.8
1877........	2,014	29.7
1878........	2,415	29.5
1879........	3,602	27.5
1880........	7,478	29,7
1881........	9,867	27.2
1882........	10,468	25.9
1883........	11,968	28.9
1884........	14,100	26.5
1885........	15,895	24.4
1886........	17,395	25.6
1887........	17,955	21.8
1888........	18,479	20.3
1889........	18,984	23.0
1890........	19,898	21.5
1891........	21,352	20.9
1892........	22,012	20.2

Each year the city prepares new land with a view to irrigation; by leveling the surface, tracing out and digging the ditches and irrigation trenches, by building dikes, limiting the beds or basins, and by building roads, etc. Over almost the whole irrigated area the initial drainage of the subsoil is considered very important and absolutely necessary, so as to obtain a filter of sufficient depth. The drains are made of terra cotta pipe, 2⅜ to 2¾ ins. in diameter and ⅜-in. thick, placed end to end and united by sleeves of terra cotta. The water enters at the joints and the lines of drain-pipe are laid about 26¼ ft. apart and they are sunk 5.8 ft. below the surface of the soil; and all abut upon a main drain, about 4 ins. in diameter, leading to an open ditch. Of the total 22,230 acres owned by the city a little more than one-half is now regularly farmed. Some of this land is rented out by the city at a rental of about $20 to $23 per acre, when irrigated; and at $8 per acre when not irrigated or prepared. The total amount of sewage water delivered, in 1893-94, upon 11,542 acres was 16,791,017,000 gallons. This corresponds to 1,455,000 gallons per acre per year, and to about 4,000 gallons per acre per day. The total monthly flow oscillates between a maximum of 1,578,859,000 gallons in July and a minimum of 1,192,070,000 gallons in April.

The table below gives the chemical composition of the sewage taken as it comes upon the farm from the pumps, and three specimens of the effluent taken from the vegetable and fruit farms, the grass lands, and finally from the winter outflow:

(Parts per 100,000.)

		Effluent, from		
	Sewage.	Vegetable farms.	Grass land.	Winter o'tfl'w.
Dry residue	65.00	70.00	80.00	115.00
Loss on ignition	18.00	10.00	10.00	22.00
Residium; ignition test	47.00	60.00	70.00	93.00
Ammonia	6.50	.10	.30	1.70
Nitrites......	.....	.14	1.00	1.35
Nitrates...............	.....	14.00	12.00	1.60
Phosphoric acid	2.00	.....	.10	.14
Sulphuric acid	2.60	4.00	.....	.....
Chlorine	13.00	15.00	17.00	32.00
Potash	4.00	2.00	.....	.....
Soda	12.00	16.00	.....	.....
Bacteria, per cu. cm...	100,000,000	23,000	50,000	60,000

The total expense of the joint construction of the drainage system of Berlin, up to March 31, 1894, was about $22,000,000. Of this about $14,900,000 went for the drainage system and $7,100,000 for the sewage farm, about $4,000,000 of the latter being for the cost of land.

The radial Systems I. to X. and XII., excepting the suburbs of Charlottenburg and Schoneberg, include 22,151 houses, of which 22,091 are drained and united to the drainage system. The corresponding population is 1,563,938 and the amount of sewage removed annually is 16,791,017,000 gallons. From these elements we may arrive at the following conclusions: The cost per inhabitant has been $13.54, of which $9.15 were for the drainage system, and $4.39 for the irrigation fields.

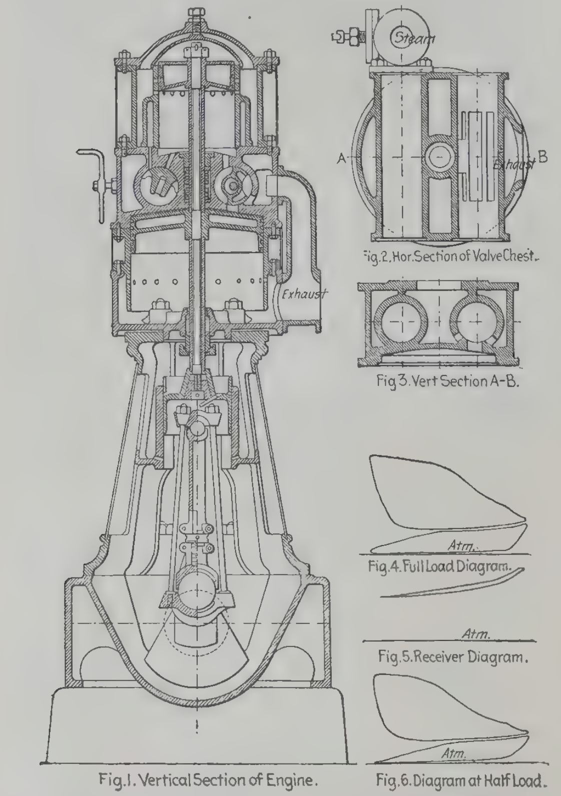
The annual cost of administration and maintenance, the clearing and care of the sewers, pumps and machinery, is $337,000; the maintenance of the sewage farms costs annually $510,000; interest upon capital amounts to $1,046,000, a total annual cost of $1,893,000. The revenue from 22,091 houses amounts to $732,000, and the revenue from the products of the sewage farms is $446,000; a total of $1,178,000. The difference of $715,000 between expenses and revenue is covered from general receipts of the municipality.

The author concludes by comparing Berlin with Paris, as follows: Berlin has not quite 23,000 houses to 1,563,938 inhabitants; while Paris has 82,500 houses to 2,500,000 inhabitants; amounting to an average of 70 persons per house in Berlin and 30 per house in Paris. In Paris, the daily outflow of sewage water is 105,700,000 gallons, of which the excremental matter would amount to 832,000 gallons, or 0.78%. In Berlin, the daily volume of sewage is 45,440,000 gallons, of which the solids represent 520,000 gallons, or 1.14%. While the filtering soil on the Berlin sewage farms is thin, less permeable and only permits an average dosage of 4,000 gallons per acre per day for the whole year, the deep sandy soil of the Valley of the Seine will admit of a dosage of some 11,400 gallons per acre per day.

◆

A NEW SINGLE-ACTING COMPOUND HIGH-SPEED ENGINE.

We reproduce from "Engineering" an illustration of a new vertical single-acting compound high-speed steam-engine, built by the Brush Electrical Engineering Co. (Limited), of London, under patents of their chief engineer, Mr. J. S. Raworth. It is designed especially for direct coupling to a dynamo. Referring to Fig. 1 it will be seen that the high and low pressure cylinders are mounted tandem, the former, which is on top, receiving steam on the up-stroke, and the latter on the down-stroke. Steam is admitted to the upper cylinder by a Corliss valve, and another Corliss valve performs the somewhat complex function of transferring the steam exhausted from the high-pressure cylinder partly directly into the low-pressure cylinder and partly indirectly through the receiver, and also exhausts the steam from the low-pressure cylinder. Fig. 2 is a horizontal section through the center of the valve chests and Fig. 3 a cross section of the chest showing the three parts covered by the low-pressure valve. Figs. 4 and 6 are diagrams taken respectively at full load and at half load, and Fig. 5 is a diagram of the receiver pressure at full load, on double the scale of the steam diagrams.

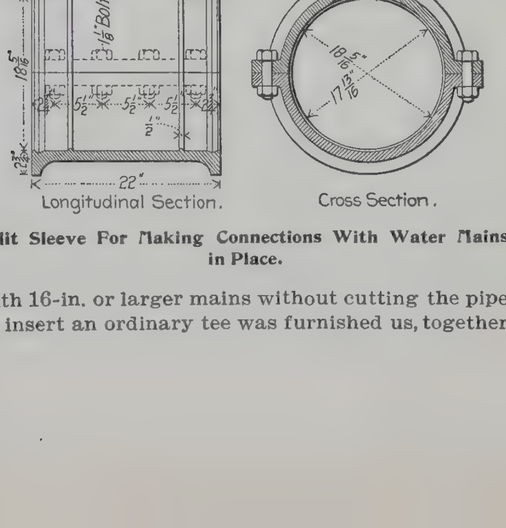


High-Speed Single-Acting Compound Engine. Patented by J. S. Raworth. Built by the Brush Electrical Engineering Co., London.

The bottom of the low-pressure cylinder is always open to the exhaust, while the upper portion of the high-pressure cylinder is in full communication to the receiver, except for a short time when the piston is near the upper end of its travel. Each cylinder has in its wall a ring of holes which acts as a supplementary exhaust. The upper holes, however, pass very little steam, because the pressure in the cylinder when they are opened is practically the same as that in the receiver. The lower ring of holes serves to drain the water out of the low-pressure cylinder. The high-pressure valve is operated by an eccentric under the control of a shaft governor, while the low-pressure valve is worked by an eccentric with a fixed stroke. The mechanical details of the engine contain a number of novelties, the leading idea being to render every part capable of being handled and adjusted by a mechanic of limited skill so that minor repairs may be made without calling in outside assistance.

A SPLIT SLEEVE FOR MAKING CONNECTIONS WITH WATER MAINS IN PLACE.

The following information regarding a special casting used for making 4, 6 and 8-in. connections with 16-in. or larger mains without cutting the pipe to insert an ordinary tee was furnished us, together with the print from which the illustration is made, by Mr. Wm. R. Hill, M. Am. Soc. C. E., Chief Engineer and Superintendent of the Syracuse Water-Works:



Split Sleeve For Making Connections With Water Mains in Place.

> The device is simply a split sleeve with a branch opening. After the main has been partly emptied of water a circular hole of the desired size is cut in the side of the pipe with a chisel. The split sleeve is then bolted on the pipe, and the lead joints are made, completing the connection.
>
> The advantage of this is that the work can be done much quicker and cheaper than to insert a tee. It is unnecessary to entirely empty the main of water, so that there can be no delay if the gates do not entirely shut off the supply as there would be if you were to insert an ordinary tee, in which case the difficulty is often increased by the inability to entirely shut off a section on account of leaky gates.
>
> The trouble of breaking a length of pipe and cutting a new piece to fit in is avoided and there is a saving of two lead joints, a sleeve, and the pipe which would have to be broken. It makes a very substantial connection, in fact a split sleeve tends to strengthen a main.
>
> On the inside of the sleeve there is a bead to hold the hemp, which will insure an opportunity to make a good joint. I would recommend this bead to be on all ordinary sleeves as it will help to make better joints.

On inquiring of Mr. Hill whether he had made use of tapping machines and if so whether he considered this device superior to them, he replied:

> We have several connections that were made by a pipe tapping machine. They have caused us a great deal of trouble and we have been obliged to abandon many of them. The split sleeve with the branch was first used at places where the connections made with the tapping machines were defective. We found the split sleeve to work so nicely that we have adopted them for general use.
>
> I do not wish to be quoted as condemning the machine made joint. I think that they could be strengthened and improved. Our trouble with them is perhaps due to the high pressure. We had them under 95 lbs. They might be all right under a moderate pressure. However, any company or department that could not afford a tapping machine would find it an advantage to use the split sleeve with the branch opening.

WATER CONSUMPTION THROUGH METERED AND UNMETERED TAPS AT LEXINGTON, KY.

A striking argument in favor of the meter system is presented by the accompanying table, showing the water consumption through metered and unmetered taps at Lexington, Ky., for the ten years, from 1886 to 1895, inclusive. The use of meters has rapidly increased in the period until now about 90% of the taps are metered. The table was sent to us by Mr. S. A. Charles, Receiver of the Lexington Hydraulic & Manufacturing Co. Mr. Charles comments on the table as follows:

> We have had some large consumers both on metered and unmetered taps, who have been quite irregular in their consumption, which accounts for the discrepancies in the average; still, the statement points to a constant increase in waste on unmetered taps and a constant decrease on metered taps, and the final average, showing a proportion of more than 4 to 1, may be safely relied on as being less than the present ratio of consumption between metered and unmetered taps.

Water Consumption Through Metered and Unmetered Taps at Lexington, Ky., from 1886 to 1895.

Year.	Av. No. taps metrd.	Metered consumption, Total.	Metered consumption, Av. per meter.	Av. No. not metered	Unmetered consumption Total.[1]	Unmetered consumption Average per tap.
1886..	33	11,738,610	355,715	238	125,706,640	528,179
1887..	103	25,287,938	245,514	264	134,150,447	508,161
1888..	209	28,971,068	143,402	271	146,237,405	539,621
1889..	344	42,648,450	123,976	267	168,479,683	631,011
1890..	486	75,576,000	155,494	254	209,215,285	823,682
1891..	659	89,231,348	135,404	239	198,928,352	832,336
1892..	829	82,642,500	99,689	230	219,229,118	953,170
1893..	942	84,486,750	89,688	216	255,053,826	1,240,990[2]
1894..	1025	85,349,250	83,267	217	262,645,590	1,210,348[2]
1895..	1100	105,771,750	96,161	223	304,893,045	1,367,278[2]
		Av. ten years,	152,531		Av. seven years,	688,023[2]

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[1] These amounts are determined by deducting from total amount pumped the amount used by city, which can be closely approximated, and the amounts used through meters.

[2] In these years 1893, 1894 and 1895, a large and unknown amount of water was used in settling earth filling in public sewers, and the grand or general average for unmetered taps is therefore based on average of preceding seven years.

A GERMAN SYSTEM OF METAL STAIR CONSTRUCTION.

The demand for fireproof construction in all details of modern buildings and the necessarily ornamental role which staircases play in buildings of architectural pretensions, has developed the problem of designing stairways into an important study. In Engineering News of April 16, 1895, the general problem of stair design was discussed in considerable detail, and in the accompanying illustrations a type of metal stair construction is shown which can be profitably studied in connection with this general article. The construction illustrated is of Prussian invention, it being marketed and controlled by the Joly Iron Works of Wittenberg, Saxony, which also holds American patents upon the construction. For the matter from which the illustrations have been prepared we are indebted to the firm named.

Fig. 1 explains the general construction of the stairs quite clearly. The stringers a a' consist of parallel wrought iron bars and are braced by similar bars d d' which extend to support the tread. The separators b b' act as stiffening members, and by means of the interior bolts c hold the whole structure together. The risers, which serve merely to cover the open spaces, are made of sheet or cast-iron wrought in ornamental patterns. They are rabbeted into the separators and have projections to which the treads are fastened. The treads consist of iron plates covered with wood or may be entirely of stone, and are ornamented as may be desired. The railing posts may be fastened to the stringers or the vertical bolts may be made long enough to screw up into the posts.

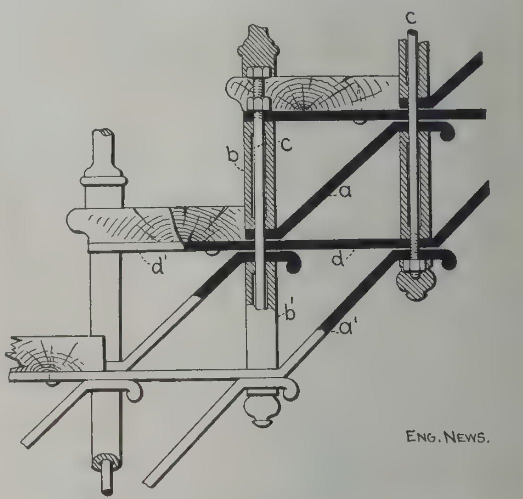

Fig. 1.—Section Showing Construction of Joly Metal Stair System

Joly Iron Works, Wittenberg, Saxony, Manufacturers.

A modification of this simple design is shown applied to a winding stairway in Fig. 2. This illustration shows the light and handsome appearance of the stringers presented by the structural design alone or with only the simplest ornamental finish. In Fig. 3 the adaptability of the construction to profuse ornamentation is shown.

Besides the designs shown, we have received from the manufacturers, circulars showing a number of other very graceful and pleasing designs, which lack of space prevents us from reproducing, but which could be studied with profit, we are sure, by every architect or engineer interested in metal staircase designing. We presume any of our readers can obtain copies of these circulars by addressing the manufacturers.

Among the claims for these stairs are the constructional advantages of having all the tension members of wrought iron, and the total disuse of splices, bolts and rivets, which detract from a neat appearance. It is also claimed, and quite justly, that the stairs in their simplest form produce a decorative effect. The construction is fireproof, or rather non-combustible, since the risers are solid, and the tread even when of wood has a solid iron plate underneath it. According to a circular published by the manufacturers, the construction has already successfully withstood fire in a burning hotel, and is accepted as a fireproof design by the local officials of Wittenberg.

IMPERMEABLE COVERING FOR STONE ARCHES.

In the "Revue Generale des Chemins de Fer," for July, 1896, Mr. Leon Malo treats of asphalt as a protection to stone arches against the infiltration of rain-water. From a general point of view the material used for such protection, says Mr. Malo, should be permanent in character, absolutely impenetrable to moisture and it should be slightly elastic so as to conform without rupture to the inevitable movement of masonry in its normal settlement under construction. This covering should also be able to support, without cracking, considerable weights which must be placed upon it.

In his opinion, asphalt alone, of all available materials, possesses the properties required, and it has been so used for a considerable time. Mr. Malo, however, warns engineers that asphalt must be employed intelligently for this purpose, and he proceeds to describe the difference between mere bitumen and mastic asphalt; and it is the latter he recommends for the use here referred to. The peculiar properties of this mastic asphalt are: That its tenacity is considerable; once cooled it adheres with great firmness to a properly prepared surface, and properly spread in a thin bed it will completely preserve the surface beneath from moisture. When mixed with a certain proportion of gravel, according to the use intended, it becomes very hard and presents an extraordinary resistance to wear.

The surface to be protected should first be covered with a bed of cement, smoothed with a trowel. The maximum inclination of this surface should not exceed 45°. When this cement is dry, pure mastic asphalt, that is without sand, is poured upon this cement in a bed from 10 to 20 mm. (2-5 to 4-5 in.) thick, acording to the importance of the work. This asphalt is spread over the cement at a temperature of 150° to 160° C. If the adjacent surface is still wet the water will at once be converted into vapor, and this vapor will escape in bubbles leaving voids below the asphalt terminating in an extremely fine vent. If it is impossible to wait until the cement bed is perfectly dry before applying the asphalt these bubbles can be smoothed down and the vents closed by applying a hot iron. When the asphalt is cool and hardened care should be taken, in filling over it, to first employ only small material, as large stones thrown upon it will crack the thin crust.

Surfaces inclined at a greater angle than 45°, or even vertical surfaces, can be protected in like manner by using greater care. In covering these steep surfaces the cement coating is purposely left rough and this surface should be perfectly dry before the asphalt is applied. Bitumen is then heated in a kettle to 180° to 200° C., and spread with a brush over the sides to be protected, but with as thin a coating as is possible. Upon this the mastic asphalt is spread with a trowel, or a batten of wood, as in the case of ordinary mortar; but care must be taken that the asphalt is kept in place and smoothed down until it is sufficiently cooled to prevent running. This is delicate work, but when executed with competent workmen and materials of the proper qualities it presents no serious difficulties.

Mr. Malo says that 35 years ago he built a dwelling house upon the side of a hill of calcareous rock, deeply fissured and filled with water at every heavy rain. The foundation wall entered into this soil for 20 ins. and the outside of this wall and the entire area covered by the house was spread with a 1-in. coating of mastic asphalt and sand. The house has always been dry from bottom to top, though the foundations, during heavy rains, are surrounded by a sheet of water from the rain.

The practical employment of asphalt as a covering for the arches of railway bridges dates from about 1858, when Mr. Jules Michel made the first experiments upon the viaducts of the Western Railway of Switzerland. About 1875 the Western Railway of France began to use a bituminous covering and 100,000 sq. m. of this material have since been put in place. Upon the Paris, Lyons & Mediterranean Ry. the viaducts built in 1848 had been protected by a coating of cement; but at the end of 25 years this cement had cracked and it was replaced at great expense, in 1875-78, by asphalt. Other railway corporations adopted the new system and the State also used asphalt largely in the protection of its fortifications. Altogether, says Mr. Malo, the area now protected by mastic asphalt aggregates 30,000 sq. m., and, as far as he can learn, no case of failure has been reported.

On the Eastern Railway of France, between 1887 and the present date about 35,000 sq. m. of the mastic asphalt have been applied to their masonry bridges, and Mr. Malo gives some of these as examples of the work done. The pure asphalt coating used is generally 15 mm. (.675 in.) thick, smoothed with a trowel and following the undulations of the extrados of the arches. The water accumulates in the hollow over each pier and is led through the arch by a metal tubing. Transversely the pure asphalt coating was carried up vertically on the inside of the side walls and at the top was connected with a footway of greater thickness made of asphalt and sand or gravel.

FIG. 2.--VIEW SHOWING WINDING STAIRS CONSTRUCTED ON JOLY SYSTEM.

FIG. 3.--VIEW SHOWING ADAPTABILITY OF JOLY STAIR SYSTEM TO ORNAMENTATION.

As the result of experience Mr. Malo thinks it would be better to apply the asphalt coating in two beds of 10 mm. thickness each instead of in one coating of 20 mm. He finds it exceedingly difficult to insure dryness in the under coating of cement, and the escaping moisture will almost inevitably produce the bubbles and vents before referred to. These vents are very minute, but if sufficiently numerous they will destroy the impermeability of the coating. For this reason he recommends that the first coat be applied as thin as practicably possible, and that a second coating of hot mastic asphalt will then absolutely close the vents left in the first. It is also essential that every precaution be taken to prevent the moisture from penetrating between the asphalt and the bed upon which it rests. In turning up the coating against a vertical side wall it would be well to cut a groove in the vertical wall bevelled from 20 mm., the thickness of the asphalt, to nothing at the bottom. This precaution adds somewhat to the expense, but it contributes in a very considerable degree to the durability and complete impermeability of the covering.

A CAVE-IN OF A SEWER is feared at Long Island City, N. Y., as the engineer of the Improvement Commission, Mr. Van Alst, has reported that an examination of the new large Broadway sewer revealed the fact that the bricks were falling from the top of the arch and that fully 300,000 had already fallen. It was only a matter of time, the engineer reported, when the sewer would cave in, and in its present condition it is very dangerous. A committee was appointed to look into the case, the work having been done and paid for by the former Improvement Board.

◆

INCREASED TRAFFIC ON THE ERIE CANAL is reported by State Statistician Ansel E. Wright. During August more coal was brought into Rochester in one day than in an entire week in 1895. From the opening of the canal to Aug. 20, 1896, 1,244 boats cleared from Rochester, as compared with 1,042 boats in the same period in 1895, and 905 boats in 1894. Detailed statements show that to Aug. 23 the increase of receipts and shipments at Rochester amounted to 60% over the same period of last year. But while the canal business is thus increasing, Mr. Wright intimates that the railways are losing a corresponding amount of trade; for while the canals, in 1895, only carried 58.7% of the total receipts of grain at New York, he expects the canal shipments of 1896 to exceed those of 1894, when they carried 94½% of all the grain sent to New York. Every available canal boat is now being pressed into service.

◆

SUEZ CANAL TRAFFIC, for 1893-94-95, is given as follows in the late report of the British directors of the Suez Canal company:

	1893.	1894.	1895.
Vessels	3,341	3,352	3,434
Gross tonnage	10,753,798	11,283,855	11,833,637
Net tonnage	7,659,068	8,099,175	8,448,383
Transit receipts ...francs	70,667,361	73,776,827	78,103,717

Of the ships using the canal, Great Britain owns about 2,400 out of the total, and Germany, France and Holland come next, in the order given; though German ships have increased from 272, in 1893, to 314, in 1895. This canal was opened to traffic in 1869; in 1872 1,082 vessels passed through, with a gross tonnage of 1,744,481 tons, yielding transit receipts of 8,993,732 francs. In 1880 the number of vessels rose to 2,026, and in 1882 to 3,198, and since the latter date the number has never fallen below 3,000. But while the mean net tonnage per vessel was 1,071, in 1872, this mean tonnage was 2,460 in 1895. The average duration of voyage is now 18 h. 44 min., for vessels navigating by night as well as by day; and the average for all vessels is 19 h. 18 min. In 1895 3,266 vessels navigated the canal by night and day. Since April 15, 1890, vessels drawing 25 ft. 7 ins. have been permitted to pass through the canal.

◆

THE BAZIN "ROLLER-STEAMER" has been launched at Paris. This craft is essentially an iron box 120 ft. long, 40 ft. wide, and 5 ft. deep, mounted upon six lenticular hollow disks or rollers, each 30 ft. in diameter and sinking into the water 10 ft. The machinery, of 750 HP., is contained in the box, and operates a screw and the six rollers, which latter pierce the box. M. Bazin expects his strange looking ship to roll over the water instead of cutting through it, and aims primarily at a vast increase of speed and an economy of fuel. He also asserts that its stability will be greater and the craft safer against danger at sea, as two rollers would keep it afloat. He proposes to navigate his ship down the Seine and across the Channel at an estimated speed of about 30 miles per hour.

◆

THE EXPLORING STEAMER "FRAM" has arrived safely at Skjervoe, near the North Cape. The captain telegraphs that he drifted to latitude 85° 57′ N., almost as far as Dr. Nansen traveled after he left the "Fram," in August of 1895. All were well on board, and a deepest sounding of 13,110 ft. and a lowest temperature of 52° below zero are reported.

◆

A FLOATING STATION for the U. S. Life-Saving Service is to be anchored in Boston Harbor. It is a triangular craft, 100 ft. long, 33 ft. beam at the stern and 12 ft. deep. The lifeboats are swung inside, on each side of an opening 20 ft. wide which extends inward from the stern for a distance of 30 ft. This is roofed over and here the boats can be easily launched, the vessel being anchored by the bow so that the boats will row off under the lee of the floating station. The vessel was designed by Mr. Kimball, Superintendent of the U. S. Life-Saving Service.

◆

THE AIR-SHIP OF CHARLES H. LAMSON made a very successful ascension at Portland, Me., on Aug. 20, and aerial experimenters declare his achievement the greatest step yet made towards solving the problem of aerial navigation. The "air-ship" used was really a box-kite made of two oblong boxes, parallel to each other and connected at the middle. It is the Hargrave ship with improvements by Mr. Lamson, tending to improve the steering qualities by hinging the rear cells of the boxes, etc. The ship was provided with a dummy weighing 150 lbs. seated in the car; it was secured by a line tested to a pull of 500 lbs., and when the forward end was slightly lifted and a short run taken it ascended steadily and safely to a height of about 600 ft. At this point a sudden gust of wind broke the cord and the ship sailed on for about half a mile and then gently descended. Had a man been in the car to attend to the steering apparatus Mr. Lamson claims it would have safely ascended to a still greater height, and as easily descended.

◆

AN AIR SHIP OR NAVIGABLE BALLOON is being built by Cusab Bros., of Walkerton, Ind. The balloon is cigar-shaped, 15 ft. long and 4 ft. diameter, with one propeller at the rear and two at the front. A car is suspended below the balloon.

◆

TWO MAIL-COLLECTING AND SORTING WAGONS are being built at Hartford, Conn., for the post office service. Each wagon has a body 12 ft. long by 5 ft. wide, and 6½ ft. high, which is fitted with all conveniences for sorting, cancelling and pouching the mail as fast as collected. Two horses will be used with each wagon, and there is room for two clerks inside. It is proposed to make collections continuously, the carriers emptying the street-boxes and bringing the mail to designated points on the routes. It is estimated that from two to three hours can be thus saved in sending mail to its destination, as compared with the old system requiring all mail to be first sent to a main sorting and distributing center.

◆

BICYCLES ARE TAXED IN FRANCE at the rate of 10 francs, or $1.93, per annum. The popularity of the bicycle in that country is thus indicated in the national tax-collector's reports. This tax was imposed on April 29, 1892, and now 160,000 machines are on the tax-lists. "Le Matin," of Paris, estimates that there is now in use one bicycle to every 250 persons of the population of France; and if the aged, young children and the majority of women be excluded, there is one bicycle to every 50 persons who can ride.

◆

A STORAGE BATTERY ELECTRIC CAR, built by the Electric Storage Battery Co., of Philadelphia, is to be tried on the 34th St. branch of the New York elevated railway.

BOOK REVIEWS.

THE ENGINEERING INDEX.—Volume II., 1892-1895. Edited by J. B. Johnson, C. E., Chairman Board of Managers, and Manager of the Index Department of the "Journal of the Association of Engineering Societies." Associate Editors: F. E. Turneaure, C. E.; C. B. Stewart, C. E.; J. L. Van Ornum, C. E. New York: The Engineering Magazine. 8vo.; pp. 474. $4.

As a labor-saving device this index ranks high among the aids to the engineer. In fact, it does more than save him labor; it points him to sources of information which it would be next to impossible for him to discover for himself.

The matter indexed, as many of our readers know, is that appearing in the leading engineering and allied periodical publications of the world. The index originally appeared in the monthly numbers of the "Journal of the Association of Engineering Societies" during the past four years, and is here brought together in convenient form. Vol. 1. was published in 1892, and covered the period from 1884 to 1891, inclusive, so that the two volumes include what has appeared in the engineering periodicals for the past eleven years. For the convenience of our readers it may be stated that copies of the first volume can still be obtained from Mr. John C. Trautwine, Jr., Assoc. M. Am. Soc. C. E., Secretary of the abovenamed association, 257 Fourth St., Philadelphia.

For many years the index work carried on by Professor Johnson was the only thing of the kind, for engineers, but lately the "Engineering Magazine" has been covering about the same ground. This fact finally led to an arrangement by which the journal was to publish Professor Johnson's index for the past four years in one volume, and bring out a yearly volume of a similar nature, the index in the "Journal of the Association of Engineering Societies" to be dropped after the close of 1895.

The volume before us, like its predecessor, aims to be more than an index, in that it gives under many of the entries some idea of the nature and extent of the article, thus enabling the user to decide, in some cases, whether the article contains the particular information which he desires.

While we cannot speak too highly of the usefulness of this volume, yet it has its faults, and they are serious ones. They relate, however, not to the matter included, nor the comments upon the articles indexed, in all of which most excellent judgment seems to have been used. The greatest fault of the book is that after the matter for it was extracted from the various sources, assorted into classes and the classes arranged alphabetically, the work was then to a large extent stopped, without making any logical arrangement of the matter in each class.

Where the number of entries under a given subject are few, like copper, dredging or flume, this matters little to the user, although none the less bad indexing, but when one wishes to find something under boilers, which occupies eleven pages, or bridges, with 25 pages, or railroads, with 32 pages, much time must be spent which might have been, and should have been, saved if the indexer had carried his task to its logical conclusion. To make this plainer, let us take up boiler explosions. There are two references to this subject on page 24, three on page 25, one on page 29, two on page 30, one on page 31, and four on page 32, and in most cases the entries on one page are separated. Or, instead of a general subject like boiler explosions let us take a specific structure of note, as the Memphis Bridge. Bridge and bridges together extend from page 38 to page 63, and there are ten entries relating to the Memphis Bridge on eight different pages beginning with the first page devoted to the subject, and ending with the twenty-first, thus: one entry each on pages 38, 46. 53, 54, 56 and 58, and two entries each on pages 45 and 57.

The criticisms thus far made are for sins of omission, rather than commission. Further criticisms relate to matters of judgment connected with the art of index-making, instead of the failure to complete the task in all its details.

The classification of subjects seems to overlap greatly in instances that cannot at all be classed as cross-references. Under "Railroads" are entries on electric and elevated roads, but both these sub-heads have their own place in the book, to which reference must be made, as well as to railroads, to find all that has been published on these subjects.

The references from one subject to another throughout the work, while in many cases valuable, seem carried to excess. Thus under "Iron" we are told to "see" alloys, bridges, buildings, iron and steel, cast iron, wrought iron and numerous other subjects, 28 in all, some of which are merely sub-divisions of the subject and should have appeared under it, instead of being scattered through the book. These lists are often placed at the middle of the section, instead of at the beginning or end, as would be expected.

No one should be deterred from securing this valuable reference book because it does not accomplish all it might when it has done so much to lighten the labors of the engineer and point out sources of information, the mere existence of which he would not and practically could not otherwise know.

GENERAL SPECIFICATIONS FOR STEEL HIGHWAY BRIDGES AND VIADUCTS.—New and revised edition, 1896. By Theodore Cooper, Consulting Engineer. 8vo.; pp. 25; 25 cts.

The last edition of the highway bridge specifications was published in 1890, but since then methods of manufacture and construction have been improved and modified, and conditions of traffic, as affecting loads on street and highway bridges have been changed. This new edition of the specifications has therefore undergone several important changes and modifications. Iron has been left out altogether, as in the new railway bridge specifications, and the classification and requirements of steel there given have been adhered to. In the arrangement of different classes of bridges important changes are noticed. It has been found necessary to provide five different classes for varying requirements of traffic and loading, instead of only three, as in the former edition. Class A 1 is entirely new, calling for a buckle plate floor with regular street pavement, an addition certainly needed in view of the growing demand for substantial bridges in the larger cities, furnishing, in fact, an unbroken street surface. One of the most important changes, which will have an influence in materially improving the safety and reputation of highway bridges, is in the provision for loading. The enormous growth of electric railways with cars far heavier and speedier than the old-fashioned horse cars, and frequently exceeding in weight all other classes of vehicles, has occasioned important changes in the loading provided for the other classes, both for suburban and town bridges. The light loads are thus left for comparatively unimportant country bridges, where there is no probability of electric railway construction, and where the loads from other sources are relatively light. The allowed tensile strains on truss members are practically the same as they were before for medium steel, but the allowed strains on floor beams and stringers have been reduced from 14,400 to 13,000 lbs. per sq. in., and the unit strains on floor-beam hangers have also been reduced. This reduction of the unit strains on members of the floor system is undoubtedly made in consideration of the electric car traffic, with high speed and frequent application of the loads. The formulas for unit strains on compression members have also been modified, especially those for posts. A special formula has been given for posts of deck bridges and trestles, allowing higher strains than on posts for through bridges. The chapter dealing with details of construction is in all essential features the same as that of the railway specifications, with some minor changes in the requirements for minimum thickness of metal, size of lattice bars, etc. As to workmanship the two specifications do not differ.

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THE BENDING OF RAILS IN THE TRACK by locomotives with faulty counterbalancing has recently been discovered on the Louisville & Nashville R. R. The rails were bent sidewise and not vertically, as is usually the case when the counterbalance is too heavy, and there seemed to be no bending action produced by the driving wheels until the speed was over 48 miles an hour. The bends were produced first at one side and then at the other, evidently by alternate blows from the sides of driving wheels. It was found that the main driving wheels were about 600 lbs. short of the correct weight for counterbalance, and this weight was distributed between the back and front wheels of the engine. This caused an oscillating motion, and the driving wheels rocked from side to side. By using lead, the proper weight was put into the main driving wheels, and the extra weight was then taken out of the other wheels. This resulted in stopping the evil effect upon the track.

◆

SOME TWO-CYLINDER COMPOUND LOCOMOTIVES, of the consolidation type, have been built by the Pittsburg Locomotive Works, of Pittsburg, Pa., for the Lake Superior & Ishpeming Ry. The compounding system adopted by the Pittsburg Locomotive Works was described in our issue of Jan. 2, 1896, and the following are the dimensions of these new engines:

Driving wheels, diameter	4 ft. 8 ins.
Driving-wheel journals	8 × 9 "
Wheelbase, driving	15 ft. 6 "
" total engine	23 " 6 "
" engine and tender	15 ft. 10½ "
Weight on driving wheels	132,800 lbs.
" total, engine	147,600 "
" of tender, loaded	76,200 "
Cylinders, h. p.	20 × 28 ins.
" l. p.	31 × 28 "
Boiler, straight, diameter	5 ft. 7 "
Boiler pressure	180 lbs.
Tubes, 240; diam. 2¼ ins.; length	14 ft. 7 ins.
Firebox	9 ft. 0 ins × 3 ft. 6⅜ "
Grate area	31.78 sq. ft.
Heating surface, tubes	2,049.50 " "
" " firebox	148.60 " "
" " total	2,198.10 " "
Height, rail to smokestack	14 ft. 11¼ ins.
Coal capacity of tender	280 cu. ft.
Water capacity of tender tank	4,000 gallons.
Fuel	Bituminous coal.
Brake fittings	Westinghouse-American automatic.

◆

RECORDING TURNSTILES are being tried at some of the less important stations of the New York elevated railways, to avoid the expense for tickets, ticket sellers and ticket choppers. One man takes the fares and releases the clutch of the machine, allowing the arms to revolve as the passenger pushes against them. The machine is locked at each quarter of a revolution and registers the number of revolutions. The machines have been in use on the Brooklyn Elevated R. R. for some time. They are manufactured by the American Passimeter Co.

◆

THE KINGS COUNTY ELEVATED RY. CO., of Brooklyn, N. Y., was placed in the hands of a receiver on Aug. 31, Gen. James Jourdan, the President of the company, being appointed to that office by general consent. This road was chartered in January, 1879, but owing to litigation construction was not commenced until 1886, and the first three miles of the railway were opened to traffic on April 24, 1888. On Aug. 20, of the same year, 4½ miles were in operation. The Fulton Elevated Ry. Co. was then organized to extend the road to Jamaica, and it was leased to the Kings County Co. for 99 years and completed in July, 1894. In 1895 the company was reorganized, absorbing the Fulton elevated railway, and its capital stock was increased from $3,250,000 to $4,750,000; both first and second mortgage bonds were issued at the rate of $550,000 per mile of road. The Brooklyn & Brighton Beach Railway was leased in December 1895, The cause given for the failure is the great decrease in revenue due to the competition of the trolley surface roads.

◆

ELECTRIC TRACTION on the Nantasket Beach Branch of the New York, New Haven & Hartford R. R. was in June last extended as far as East Weymouth in the direction of Boston, on the main line of the Old Colony Division. On the new line, however, the overhead conductor is not used. A third rail laid between the rails of the surface track takes the place of the trolley wire, and the cars have been regularly operated over it between the regular steam trains without hitch or difficulty. In the operation of the cars the change from the overhead trolley to the third rail source of power is made imperceptibly. When the car approaches the end of the trolley wire a knife switch under the hood of the car is closed connecting the shoe beneath the car with the motor circuit; the trolley slides off the overhead wire and is hooked down, the car meanwhile continuing on its journey. On the day of the inauguration of the third rail section several high speed spurts were made, and these have frequently been exceeded in the actual service. The first section, with overhead trolley wire, was described and illustrated in our issue of Aug. 1, 1895. The overhead wire and third rail sections were both built by the General Electric Co. The car house has four pits over which the cars may be run for examination of the motors and is fully equipped with all the necessary appliances.

◆

IRON CAR-TRANSFER BRIDGES are being placed at certain points along the water front of Brooklyn, N. Y., in connection with the new dock railway system of the Brooklyn Wharf & Warehouse Co. Each transfer bridge has two through trusses, 100 ft. long, 33 ft. wide and 9 ft. deep, and weighs about 120 tons. The river end will be supported by a wooden pontoon, 40 × 30 ft., 7 ft. deep. The bridges are built on the ground by the Elmira Bridge Co., of Elmira, N. Y.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment of the southbound White Mountain express, of the Boston & Maine R. R. at Concord N. H., Aug. 27. The train was entering the yard at a speed of about 30 miles an hour when it was derailed by a defective switch, the engine and tender were upset and fell over on their sides, and the heavy baggage car telescoped the smoking car for half its length. None of the other cars were badly damaged. Nobody was killed outright, but fifteeen persons were injured, some seriously. ——A rear collision between a westbound special freight train and a newspaper express occurred Aug. 30 at Orange, Mass., on the Fitchburg R. R. The freight train was ahead, but had broken apart while east of Orange, and as the delay made it impossible to reach Erving, where it had orders to let the express pass, the train was trying to reach Orange to cross over to the eastbound track. It did not reach the crossover in time to avoid the collision. The engine of the express smashed and derailed twelve cars and then left the track and fell over on its side, the engine and one passenger car being wrecked. The engineman and fireman were killed.

◆

A GRADE CROSSING DERAILMENT occurred Aug. 19 at Columbus, O., at the crossing of the Ohio Central Ry. and the Cleveland, Cincinnati, Chicago & St. Louis Ry. The tower man gave a clear signal for a train on the former line and then changed it to danger in the face of the train, with the result that the train was derailed by the derailing switch, but nobody was hurt.

◆

THE SOUTH HALSTEAD ST. LIFT BRIDGE over the Chicago River at Chicago, Ill., was raised on Aug. 25 while an electric car was crossing. The signals were not displayed to stop the car, but the engineman claimed that a steamer was so close to the bridge that he had to raise it to avoid an accident. The passengers were considerably scared, fearing that the car would run off the end of the bridge span. The matter has been made the subject of an investigation.

◆

THE FALSEWORK OF THE MISSION ST. BRIDGE over the Spokane River, at Spokane, Wash., gave way Aug. 25, and five men were injured. The men were raising some of the supports at the pier when the falsework broke loose from these supports and fell over.

◆

A POWDER EXPLOSION occurred at the dryhouse of the Miami Powder Works, five miles from Xenia, O., Aug. 26, and two men were killed. The men were in the dryhouse when the 30 tons of powder in the building exploded.——An explosion of 5,000 lbs. of giant powder occurred Sept. 1 at the Equitable Powder Mills, Alton, Ill., by which three men were killed.

◆

A FIRE AT ONTONAGON, MICH., on Aug. 26, practically destroyed the town, which had a population of about 2,000, and a number of people are thought to have been lost. An immense amount of lumber was destroyed, and the water-works plant and government breakwater were badly damaged, while the great works of the Diamond Match Co., valued at $1,000,000, were destroyed. The town is in the copper mining district and is the Lake Superior terminus of the Chicago, Milwaukee & St. Paul Ry.

◆

THE COST OF THE NEW EAST RIVER BRIDGE is placed at $7,510,000 by the Chief Engineer, Mr. L. L. Buck, M. Am. Soc. C. E., in his statement to the Commission. It will require this amount to complete it by Jan. 1, 1900. The amounts estimated for the several parts of the work is given as follows:

Description of work.	Cost.
New York tower foundations	$500,000
Brooklyn tower foundations	860,000
New York anchorage	820,000
Brooklyn anchorage	820,000
New York tower, steel	186,000
New York tower, erection	124,000
Brooklyn tower, steel	186,000
Brooklyn tower, erection	124,000
Cable strands	450,000
Cable erection	300,000
Suspended superstructure, steel	966,000
Suspended superstructure, erection	644,000
Approaches, steel	780.000
Approaches, erection	520,000
Flooring, painting, &c.	230,000
Total	$7,510,000

◆

THE HARLEM VIADUCT of the New York Central R. R. will not be opened to traffic before the end of this year, or perhaps next spring, according to the Chief Engineer, Mr. Walter Katte, M. Am. Soc. C. E. The reasons given are an injunction affecting the proposed Harlem station, and a law passed through the Legislature compelling the company to change its plans for the station at 125th St. The new station is to be under the structure, in the center of Park Ave., and it will cost about $95,000. The four-track drawbridge over the Harlem River and the approaches on both sides are completed and the tracks are already laid.

◆

AN ELECTRIC DREDGE has recently been built by A. F. Smulders, of Rotterdam, Holland, for service on the Esla River, in Spain. It is a ladder dredge, and a 45-HP. motor running at 600 revolutions per minute drives the dredging chain, although the average power required is only 15 HP. The hoisting engines for operating the spuds are operated by motors, as are also the screws. the drums for raising and lowering the dredging chain, and a centrifugal pump. On the river bank is a power house with three-phase alternating dynamos delivering the current of 2,000 volts, which is transformed on the dredge to 200 volts. This plant also furnishes current for the motors which operate a discharging plant, which elevates the dredged stuff from the scows and loads it into railway cars.

◆

THE DUPLICATE STEEL SUPPLY MAIN for the water supply of Newark, N. J., is practically all laid. It is 21 miles long, 48 ins. in diameter for about five miles and 42 ins. for the remaining distance. It parallels the 48-in. steel main put in use in 1892, but was laid in less than half the time taken in putting down the first one. Some trenching was done as early as the latter part of December, 1895, and pipe laying was begun in March, 1896, but none of the work, it is said, was pushed until April. The work has been done by the East Jersey Water Co., of which Mr. Clemens Herschel, M. Am. Soc. C. E., is engineer, with T. A. & R. G. Gillespie, of Pittsburg, Pa., as contractors. The same contractors laid the original pipe line.

◆

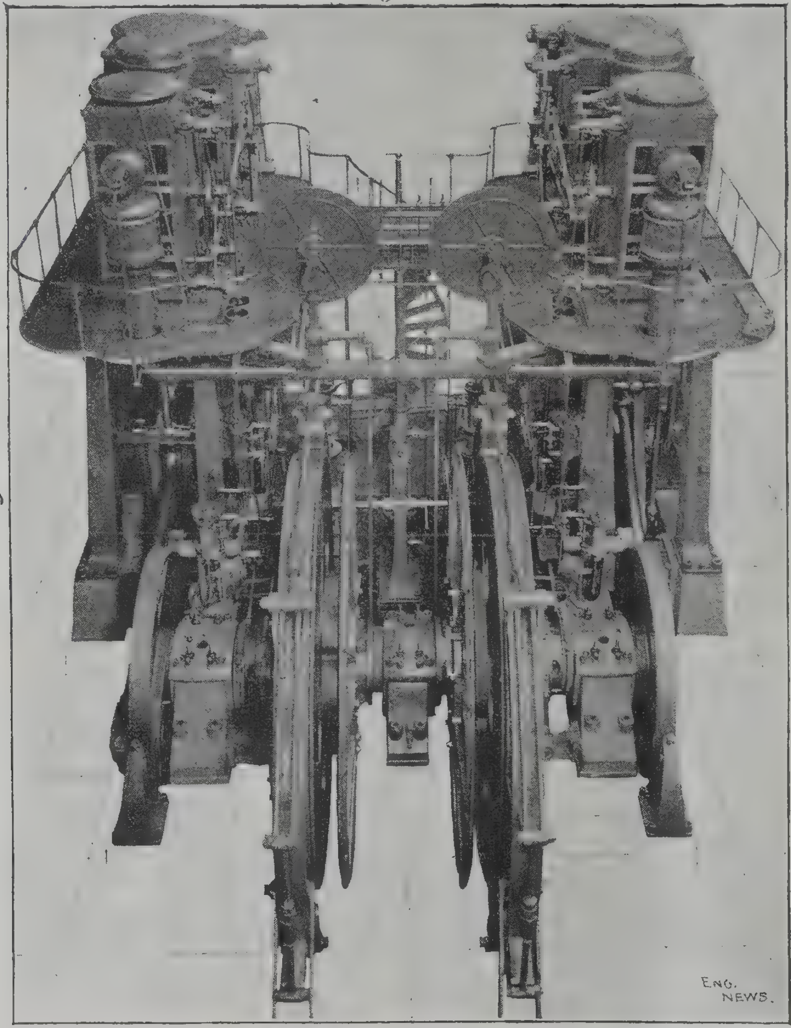
BIDS FOR PUMPING MACHINERY with a capacity of about 23,800,000 U. S. gallons are wanted by the Sanitation Board of the City of Mexico until Nov. 14. There may be one or more pumps, with a guaranteed duty of about 100,000,000 lbs. per 100 lbs. of Cardiff coal. Water tube boilers are required. The delivery from the pumps will be through a 42½-in. pipe, with an initial pressure of 17 lbs., water to be taken from a reservoir with a constant water level 5 ft. below "the level of the soil." The water pumped will be used for sewer flushing. Mr. Roberto Gayor, M. Am. Soc. C. E., is city engineer and Mr. Jose Ives Limantour is Chairman of the Sanitation Board of the City of Mexico.

THE GREAT HOISTING ENGINES FOR THE ANACONDA COPPER MINING CO.

Many of the large and deep mines in this country require very large and powerful plant for hoisting and pumping, and we illustrate, this week, two immense hoisting engines which have recently been built for the Anaconda Copper Mining Co., of Butte, Mont., by the Union Iron Works, of San Francisco, Cal. These engines were described to us during a recent visit to these works, and we are indebted to Mr. H. T. Scott, President of the Union Iron Works, for photographs and particulars of the engines, which have been named the "Aztec" and "Modoc." The larger view shows the engines in the erecting shop, at San Francisco.

Each pair of engines consists of one left hand and one right hand compound beam engine, connected to the reel shaft by disk cranks with crank pins set at right angles.

The cylinders are vertical and inverted, each engine having one high pressure cylinder, 26 × 72 ins., and one low pressure cylinder, 46 × 72 ins. The pistons are connected to opposite ends of the beam by piston rods, crossheads, and reach rods, or links. At the top, or king post, of each beam, one of the main connecting rods take hold, while the opposite end of the rod is connected to the crank pin, thus giving at all times a positive stroke of 72 ins. to the pistons.



END VIEW OF HOISTING ENGINES FOR THE ANACONDA COPPER MINING CO.
Union Iron Works, San Francisco, Cal., Builders.

The high pressure cylinder is located in front of the low pressure cylinder and a reheater is placed between them. The high and low pressure cylinders are steam jacketed, and the water of condensation is automatically carried off from the jackets by steam traps, which discharge into feed tanks or condensers. The cylinders of each engine are supported by a cast-iron framing, consisting of four vertical and four diagonal columns, resting on a heavy bed plate and securely bolted thereto. All the cylinders are covered with teak wood lagging, and have highly finished metal covers.

The main valves of each engine will be of the Corliss type, worked by a wrist plate, which derives its motion from an eccentric on the reel shaft, and a crank on the beam pin. The valve motion is a modification of the Walschaert valve gear. The reversing gear is operated by a separate engine and hydraulic controlling cylinder. The cut-off valve gear mechanisms on the low pressure cylinders are adjustable by a hand lever or governor, as desired, and the cut-off valve gear mechanisms of the high pressure cylinders are controlled by a governor and by a hand lever on the working platform.

The beam center bearings and the main bearings for the crank shaft are cast in and form a part of the main sole plates. All the bearings are substantially fitted and provision is made for adjustment to allow for wear of the moving parts.

There are two reels or drums on each crank shaft, each having a capacity of about one mile of flat wire rope. The reels may be operated independently of each other or in balance as desired. Each reel is fitted with a patent friction band clutch applied by an entirely separate engine, and hydraulic controlling cylinders. The reel brakes are of the Post pattern, with beams of heavy cast iron, securely braced with steel rods, tied together top and bottom. Each is operated by a separate engine and controlled by hydraulic cylinders.

The auxiliary engines for working the reel brakes, reel clutches, reversing gear, and disk brakes, are operated by hand levers, all grouped conveniently together on the operator's platform, which is located between the engines, and forms a part of the main engine gallery. There are eleven separate engines to each pair of these hoisting engines.

To the end of the rope on each reel is secured a four-deck cage, which when loaded and in full motion in the shaft will travel with a velocity of 40 ft. per second. Each reel is provided with a very ingenious rig for indicating the position of the cages in the shafts, and the speed at which they are traveling.

A governor is fitted to each pair of engines, which, when at full speed, assumes entire control of them, giving a uniform speed to the cages, and regulating the valve-gear tripping mechanism to cut off at the most desirable portion of the stroke, which means an economical distribution of steam in the cylinders and an economy in fuel consumption.

There is one main central winding stairway leading up to the upper gallery or operator's platform, with numerous smaller platforms, giving access to all the parts of the engines requiring constant attention and adjustment. The platforms are provided with iron stanchions, capped with brass hand railing, neatly designed and highly polished. Brass drip pans are provided to catch any waste oil from journals, and all piping used around the engine is of brass.

To work one pair of these engines in all their requirements, the man has seven levers and one foot lever to operate, while just in front of him are located the two dials or indicators, which require his constant attention while the cages are in motion.

Each pair of hoisting engines weighs about 400 tons, and the rated power of the two sets of engines is about 5,000 HP. The engines are said to be the largest of their kind in the world

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NOTES OF A TRANSCONTINENTAL TRIP.

(Editorial Correspondence.)

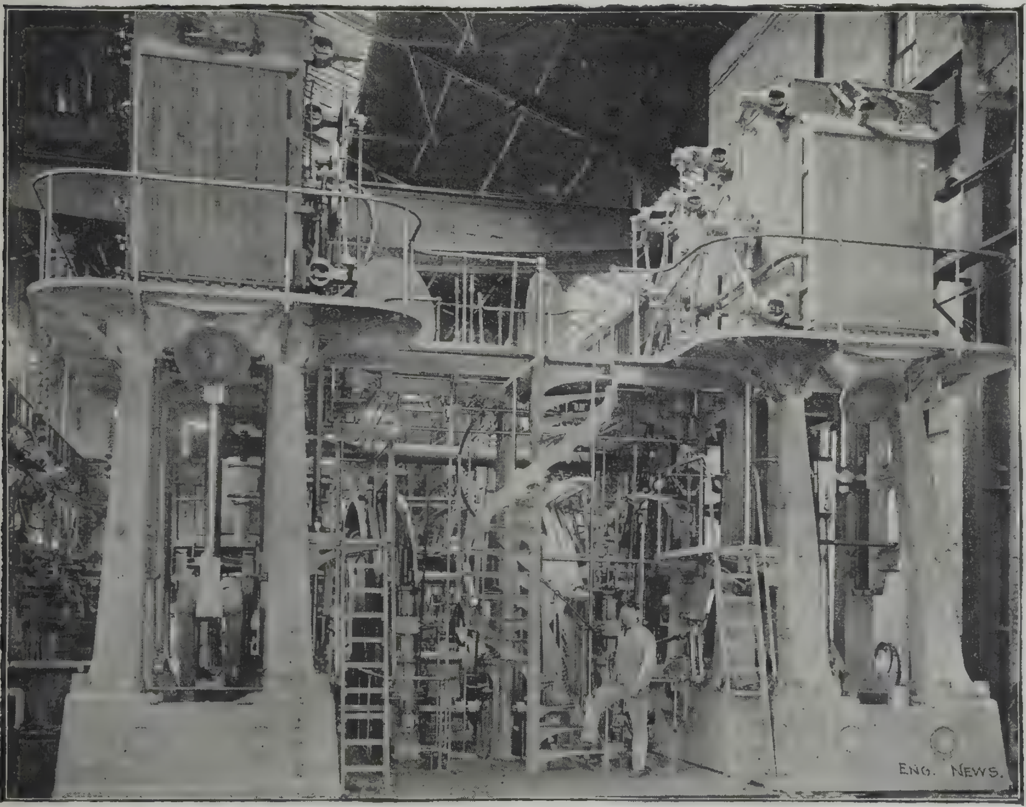
I.

It had been my intention to attend the annual convention of the American Society of Civil Engineers, held in June, at San Francisco, Cal., and to accompany the party on the special train from New York. Circumstances, however, prevented this, but as all preliminaries had previously been arranged it was eventually decided to make an independent trip later to the Pacific coast, and to spend some time looking up friends of Engineering News, and in looking up work in the "far west" that would be of interest to its readers.

Erie Railway.

The first stage of the trip was made on the Chicago Vestibule Limited express of the Erie Ry., leaving New York at 2 p. m., on June 30, and one of the first points calling for comment was the apparently small percentage which this route receives of the heavy through traffic between New York and Chicago, meaning thereby the first-class traffic on the express trains more especially. The time is convenient (the Vestibule Limited leaving New York at 2 p. m., and arriving at Chicago at 5 p. m. the next day), and, as was explained in an editorial on "Accelerating the Speed of Express Trains" (Eng. News, Sept. 19, 1895), convenience of time in train service is a greater aid to the encouragement of traffic than is a mere matter of actual speed, or a little saving in time, though as far as this is concerned the speed on the Erie Ry. is practically equal to that of its competing lines. The road is well built and well managed; it is operated on the block system for the entire distance of 998 miles (which at present includes a considerable stretch of single track); the equipment cannot be surpassed by that of any other road in point of comfort, convenience and ease of riding; and the attendance and service on the cars is all that could be desired, while besides all this there is an abundance of fine scenery along a large part of the line. In spite of all these advantages, however, the number of passengers on the through cars has been found on more than one occasion to be comparatively small, which is an additional point of convenience to the passengers themselves, but is not a source of satisfaction to the railway company. Perhaps one reason for this is the unfavorable reputation which the railway acquired in years past, and which still exists as a difficulty which the present management has to contend with in its endeavors to increase the patronage, in spite of which the management has had and is having considerable success in building up its traffic. It is earnestly to be hoped that the many financial troubles of this important system may have been practically terminated by the recent reorganization, and, as has already been noted, there are now but few objections to be made from a passenger's point of view. As to the general aggregate of the through traffic it appears from official information that this line is at least holding its own.

The construction, track and equipment of this road have been described at various times in Engineering News, more especially in the issues of Feb. 8, 1894, and Jan. 9, 1896, and these matters need not therefore be dealt with here. Reference may, however, be made to the excellent standard of maintenance and discipline generally observed. New ballast is being put in quite extensively, but some parts of the western divisions are still very dusty, and an extension of the use of stone and slag ballast as means will permit, will add considerably to the comfort of passengers. The Chicago & Erie Division is being largely relaid with 80-lb. rails, having suspended, broken joints, spliced with six-bolt angle bars. Two important improvements in operating, which have recently been put in force, are (1) the making up of freight trains on a tonnage basis (that is to say, by actual weight of train instead of by a fixed number of cars); and (2), giving the freight engines a straight run of 192 miles (from New York to Susquehanna) instead of changing engines at Port Jervis and thus making two runs of 88 and 104 miles. The advantages and economies resulting from these improvements were editorially commented upon in Engineering News of July 23, 1896. The Chicago Limited express on the particular date of this trip (June 30) consisted of a powerful ten-wheel engine of the class now largely used for fast and heavy passenger trains, a mail car, baggage and smoking car, day car, Chicago sleeping car, Cleveland sleeping car and Cincinnati sleeping car, this latter having a drawing room and a roomy observation platform fitted with camp stools.



THE GREAT HOISTING ENGINES FOR THE ANACONDA COPPER MINING CO.
Union Iron Works, San Francisco, Cal., Builders.

One point which seems to call for criticism in this train service is the method of handling the dining car service. Formerly the dining car on this train was run through for the entire distance, but now dinner is served on a dining car which runs through from New York to Susquehanna, and breakfast is served on a dining car put on at Kent (6.50 a. m.) and taken off at Marion (10.15 a. m.), while lunch has to be scrambled for in an ordinary eating house at Huntington during a stop of only ten minutes, which is a very inconvenient and unpleasant arrangement, especially in bad weather. Of course a through dining car means hauling an extra dead load for many hours, but it ought to be practicable to extend the run of the dining car to include lunch time, or at least to furnish a buffet lunch, as a lunch stop is certainly beneath the dignity of a "Chicago Limited." It is said that when the cars were run beyond Marion to serve lunch the patronage was so light that they were taken off to save the 254 miles extra mileage and the loss on the meals, but it is difficult to see why this should be, especially if the ten minutes stop at Huntington was reduced to an ordinary stop, since no passenger having breakfast before 9 a. m. would want to go without any meal until after 5 p. m.

Dining Car Service.

In the operation of through trains on very long distances an important point for consideration is the best method of arranging the dining car or eating accommodation so as to most satisfactorily meet the comfort and convenience of the passengers as well as the operating requirements. The three principal methods are as follows: (1) To run a dining car right through with the train; (2) To attach a dining car every morning and cut it off at night; and (3) To provide a buffet car service. The first method is undoubtedly the best as far as the convenience of the passengers is concerned, and it insures a supply of provisions in case the train is delayed or the line is blocked, but on the other hand, it involves the hauling of a considerable extra dead load which may be a serious objection on lines having heavy mountain grades. This plan is, nevertheless, adopted by the Northern Pacific R. R. for all its transcontinental trains, between St. Paul, Minn., and Portland, Ore., 2,056 miles. The second method is almost as good as the first, under all ordinary conditions, provided that the car is put on sufficiently early and not taken off too soon, although it often happens that the schedule cannot well be arranged to make this fit in conveniently with the time of arrival at divisional points between which the cars run. Should the train be late, however, in the morning, the absence of breakfast will cause considerable grumbling, while in case of a block or a breakdown the lack of provisions may be very inconvenient. This method is employed by the Canadian Pacific Ry. for its transcontinental trains, at least east of the Rocky Mountains, and in one particular case on that road an accident in winter blocked the track and the Pacific express, minus a dining car, was held for a day or more on the track amid the snowdrifts. Through the Rocky Mountains no dining cars are used, on account of the heavy grades on the line, but the trains are timed to reach the company's hotels at meal times, and it must be said that a very exceptionally good service is maintained at these places, far superior in fact to any other railway eating house at which it has ever been my fortune to take a meal. The meals are excellent, and well and promptly served, but without the slightest hurry or bustle. The amount and character of the traffic, as well as the character of the line, must, of course, be taken into consideration in deciding which of these methods should be adopted in any particular case. In any case it is important to have the meals served at convenient hours, but this is not always done, as for instance, on one part of the run of the eastbound trains on the Canadian Pacific Ry., where breakfast is served at 8.30 a. m., lunch at 11.30 a. m., and dinner at 5.30 p. m. The first interval is too short, and the time for dinner is too early, especially as the car is run until 7.45 p. m. The buffet car service is not adapted for very long runs, but is specially convenient for day runs (serving two or three meals) or night runs (serving supper and breakfast) of 10 to 14 hours' duration. It is also very convenient in cases where single through cars are run, being attached to different trains on the different lines forming the route. In the buffet car, as is well known, the car porter cooks and serves light meals in the car, the charges being a-la-carte, while on the dining car there is usually a fixed price of 75 cts. or $1 per meal, though some roads (including the Union Pacific Ry.) serve meals a-la-carte on the dining cars. For first-class traffic it is not enough to stop the train for 10, 20 or 30 minutes at an ordinary railway eating house, as the hurry and scramble and the character of the food do not suit persons in delicate health or with weak stomachs. This plan is, however, followed on some lines, but while the patronage may not be enough to warrant a dining car service it would in most cases warrant introducing a buffet service on the sleeping or parlor cars. The dining car service is usually operated by the Pullman or Wagner palace car company, under contract, and at a loss to the railway company, but in some cases the railway company could operate this service more profitably, and the Baltimore & Ohio R. R. has recently purchased the dining cars of the Blue Line express trains between New York and Washington, and will operate them under its own management, as they have hitherto been operated by the Pullman Palace Car Co. at a loss to the railway company. It is a common practice to run dining cars on express trains running distances of 100 to 400 miles, as between New York and Philadelphia, Boston or Buffalo. The Lehigh Valley R. R. has also a unique lunch car service on excursion and day trains, the car being fitted with a regular lunch counter where light refreshments are served.

Chicago.

This city was reached at 5 p. m., July 1, and was left again at 6 p. m., on July 2, only one day being spent here, as all engineering matters of interest in that vicinity are well looked after by the Chicago editor of Engineering News, and it was a relief to get away from the heat and humidity of that city.

One of the striking pieces of engineering work now in progress is the lowering of the grade of the Illinois Central R. R. along the lake front, and the reclamation of submerged land to form a park east of the railway. Practically the whole of the lake front, for a long distance south from the mouth of the Chicago River has been occupied by the railway, but now there is to be eventually a fine lake front park close to the main business part of the city, similar to Lincoln Park and Jackson Park in the north and south suburban districts of the city. A bulkhead or sea wall, 6,200 ft. long, is now being built 1,250 ft. from the shore, and the space between this and the present shore will be filled in, forming a park of some 164 acres, the grade of which will be sufficiently high above the railway to allow of bridges spanning the tracks. The filling in, on such a large scale, will be quite an interesting piece of work in itself.

Another noticeable work is the construction of the terminal loop for the joint use of the several elevated railways, and while this will be a great advantage to the local traveling public, it must be said that the structure is very detrimental to the appearance of Van Buren St. This work was described in Engineering News of July 16 and Aug. 20, 1896. The demolition of the old Post Office, to make way for a new structure (with presumably better foundations) on the same site, is an indication of progress. The noted Grand Pacific Hotel, opposite the Post Office, is closed and is to be pulled down, while on its site a trust company intends to erect a one-story business building for its own sole use and occupancy, the idea being to follow somewhat the plan of the Bank of England (in London). Thus Chicago, which first began the craze for sky-scraping buildings of 15 to 20 stories (and which has now been surpassed in this respect by New York), has now gone to the opposite extreme, and will have a lowly (though by no means a humble) one-story structure in that section of the city where 12 to 15-story buildings are quite common. There is no indication, however, of any cessation of the construction of tall buildings. At Lincoln Park may be seen the great 250 ft. Ferris wheel from the Columbian Exhibition, and the taking down and re-erection of this wheel must have been a complicated and troublesome work. It is now in a small private park, operated by a syndicate, but as this syndicate has not been able to secure a liquor license, it does not seem likely that the park and wheel will be a popular resort or a profitable enterprise. One must not leave Chicago without a reference to its Drainage Canal. The main work of the canal proper is now practically completed, and its extension to the lake is now being advocated by those who look upon the drainage channel as a part of an important navigable canal to connect Lake Michigan with the Mississippi River.

Chicago & Northwestern Ry.

The Wells St. terminal station of this road is not very large or imposing, but the long through trains which one sees in the station, with cars labeled for various far away cities, give an impression of the great extent of the railway system and its direct connections. It may be noted in passing that this is one of the few American stations at which a service of porters has been established, but while these red-capped assistants are conspicuous enough they are not very alert or attentive, and are in no way to be compared with the prompt, active and obliging (albeit somewhat obsequious) porters who abound at all the English terminal stations. The same remarks apply to all the station porter services in this country, which have come under my notice, including those at the Grand Central Station, New York, and the Union Station, at Boston.

The route of the Overland Limited express for the Pacific coast is by way of the Chicago & Northwestern Ry. to Omaha, the Union Pacific Ry. to Ogden (through Cheyenne), and the Southern Pacific Ry. to San Francisco. This train leaves Chicago at 6 p. m., and is due at San Francisco, 2,357 miles, at 8.45 p. m., the second day, or in 74¾ hours. On July 2 this train consisted of eight cars, as follows: Union Pacific Ry. baggage and smoking car, Pullman sleeping car for San Francisco, three Wagner sleeping cars for Salt Lake City, Hawarden and Sioux City, a through dining car for San Francisco (on which meals are served a-la-carte), a Union Pacific Ry. reclining chair car for Ogden and a Chicago & Northwestern Ry. day car in the rear. The locomotive was the powerful eight-wheel engine, No. 908, illustrated in Engineering News of Jan. 9, 1896, which was one of several built by the Schenectady Locomotive Works, of Schenectady, N. Y., and designed specially for high speed with heavy trains between Chicago and Omaha, 492 miles. These trains have from 8 to 11 cars, with sometimes as many as 6 sleepers. The engine has cylinders 19 × 24 ins., driving wheels of 6 ft. 3 ins. diameter, and weighs 125,600 lbs., with 78,000 lbs. on the driving wheels. Its appearance is somewhat grim, being painted entirely black, relieved only by the glistening of the varnish and the bright finished edges of the coupling rods, which are of I-section.

In leaving Chicago the great amount of work for the elevation of the tracks above the street grade (Engineering News, Aug. 20, 1896) is very noticeable, as is also the extensive use of the Hall automatic block signals. During the night a furious and long continued thunderstorm on the plains necessitated the slowing down of the train on account of fear of washouts, the torrents of rain obstructing the view almost like a solid wall of water, while the vivid and almost incessant flashes of lightning blinded the eyes. This road has a very good and easy riding track, and on double track divisions the trains run on the left hand track, which is contrary to the general custom.

Omaha, Neb.

This city was reached at 8.10 a. m., July 3. The train makes a stop of some 15 minutes at Council Bluffs, Ia., on the east side of the Missouri River (which is not a very imposing stream at this point) and in the yards the train has its running gear inspected and the tanks of the cars supplied with water and ice. After this it crosses the river and enters the city of Omaha, which is noted as the starting point of the Union Pacific Ry. (for the first transcontinental line) in 1865. The city has a population of about 150,000, and is 1,031 ft. above sea level.

Leaving the train to proceed on its way, a few hours were spent here, but the heat and humidity made a combination unfavorable to much sightseeing. Here, as in most of the large western cities, one cannot but be struck with the number of large and handsome office buildings, many of them owned by insurance and trust companies. The main part, or business section of the city, is of good appearance, but everything appeared to be very quiet, with little business in progress, times being dull now all over the country. The city has suffered somewhat from a land boom of some years ago, when prices became inflated and everybody was buying and selling land, but this boom died out or collapsed, as booms do, and left more or less injurious effects behind. However, the city is an important railway and commercial center and has some manufactories, distilleries, smelting works, linseed oil works and large meat packing establishments, ranking the third city in the country in this latter respect. The general offices and the extensive shops of the Union Pacific Ry. are also located here. A Trans-Mississippi Exhibition is to be held in Omaha, from June 1 to Nov. 1, 1898, and is intended to be an exhibition illustrative of the resources, products and possibilities of the western regions, and designed particularly to educate people in the east and south as to these matters. This was decided upon in 1895 at the eighth convention of the Trans-Mississippi Commercial Congress, and the matter has been energetically pushed, while the U. S. Congress has appropriated $200,000 towards the expenses of the exhibition. Mr. G. W. Wattles is President of the exhibition, and Mr. C. F. Weller is President of the Omaha Commercial Club.

The union station is at some distance from the business section of the city, and is an old, shabby, one-story frame structure at the side of the track, having been built apparently in the early days of the Union Pacific Ry. It has no trainshed, no modern conveniences, and only a very third rate dining-room and lunch counter. Some time ago the Union Station Co., in which the Union Pacific Ry. is interested, received authority and assistance from the city to build a new station close to the old one, but on the opposite side of the tracks, the city voting bonds to assist the project. Work was commenced and the lower part of the building practically completed, when the city made objection that the plans submitted by the company were not being strictly adhered to, but that certain dimensions had been reduced. The repudiation of the bonds was threatened, and this led the company to stop work and the railways to abandon the project. The partly completed building (which appears to have been designed as a handsome and commodious structure of brick, stone and iron), remains a weatherbeaten monument to the difficulty of ensuring harmonious relations between railway and municipal authorities. A project now on foot is to build a new station on a different site, more nearly within the city, and accommodating some other roads. This station would be a terminal having a headhouse, which does not seem to be the most desirable plan for a station which has to accommodate so much through traffic, as was noted in Engineering News of July 16. Wherever the new station may be located it should certainly have a trainshed, as no amount of splendor or comfort in the station building can compensate for the inconvenience and discomfort of passing between station and train during rain and snow. Yet it must be said that this is a common defect of many new and handsome stations, not even the makeshift of a shed roof over the platforms or between the tracks being provided.

(To be continued.)

THE REQUIREMENTS OF TIE-PLATES FOR RAILWAY TRACK.

By Benjamin Wolhaupter.

As soon as George Stephenson triumphed with his locomotive "Rocket," in 1829, he became the recognized authority in railway construction, and he adopted the fish-bellied rail with chair supports, which had already been in use for some time. The rail was first laid without chairs, these supports having first been used about 1797. The use of such chair supports has been continued in service in England on all up to the present day, but with the bull-head rail. In America they were soon discarded, the Stevens flange or T-rail being adopted, made with a flat base and spiked directly to the ties, and the chairs placed only at the joints. Under these conditions the chairs were subjected to a heavy rocking and pounding action by the passage of the train over the light iron rails then used, which soon battered out the joint ties and the rail ends. These joint chairs have long ago been obsolete, having given place to the more scientific fish plate joint. On account of the great weight and the looseness of the joint chairs, and the alternate loading on one side and then the other, and the hammer blows before mentioned, they destroyed the joint tie rapidly, and have remained up to the present time in much disfavor with old engineers who once used them. Hence it was that the first tie-plates were received with much skepticism by engineers, and it is even now not fully recognized that the tie-plate is distinct from a chair. Much credit is due to Mr. Benj. Reece for the manner in which he has carried out his practical tests with tie-plates, and educated the engineering world away from the false impressions formerly existing regarding them.

The tie-plates are placed directly upon wooden ties, and we find that all wood is composed of a fibrous, cellular or minute tubular structure. This is of two kinds in the same wood; one kind practically open, thin-shelled tubes called "ducts," which when new are filled with sap, and when old, filled with air. The other is of a hard dense, thick-shelled nature, and is called the "woody fiber," and is the "substance" of the material, and it is through these cells that the sap flows. It is thus evident, that to entirely exclude moisture and air it is necessary to compress the walls of these tubes together and keep them so compressed. In "soft woods" the shells or walls of these "woody fiber" tubes are thin, and consequently allow of great compression. In "hard woods," on the other hand, they are thick and strong, and leave little room for the sap to ascend through them. Therefore, a certain definite pressure applied to the former will compress them (squeezing out the air and moisture) to a greater extent than it will in the latter.

The prime requisite of all "base" of track below the rail head, whether of rail, plates, ties, or ballast, is to carry the loads received from the wheel treads and equally distribute them to the roadbed (which is the final supporting medium) in such a manner that no single part shall receive, and be required to transmit, a strain beyond the elastic or crushing limit of its component particles. Where this is not carefully guarded against, rapid deterioration takes place and soon complete destruction.

Except during the coldest weather in the northern section of this country, all ballast is flexible and forms a yielding support to the track. The rail also is flexible and will bend and spring within the elastic limits of the steel of which it is composed. Therefore, when a heavily loaded wheel passes over the track, depression of the rail immediately below the wheel takes place, the adjacent ties supporting the rail will force it into a curve, thus tending to raise it off the second ties from the wheel, to be instantly forced onto the tie as the wheel reaches it. Thus is produced a certain undulatory or wave motion in the track, which may cause the rocking or churning of the tie as the wheel passes over it, a rise and fall of the rail on the tie, and also a longitudional movement of the rail bodily. We will call these the first forces acting on the tie-plate, and will call them longitudinal and rocking forces. Under excessive loads, light rail and poor ballast, these conditions are magnified.

Fig. 1 shows tie plates in use with the above conditions of forces on an exaggerated scale. It will be seen that the tie-plate will first receive a blow and then a heavy load on one edge, forcing this edge into the tie, compression of the fiber under this edge takes place, lifting the other edge off the tie. Next the middle of the tie is loaded centrally, and finally the opposite edge of the plate is loaded, forced into the tie, lifting the other edge of the plate off the tie, the tie moving in the ballast to correspond slowly with the action as above. This action will increase with the width of the plate and the softness of the tie. It is similar, also, but in a minor degree, to the action of the load on the old joint "chairs" in use on iron rails, and would in time cause the destruction of the tie, unless the plate is immovably fixed thereon. This deleterious action can be entirely overcome by giving a central point of support on the plate as shown in Fig. 2, or by making the plate sufficiently narrow. Some well-known plates have been made 6 and even 10 ins. wide, with a smooth top surface, but experience has shown that they would rock on the tie, become loose, and soon grind out.

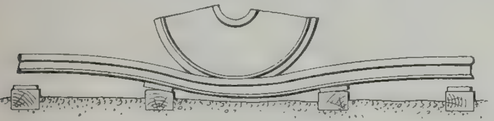


Fig. 1.

One of the most detrimental actions of track in practice is the rise and fall of the rail on a flat plate. With high speed the rail is raised instantly off the plate on which a close contact had been previously maintained. At once air rushes in with excessive velocity, carrying with it sand and other gritty particles. This sand grinds between the rail and the plate, and as is perfectly clear on examination of an old plate, wears a thin plate through in a short period. The larger the rail base and the plate, the greater the velocity of the air and the greater the tendency to suck in grit. This grinding of the sand on the plate is one of the chief sources of destruction of tie-plates in practice.

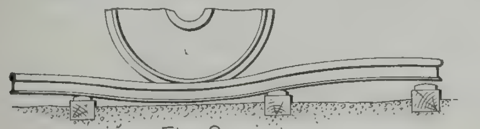


Fig. 2.

The second and greatest loading on the plate is the vertical loading, produced by the wheel and its superincumbent load applied to the rail head, and through it and its base direct to the tie-plate. Referring now to Fig. 3. This vertical force is applied to the rail head at G, and is then transmitted vertically through the rail web to F, where the web joins the base A B. Here the tie-plate takes it and is called upon to distribute it over the tie and out to its outer edges at C and D, and in doing so must not have its fibers strained beyond their elastic limit. If they are so strained, the plate will buckle or curl up at the edges of the rail flanges, because there the greatest bending moment occurs, and the plate will assume the shape shown in Fig. 4. It will then become loose and rattle; will suck moisture beneath it and will apply a hammer blow to the fibers of the tie as the wheels pass over it.

There are three methods of preventing this bending of plates: (1) increasing their thickness; (2) decreasing their length; or (3) adding vertical ribs or "girders" from end to end of the plate. If the first method is resorted to, the plate becomes too heavy for economical practice, and at the same time from its inertia cannot be immovably secured to the tie. By the second method the area of bearing on the tie is greatly reduced. By the third method the objections to the two former are answered, and the exceedingly important feature of providing successful means for securing the plate to the tie is obtained by opening up the grain of the wood and placing the flanges therein.

Considering the plate strong enough for this purpose, it is next the duty of the fiber of that part of the tie immediately beneath the plate, namely D, H, K, C, Fig. 3, to support this distributed load without being crushed or torn away from the adjacent fibers at M and N. From the spaces beneath the plates this force is distributed through the tie to the ballast beneath.

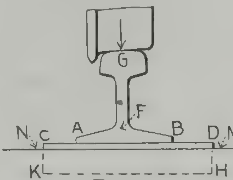


Fig. 3.

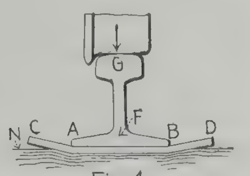


Fig. 4.

For the simplification of this question of the vertical force, let us assume that each tie supports its own section of rail and is called upon to individually carry the load coming to that section. The loads we find as follows:

Locomotives (Central R. R. of New Jersey), 88,400 lbs. on 4 drivers; 22,100 lbs. on 1 driver.

Modern box car (light weight), 32,000 lbs.; full load, 60,000 lbs.; 92,000 lbs. on 8 wheels, 11,500 lbs. on 1 wheel.

Considering now the effect of these loads upon the two extreme cases of cedar and oak ties we find that with a 60-lb. rail having a base 4¼ ins. wide, resting on a standard tie 6 × 8 ins., the area of contact will be 4¼ × 8 ins., or 34 sq. ins., on which a load of 22,100 lbs. will give 650 lbs. per sq. in. The effect of this load passing over at high speed and thus being suddenly applied should be considered as double this, or 1,300 lbs. per sq. in. The wood of ties used varies in different sections of the country, and includes soft white cedar, cypress, redwood, chestnut, pine and hard oak. Considering the compressibility of the tie, we find that the extensive U. S. government tests of the compressibility of woods at Watertown, Mass., show that 0.1-in. of indentation is made on unseasoned cedar with a load of 450 lbs. per sq. in.; on thoroughly seasoned cedar, 900 lbs. per sq. in.; on unseasoned white oak, 2,000 lbs. per sq. in.; and on seasoned white oak, 4,000 lbs. per sq. in. The pressures on other woods to give a like indentation varies between these two extremes in the proportion of the hardness of their fibers. It is thus clear that with a perfectly vertical application only of the above loadings it is only in the softer woods when moist that the fibers will crush and destroy the life of the tie.

The above examples are of extreme conditions of the present practice as to loading, conditions of wood and width of rail base, and hence it would appear that under favorable conditions no additional bearing surface in the form of a tie-plate would be required in addition to the ordinary rail base, even on soft ties, to take care of this vertical load.

The third loading or strain applied to tie-plates is apparently insignificant except upon the sharpest curves. It is a lateral force and is caused on curves by the centrifugal force produced by the load moving around the curve. It is applied to the rail head by the wheel flange and is carried through the web to the base and there applied to the tie-plate and spikes, and through them to the tie. On tangents this force is produced by the swaying of the train, side winds, unlevel track and trucks skewed out of square, and though apparently comparatively slight, produces with the other before mentioned forces, the chief source of tie and tie-plate destruction.

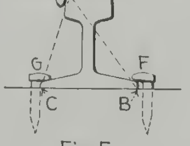


Fig. 5.

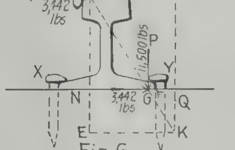


Fig. 6.

Referring now to Fig. 5 and considering that this lateral force is applied at the head of the rail at D in the direction A D we see that it thus tends to move or slide the rail laterally on its base B C until it comes in contact with the spike F, after which the tendency is for the rail to revolve on its edge B, elevating the other edge C and drawing spike G. This latter action is prevented by the vertical load from the wheel. In fact it is necessary to consider both of these forces together. Considering now both of these forces together and applying them as produced by the car before mentioned, we get the forces shown in Fig. 6 (where spikes G and F are marked X and Y respectively).

By assuming an extreme case of speed of 40 miles an hour around an 8° curve and using the formula:

$$f = \frac{w\,v^2}{32.166\,R}$$

(Searles' "Engineers' Pocket Book," p. 177) for the centrifugal force, where f = centrifugal force, w = weight of car in pounds, v = velocity of car in feet per second, and R = radius of the curve in feet. In this case w, on one axle, is 23,000 lbs.; v is 40 miles per hour, or 58.67 ft. per second; R is an 8° curve, 716.8 ft. radius, thus giving us a horizontal force, f, of 3,442 lbs. We have already a vertical force of 11,500 lbs. applied to point A. Forming now the parallelogram of forces A D K E we find a resulting force acting in the direction A K and striking the rail base at G, where it is again resolved into the original forces of 3,442 lbs., acting along the base of the rail in line N G and 11,500 lbs. acting vertically in line P G. In an 80-lb. rail G comes within ⅜-in. of the edge of the base.

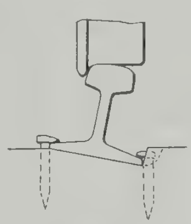


Fig. 7.

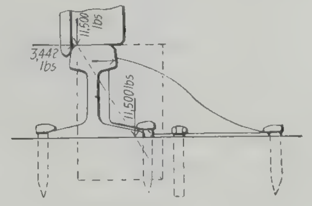


Fig. 9.

We have now the most serious and extreme condition in which ties and plates are placed, and under which ties will cut, and improperly designed tie-plates will fail. Assuming that this 11,500 lbs. of vertical force applied at ⅜-in. from the edge of the rail is distributed over 8 ins. of tie for a width of ¾-in., we now get a loading on fibers of 11,500 lbs. divided by 6, or 1,917 lbs. per sq. in. This pressure will cause a very decided compression of the fibers of all of our tie woods and even of the hardest oak along the edge of the rail at Q, as before shown, and as the wood gets old this will soon cause destruction. At the opposite edge but little pressure exists.

It has just been shown, however, that except under the extreme conditions found in practice a purely vertical force will not destroy a soft wood tie. We now find that under ordinary conditions with a lateral force added to the vertical, we get a destructive force even for the hardest oak. Further we have a horizontal force which moves the rail until it comes in contact with spike F (or Y) under this extreme vertical pressure. These two combine to rapidly destroy the fibers even of the hardest wood on this side, and as they give way the rail cants, thus throwing the resulting forces nearer the edge of the rail flange, which soon throws the rail into the position shown in Fig. 7.

This concentrated vertical pressure and the lateral pressure causing movement of the rail, combined with the destructive abrasive action of the sand on the wood fibers beneath, is the chief source of tie-plate wear, and can be avoided only by a carefully designed plate. The plate, however, must be fast to, or embed itself in the tie, otherwise there will be movement between plate and tie which will also cause absorption of moisture and sand, severe abrading action and complete destruction of the tie. The eccentric loading, however, not being so great as with a rail alone, it will take a greater period of time to cause such destruction.

This before-mentioned lateral pressure and its resulting action are the cause of the chief differences of opinion among the advocates of the two types of tie-plates.

Considering now the resistances encountered by this force from the base of the rail until it is absorbed in the tie, we find that this lateral pressure is absorbed (1) by the friction of the rail on the tie or plate, and (2) by the resisting action of the spike. As the tie becomes smooth, the co-efficient of friction will amount to 0.18 (Trautwine's "Engineers' Pocket Book," p. 373, steel, on smooth mahogany) or 2,070 lbs., leaving 1,372 lbs. to be resisted by the spike. Allowing now the very low shearing strain of 30,000 lbs. for iron used in spikes, we have for a spike 9-16 × 9-16-in. square, 0.316 sq. in. of area, or 9,490 lbs. of shearing strain to resist a thrust of 1,372 lbs.

Though the spike will not shear under these conditions it is supported by wood which may compress and give way. Assume that for 2 ins. down the spike the fibers of wood are compressed, and we have 9-16 × 2 ins., or 1,125 sq. ins., or say 1,220 lbs. per sq. in. on the fiber produced by the 1,372 lbs. of thrust. If there is any material rail movement before the rail strikes the spike and a blow is given, this should be doubled, or say 2,440 lbs. The resisting power, however, of the end of the fibers amounts to from 4,400 lbs. per sq. in. in cedar to 7,000 lbs. per sq. in. in oak. On a bare cedar tie we thus have a factor of safety of 2.

If a tie-plate is used under the above conditions, we have a co-efficient of friction of 0.14, or 1,610 lbs. of friction on the plate, leaving 1,732 lbs. to be resisted by two spikes, and if the plate is punched, as it should be, in such a manner that no rail movement is allowed between the spikes, we thus obtain with a tie-plate a factor of safety of nearly 6 under these conditions with cedar. This factor of safety certainly should be all that is required.

In the above examples, forces and conditions were considered which can be readily ascertained. In practice, however, these conditions will vary, and when varying can never be accurately obtained. They may be varied for such reasons as the following: Short sections of track may have very narrow rail base, gage of track may be tight, locomotives may have long, stiff wheel base and frames, ties may be old, besides which spikes when driven are not entirely supported by the end wood but partly by end wood and partly by side wood.

The conditions of these forces, as has been shown, require a narrow plate or one with a raised center; they also require one which will collect little or no sand. The Wolhaupter plate (Eng. News, July 18, 1895, is only 4¼ ins. wide, and can be made with a raised or crowning center, under special patents. It also has channels on top, thus allowing large air ducts beneath the rail, which greatly reduce the velocity of the inrush of air and at the same time afford channels for collecting grit or sand that may get beneath the rail base. In practice this is very noticeable.

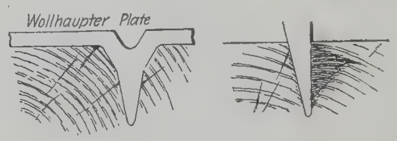


Fig. 8.

The vertical force was shown to amount to 650 lbs. per sq. in. on an area of 4¼ × 8 ins., which is also the size of this style of plate. This loading on a cedar tie was not injurious, and as the plate has bottom flanges it carries this loading right to its extreme ends without buckling. The lateral force combined with the vertical has been shown to move the rail on the tie under a large vertical load and to rapidly disintegrate the wood fiber thereby and to be the chief source of tie destruction. The Wolhaupter tie-plate has flanges which embed themselves parallel with the grain of the wood and is therefore held firmly by such flanges, it being a well-known fact that the expansibility of wood is almost entirely at right angles to its fibers. In a heavy terminal yard with excessive traffic, where the Wolhaupter plate, a plate of the same type and one of a type having flanges cutting across the fibers were placed, the former plate was in for ten months; the others for seven months each. The plates having flanges across the grain had 1% tight at the end of the seven months; the plate of the same type as the Wolhaupter had 16.7% tight at the end of seven months; the Wolhaupter plate had 34.5% at the end of ten months.

A great source of tie destruction, in addition to the action of the forces above mentioned, is the natural decay of the wood. This decay is caused by the alternate absorption and evaporation of water, which action a flat or loose plate will of course increase. The flanges of the Wolhaupter plate being V-shaped on top, compress the upper fibers of the wood to such an extent as to tend to prevent absorption of moisture. Careful examination will show that if chisel-pointed flanges are driven into soft wood parallel with its grain, the top surface of the wood is readily penetrated by the flanges. The fiber immediately beneath is, however, carried down with the flanges, and thus forms a pocket or receptacle for moisture immediately beneath the surface of the tie and next to the flange of the plate as shown in Fig. 8. The plate having these V's at the upper end of the flanges compresses the surface fiber down into these cavities, filling them and preventing the collection of moisture at these points.

A slight consideration of the strains placed upon tie-plates and rail braces will show readily which of them must of necessity be the preferable.

In Fig. 9 we have a rail brace, and (as before illustrated in Fig. 5) vertical and lateral forces produced by a loaded car on a curve. We see that here the only force which the rail brace is capable of resisting is the lateral or horizontal one of 3,442 lbs., which is only one quarter of the other or vertical force; in other words, the rail brace is placed to resist this small force, and the greater force of 11,500 lbs. takes care of itself on soft woody fiber. This might be possible if the braces were absolutely tight against the rail head, but in practice this is not so, and the moment looseness occurs between the head of the rail and the braces, we get a concentrated load at G as before; then the tie cuts, the rail cants and carries down with it the head of the brace, at the same time canting up the other end.

On the other hand by using tie-plates this great vertical force of 11,500 lbs. is distributed over the tie. The small lateral force of 3,442 lbs. is readily taken care of by the friction of the rail on the plate, but more particularly by one inner and one outer spike, or in extreme cases by two outer and one inner. A number of railways, after making careful comparative tests both of rail braces and tie-plates have had such strong practical demonstration of the above facts that they have abandoned the former and adopted the latter.

VERTICAL LIFT LOCK FOR DORTMUND AND EMS CANAL, HEINRICHENBURG, GERMANY.

(With inset.)

A vertical lift lock, possessing several novel features in its construction, has been built to overcome a rise of 16 m. (62.48 ft.) at Heinrichenburg, on the Dortmund branch of the new canal, being constructed to join the Rhine and Ems Rivers in Germany. Except in the height of lift this lock corresponds very closely in size to the proposed lift lock for the Erie Canal at Lockport, N. Y., and in view of the full description of the Lockport structure given in Engineering News, April 18, 1895, it is interesting to study the ideas of foreign engineers in the solution of their very similar problem. As a preface to this consideration it may be stated that in the issue of Engineering News, noted above, the structural features characteristic of this type of canal locks were described and their advantages and disadvantages under different conditions were discussed at length. For the description of the Heinrichenburg lock given here we are indebted to an article in our French contemporary "Le Genie Civil."

The construction and operation of the Heinrichenburg lift lock are indicated in a general way by Figs. 1, 2 and 3. As will be seen, a trough or lock chamber of sheet iron, 70 × 8.6 × 2.5 m. (229.6 × 28.2 × 8.2 ft.) is carried on five hollow cylinders immersed in vertical wells filled with water. The buoyancy of these cylinders when midway of the total rise, 16 m., just counterbalances the superimposed load, which comprises the weight of the cylinders, the metal work of the trough and supporting framework, and the water in the trough. Any increase or decrease, therefore, in the superimposed load tends to cause a vertical movement of the cylinders and lock chamber. To quiet this movement four framework towers of steel are located about at the four corners of the lock chamber, and to regulate the movement as well as to supply the additional force necessary to cause it under certain conditions, four screws are placed, one at each tower.

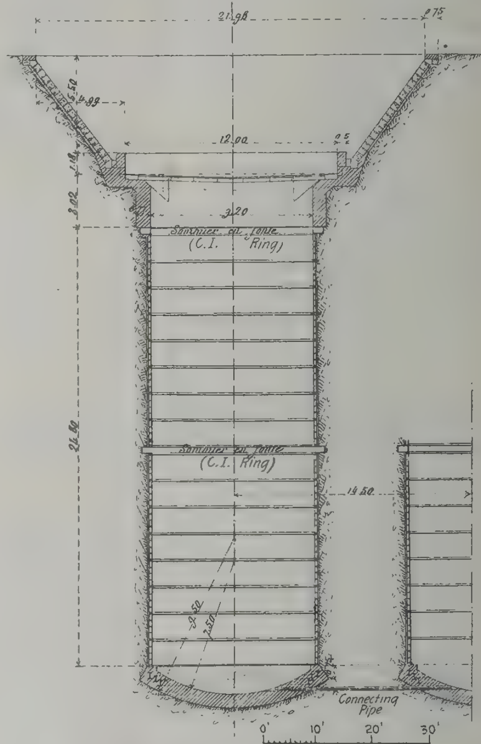


Fig. 5.—Cross Section of Well.

The mode of operation is evident from the foregoing. When it is wished to pass a vessel into the lock the gate of the lock chamber and that of the corresponding level of the canal are opened. The vessel once being in the lock the gates are closed and the lock chamber raised or lowered, as may be desired, to the opposite canal level. The process of taking the vessel from the lock chamber is similar to that of passing it into the lock chamber. Power for operating the lifting screws, the lock and canal gates, and the capstans hauling the boats, is furnished by a 220-HP. electric plant. With this general explanation attention may now be turned to the details of construction.

In constructing the lock the first work was the excavation of the pit and the construction of the wells. The excavation was on a side hill, but the material was very favorable, being a marl, with occasional seams of rock, but bearing very little water. The surface dimensions of the excavation were 100 × 54.5 m. (328 × 178.76 ft.), which, with the slopes and terrace, Fig. 4, gave 72 × 11.5 m. (235.2 × 37.7 ft.) as the bottom dimensions of a pit 12 m. (39.36 ft.) deep. The five wells were begun at this bottom level. These wells are 9.2 m. (30.17 ft.) in diameter, each, and were placed 11.5 m. (37.7 ft.) apart, c. to c., in a single row. At the top of each well a ring or crown of concrete was built and at the bottom there was placed an inverted dome or spherical segment of the same material. The sides of the wells were lined with cast-iron rings or cylinders, each 1.5 m. (4.92 ft.) deep. These consecutive rings were screwed together, the hub and spigot ends being threaded for this purpose, and made tight by lead joints. The well construction is clearly shown by Fig. 5, and the nature of the plant used in doing the work is shown by Fig. 4. Altogether seven months were required to complete the excavation and well con-

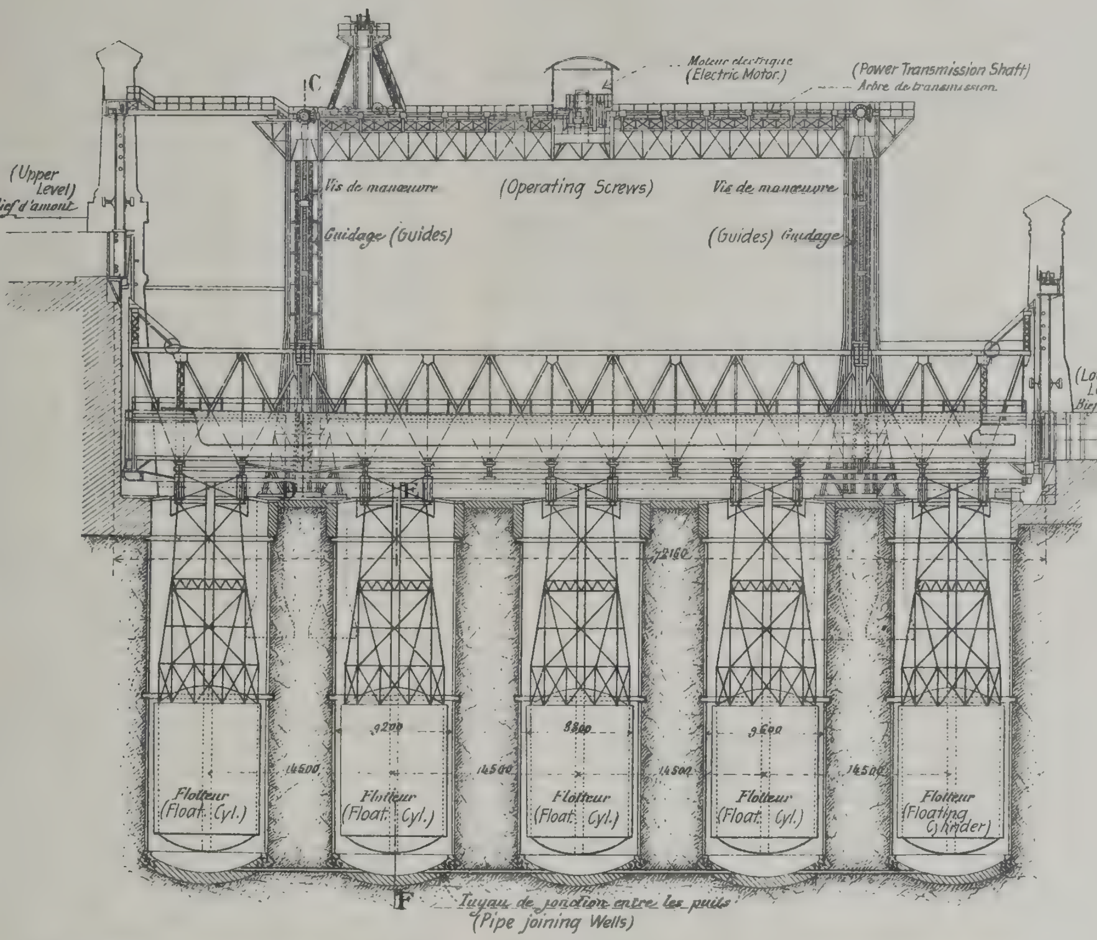


FIG. 1. LONGITUDINAL SECTION A-B.

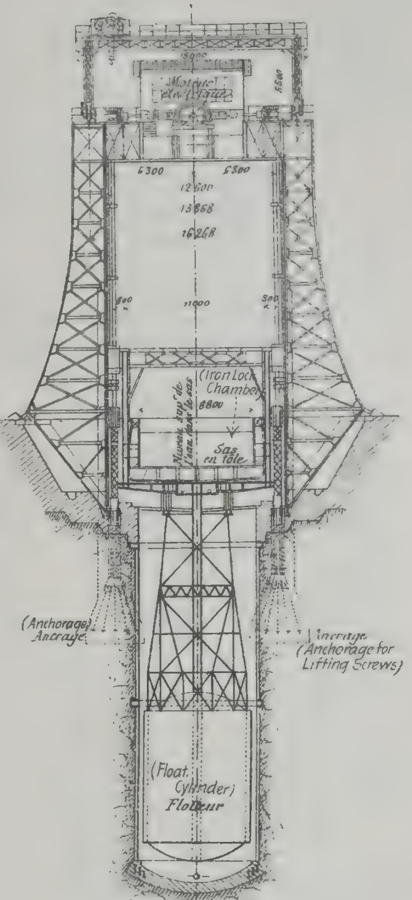


FIG. 2. TRANSVERSE SECTION C-D-E-F.

0' 10' 20' 30' 40' 50' 60'

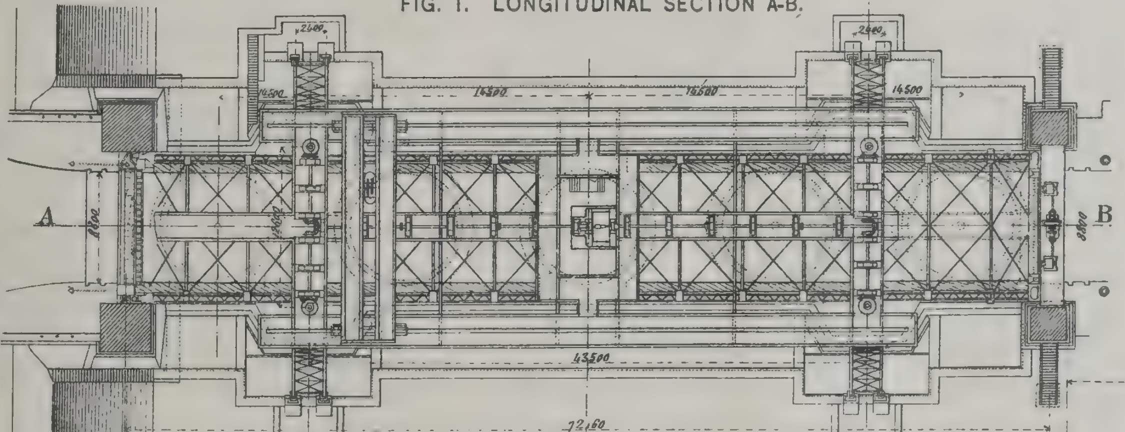


FIG. 3. PLAN.

VERTICAL LIFT LOCK
FOR THE
DORTMUND AND EMS CANAL;
HEINRICHENBURG, GERMANY.

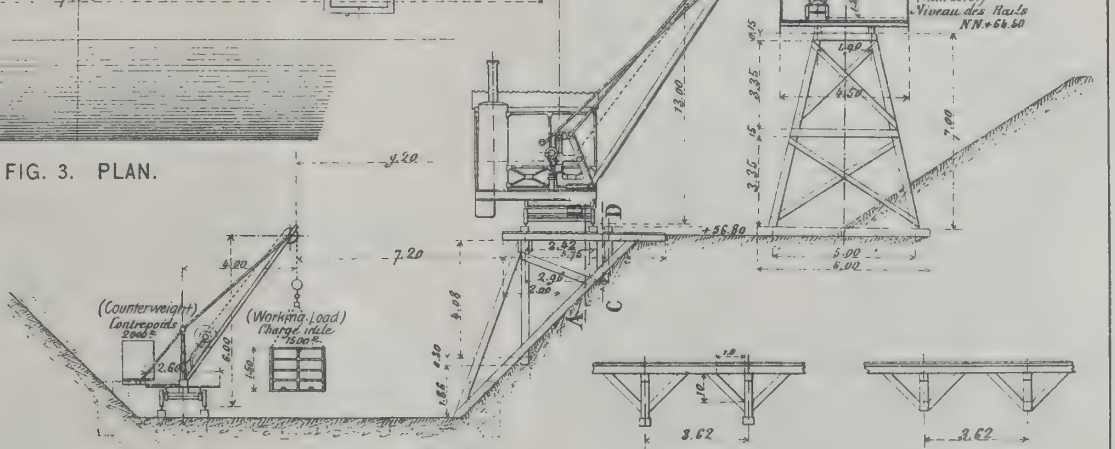

9.00
1.67
(Rail Level) Niveau des Rails N.N.+64.60
13.00
7.00
5.00
6.00
+56.80
D
C
9.20
7.20
(Counterweight) Contrepoids 2000 k.
(Working Load) Charge utile 1500 k.
6.00
3.62
3.62
Section A-B.
Section C-D.
0' 10' 20' 30' 40' 50'

FIG. 4. CROSS-SECTION OF EXCAVATION.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

struction, exclusive of the construction of the passageways connecting the bottoms of the wells. The work was done by the contractors for the lock, Haniel & Lueg, of Dusseldorf, Germany.

Following the well construction, work was begun on the foundations for the operating screws. Four rectangular wells 2 × 2.6 m. (6.56 × 8.52 ft.) in lateral dimensions and 10 m. (32.8 ft.) deep were dug and a pier of concrete built at the bottom of each. These piers take the thrust of the screws, which, under certain conditions, amounts to 1,600 tonnes. Simultaneously with the construction of the screw foundations, work was completed on the towers, the nature of whose construction is shown by the illustrations. Each screw was a single piece of forged steel 24.5 m. (80.36 ft.) long, 17.5 m. (24.6 ft.) of which are threaded, and has an outside diameter of 28 cm. (11 ins.). To make certain of the quality of the material a 100 mm. (3.93 ins.) hole was bored the entire length of each screw at the center.

The floating cylinders were built by the Harkort Works, of Duisburg, Germany. Each was 8.3 m. (27.22 ft.) in diameter and 10.275 m. (33.7 ft.) long, outside dimensions, and had cylindrical sides and spherical ends. The material was 18 to 20 mm. (0.7 in. to 0.78 in.) steel plates. Inside each cylinder was a steel framework to give rigidity to the surface plates. Each cylinder carries a tower of steel framework and the tops of all five towers are connected by a bridge which carries the iron trough or lock chamber and gives it the necessary bracing. The trough itself is made of 10 mm. to 14 mm. (0.39 in. to 0.55 in.) iron plates, which are reinforced on the bottom with plates varying in thickness from 8 mm. (0.31 in.) at the center to 16 mm. (0.62 in.) at the sides.

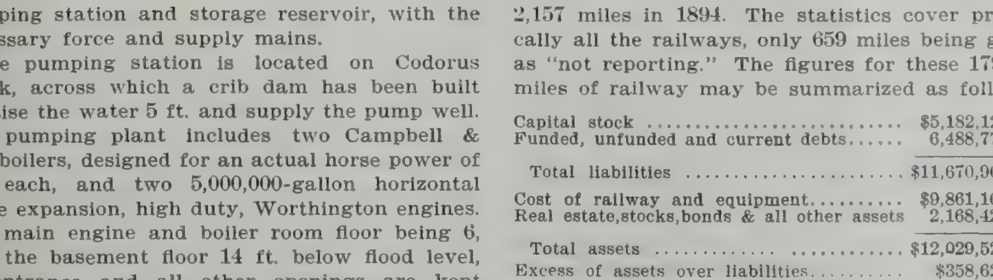
The power for operating the screws is provided by a 150-HP. electric motor located in a cabin at the middle of the bridge connecting the four main towers. From this motor the power is conveyed by the shafts and gears plainly shown by Figs. 1, 2 and 3. The speed of travel given to the lock chamber by this machinery is 10 cm. (3.937 ins.) per second, making the time necessary to pass a boat through the lock 15 minutes altogether. An independent motor of 100-HP. operates the lock gates.

The foregoing description and illustrations give a very fair idea of the Heinrichenburg lift lock. No figures of the cost of construction are available nor is information yet available regarding the success of its operation.

◆

IMPROVEMENT TO THE WATER SUPPLY OF YORK, PA.

One of the earliest towns in the United States to enjoy a public water supply was York, Pa., where works were built in 1816 by the York Water Co. What parts of the old works, if any, are still in use, we cannot say. Just now the works are being improved by the addition of a pumping station and storage reservoir, with the necessary force and supply mains.



SECTION OF RESERVOIR EMBANKMENT, YORK, PA.
Chas. A. Hague, M. Am. Soc. C. E., Engineer.

The pumping station is located on Codorus Creek, across which a crib dam has been built to raise the water 5 ft. and supply the pump well. The pumping plant includes two Campbell & Zell boilers, designed for an actual horse power of 350 each, and two 5,000,000-gallon horizontal triple expansion, high duty, Worthington engines. The main engine and boiler room floor being 6, and the basement floor 14 ft. below flood level, the entrance and all other openings are kept above that level to prevent flooding. There is a gallery floor at the entrance with steps down to the main floor.

The pumps work under a pressure of 150 lbs., delivering water through a 24-in. cast-iron force main, about 11,000 ft. long. This main passes over four hills and at the summit of each is an air vent consisting of a 24 × 8-in. T-branch, surmounted with one length of 8-in. pipe, properly protected at the opening.

The reservoir has a capacity of about 40,000,000 gallons. It is built in two compartments, is located on a hillside, and is formed by a curved embankment somewhat resembling a horse-shoe in shape. A section through the main embankment is shown by the accompanying illustration.

The force main extends over the top of the embankment, instead of through it. There are two gatehouses, one at the adjoining corners of the two basins, arranged so as to draw water at two different levels, from either or both basins. The other gatehouse is at the foot of the outer slope, and controls the supply in either of two directions, or permits the emptying of the reservoir through the one outlet pipe. A new 20-in. supply main will lead to the city. The reservoir has an overflow into a ravine through a culvert.

We are indebted to Mr. Chas. A. Hague, M. Am. Soc. C. E., of 39 Cortlandt St., engineer for the improvements, for the information given. The contractor for the pumping station, reservoir, force and supply mains was Mr. John Berkery, of New York city and West Hoboken, N. J. Mr. J. L. Kuehn is superintendent of the York Water Co.

◆

THE RAILWAYS OF THE UNITED STATES IN 1895.

The introduction to the yearly volume of Poor's "Manual of Railways" always contains a summary of the statistics of the railways for the preceding year, and we give below an abstract of these statistics, taken from advance sheets of this introduction for the volume for 1896, which is the 29th annual number. The statistics are for the year 1895, and the book is issued somewhat later than usual, for which three reasons are given: 1, an increase of 300 pages in size; 2, the delay occasioned by printers quitting work for more than two weeks during the recent hot spell; and 3, a loss of over two weeks on account of a printers' strike. The total mileage of railway on Dec. 31, 1895, was 180,955 miles, only 1,627 miles having been built during the year, as against 2,157 miles in 1894. The statistics cover practically all the railways, only 659 miles being given as "not reporting." The figures for these 179,821 miles of railway may be summarized as follows:

Capital stock	$5,182,121,999
Funded, unfunded and current debts	6,488,779,615
Total liabilities	$11,670,901,614
Cost of railway and equipment	$9,861,102,973
Real estate, stocks, bonds & all other assets	2,168,421,392
Total assets	$12,029,524,365
Excess of assets over liabilities	$358,622,751
Train mileage, passengers	327,294,734
" " freight	491,410,820
" " mixed	15,457,939
Total revenue train mileage	834,163,493

Passengers carried		543,974,263
Passenger, mileage		12,642,202,551
Freight moved, tons		763,799,883
Tons of freight moved one mile		88,567,770,801
Earnings, passenger		$261,640,598
" freight		743,784,451
" other		87,714,556
Total traffic revenue		$1,093,139,605
Operating expenses		$769,943,151
Net earnings		323,196,454
Rentals and other receipts		113,768,075
Total available revenue		$436,964,529
Payments from available revenue:		
Interest on bonds	$239,944,229	
Other interest	8,191,655	
Dividends	81,375,774	
Rentals, tools, etc.	68,885,266	
Miscellaneous	33,404,887	
Total		$431,801,811
Balance		$5,162,718

A comparison with the general results of operation in 1895 and in 1894 are given in the following table, from which it will be seen that the differences are very small, but are encouraging as compared with 1894, for which purpose we have added the last column of the table, showing the percentage of increase and decrease of 1894 over 1893. In 1895 the freight traffic increased 11.72% over 1894, but the earnings from freight only increased 6.18%, while the passenger traffic and earnings show a decrease.

				P. c. of increase or decrease.	
	1895.	1894.	Increase or decrease.	In 1895.	In 1894.
Miles of railway operated	179,162	176,229	+ 2,933	+ 1.66	+ 1.19
Tons of freight moved	763,799,833	674,714,747	+ 89,085,086	+ 11.72	—10.85
Freight mileage	88,567,770,807	82,219,900,498	+ 6,347,870,303	+ 7.72	— 9.12
Passengers carried	543,974,263	583,248,007	— 39,273,744	— 6.73	— 7.25
Passenger mileage	12,642,202,551	13,600,531,635	— 958,329,084	— 7.05	—10.20
Earnings, freight	$743,784,451	$700,477,409	+ 43,307,042	+ 6.18	—13.36
" passenger	261,640,589	276,031,571	— 14,390,973	— 5.21	—11.52
" miscellaneous	87,714,543	91,134,533	— 3,419,990	— 3.75	+ 3.36
" gross	1,093,139,605	1,067,643,513	+ 25,496,092	+ 2.39	—11.64
" net	323,196,454	317,757,399	+ 5,439,055	+ 1.71	—11.53
" per ton per mile, cts.	0.839	0.864	+ 0.025	+ 2.89	— 4.70

A statement prepared with a view to ascertaining the relation borne by the great trunk lines of railway to the entire railway system of the country shows that 59 railway systems control more than 61% of all the railways in operation. Of the passengers carried in 1895 (543,974,263) these 59 systems carried 386,625,325, or 71%, a total distance of 9,686,080,240 miles at an average charge of 2.016 cts. per passenger per mile, against a general average of 2.069 cts. for all the railways of the country. Of the freight tonnage they hauled 60%. Their aggregate haulage equalled 67,268,068,380 tons one mile, being 76% of the grand total, while the average charge per ton per mile was 0.834 ct., or 0.015 ct. less than the general average for the whole country.

The street railway statistics may be summarized as follows, but it is stated that many companies have furnished very meager information. The rapid substitution of electric traction for horse power may be gathered from the fact that since 1891 the number of horses employed in this service has decreased by 162,000, or about 80%.

Total mileage of track	15,956
Capital stock	$828,547,285
Bonded debt	$525,949,928
Mileage of electric lines	13,556
" of cable lines	612
" of horse lines	1,351
" of dummy lines	384
No. of horses and mules	28,154
" of dummy engines	206
" of motor cars	20,777
" of passenger cars	28,621

On the steam railways the average haul was 23.24 miles per passenger and 115.96 miles per ton.

	1885.	1894.	1895.
Miles of steel rails	98,102	196,653	205,546
Miles of iron rails	62,495	35,266	28,652
Miles of track	160,596	232,919	235,198
Per cent. of steel rails	61.0	84.8	87.8
No. of locomotives	25,937	36,784	37,090
No. passenger cars	17,290	27,921	27,979
No. bag'ge, mail and exp. cars	6,044	7,921	7,891
No. freight cars	805,519	1,288,799	1,230,817
No. of all cars	828,853	1,264,641	1,266,687

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THE INVENTION OF THE ART OF LITHOGRAPHY, by Alois Senefelder, in Germany, in 1796, is to be celebrated in New York on Oct. 16 and 17. This celebration will take the form of an exhibition of all the different products of lithography, including prints from the earliest date and from all countries. Lectures upon the history and progress of this art by experts will also be given. Any one who can aid the committee in this laudable work by loaning specimens in their possession or by suggestions should communicate with the chairman, Mr. Joseph R. Keogh, 23 Third Ave., New York city.

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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

The development of rail sections has always been an interesting subject for railway engineers and rail manufacturers, as in the early days of railways each engineer wanted to have a special section of his own on his own line, and each man had his own particular hobby as to rail sections. Within recent years a very close concensus of opinion has been reached as to the forms and proportions of rails, but on the less important branches and portions of many railways of any considerable age there are to be found various types of sections now obsolete. The development of the form of section on such roads is particularly interesting since it shows the changes that have been introduced under similar conditions, and in another column we give a set of the eight sections which have been used on the Denver & Rio Grande R. R., beginning with a 30-lb. rail in 1871, when the road was first commenced, and ending with an 85-lb. rail, which has been laid during 1895 and 1896. The oldest rails were of peculiarly round-headed section, showing evidently the influence of English practice, but more curious still are the two sections in which the sides of the head flare inward from the top, a form of section which was designed from wrong ideas and was but little used. The present rail section conforms practically to the type recommended by the committee of the American Society of Civil Engineers, except that the top corners appear to be of larger radius, while the sides of the head, instead of being vertical are slightly flared outward from the top. This latter practice is followed by a large number of railways, and is incorporated in the Dudley patented form of section now so extensively used. The set of sections which we illustrate in comparative form is a good example of the history of rail sections on individual railways in this country.

While the tie-plate is a decidedly modern invention it has already fully borne out the ideas of its designers and is now very extensively used, while its application is spreading very rapidly. Briefly this device consists of a metal plate interposed between the rail and the wooden tie, its purpose being to protect the wood of the tie from the cutting and abrading action of the rail, which action is more influential than any other in causing the destruction of the tie and rendering tie renewals necessary. The tie-plate is thus a species of tie preservative or protector, and is not to be classed with the old chairs and joint chairs whose office was to support the rail and hold it in position. It would seem at first glance as though such a simple thing as a tie-plate would not require much designing, and would not call for much theoretical consideration of the forces it has to sustain, but as a matter of fact, while the tie-plate is a small and simple thing enough in itself yet its efficiency may be very greatly increased by a little care in designing it with due regard to the work it is required to do. That this is so will be clearly understood from the perusal of a paper in another column. The manufacture of tie-plates is now one of the most important industries in the railway supply business, and while almost any form of plate is an improvement over the direct contact between rail and tie, yet it may readily be seen that there are opportunities for increasing the practical efficiency of the plates. The main objection to a simple flat plate is that it is impossible to keep it tight, so that there will be a continual movement of the rail on the plate and the plate on the tie, with a consequent admission of dust and moisture to cause wear and decay, and also a consequent clattering under traffic. Besides this, if the plate is thin and wide it will bend and buckle, while if made sufficiently thick to resist bending the plate will be clumsy and expensive. The question then is, how to secure a permanent connection between the plate and the tie, and this appears to have been most efficiently attained by making a plate with longitudinal ribs or flanges which sink into the fibers of the wood and are tightly held by them, while the size of the flanges is not such as to crush or split the wood. These flanges also serve to stiffen the plate and enable a thin plate to be used without buckling under heavy loads. The use of the tie-plates not only effects an improvement in the track, but also (at very little expenditure) effects a reduction in the expenses of track maintenance, since it enables soft and cheap durable timbers to be used for ties, as the timber is protected from the cutting action of the rail, and such cheap ties thus protected may actually last longer (and be thus more economical) than more expensive hard woods not thus protected.

The substitution of cable for horse-power on surface railways, and the consequent increased speed, reduced operating expenses and better service, certainly seems to pay in New York city, as is indicated in several directions. The Broadway cable-line, in its first year of operation, reported to the State Railroad Commission a gain of 25% in total traffic and a decrease of 20% in operating cost, or a total gain of 45%, as compared with the operation of this line by horse-power in the year preceding. The actual gain in passengers carried since then is not now at hand, but the Third Avenue cable-line was opened on Dec. 4, 1893, and the official figures for the year ending June 30, 1894, show a gain of nearly two million passengers carried over the average for the three previous years, though this report would include only about six months of cable service. How much loss of traffic might be charged to the delay in operation caused by the change from one system to the other it is impossible to state; but the undoubted and sudden increase in passengers after the cable was completed would seem to prove that the change was a popular one. That some other lines of traffic suffered by the changed conditions on these two cable surface roads is indicated in the lately published report of the Manhattan Elevated Railway Company to the State Railroad Commission. The report of this parallel and competing system is made up to June 30, 1896, and shows that the "total income" of elevated roads has steadily decreased since 1893, when the cable system practically came into competition. In this period the Manhattan has made considerable effort to maintain its traffic, and the growth of population in the northern section of the city has certainly not decreased. But the advantages of more rapid transit on surface roads, with no stairways to climb and somewhat less travel from the centres of traffic, has certainly had an effect upon the number of passengers formerly using the elevated system. The fact of the matter is that the cable surface roads are not only catching the short-haul passengers, but also many riding for long distanecs, who find the surface lines more convenient for their purposes and now fast enough to use.

Cuban, or rather Spanish methods of estimating upon and contracting for the execution of public works in that island are peculiar, to say the least. In a paper lately presented to the American Society of Civil Engineers, Mr. E. Sherman Gould, M. Am. Soc. C. E., describes the new water-works of Havana, and incidentally treats of the contract system prevailing there. After the preparation of the plans, an estimate must be made, down to the most minute details of the exact quantities of each class of work required. These plans, estimates and quantities, accompanied by a report, must then be submitted to the home government for approval; and after such approval any radical change found necessary during construction must first be submitted to the Cuban authorities, then to the home authorities, and a royal order obtained before anything can be done. While this may seem necessary, under the "paternal" form of government assumed by Spain towards its colonies, it is likely to be embarrassing to both engineers and contractors and certainly does delay execution. But another and seemingly very useless and objectionable feature of the system is the requirement that in quantity and cost each class of work must stand by itself. Consequently, if in the execution of the work any quantity, and, of course, the resultant cost, should fall short of the submitted estimate, this surplus is not available to make good any excess of quantity and cost in another piece of the same work; but a new appropriation for "extra work" must be carried through the network of red tape referred to, though there is actually an unexpended balance on hand. Another rule, which holds good in Spain as well as in Cuba, is that acceptance of the contract, after an examination of the plans and documents, makes the design virtually the contractors, and the contractor and not the engineer is responsible for all failure that may result from the plans. The only loop-hole of escape for the contractor is the filing of a written protest before commencing any work in which he deems the plans insufficient.

This system is certainly ingenious in its complicated difficulty, its multitude of authorities, enforced delay in execution, and in its disregard of the many contingencies which may make necessary some radical change in plan during the progress of the work. But it also indicates the tenacity of Spain's grip upon her colonies and how little she trusts them to attend to their own business. The proviso for shifting responsibility for the failure of plans, from the engineer to the contractor, reflects rather badly upon the confidence a Spanish engineer seems to have in the sufficiency of his own designs. And Mr. Gould shows in his paper that the original plans for part of the Havana work were insufficient. This reservoir was to be covered with groined elliptical arches of cement that were to rest upon granite columns made of three separate blocks of stone. The execution of this work was so difficult and almost impossible that the reservoir remains uncovered to-day, and plans for a safer and simpler covering were rejected. Under the peculiar Spanish laws regarding responsibility for plans, this failure to cover the reservoir must be charged to the contractor.

The use of springs for sources of public water supply is quite common in some parts of the country, notably in New England. The conditions governing the yield of springs have not been so carefully studied as those relating to surface sources. The reason for this, apparently, is that most springs have been utilized in this country where only comparatively small quantities of water are required. One or more springs have been piped to towns at the outset, and others have been added later, or other sources of supply sought, as the demands for more water arose. But even where only small water-works are to be supplied prudence demands that the available yield from a spring, or springs, shall be determined as nearly as possible, before adopted as a source of supply. The most obvious and common method of determining the yield is to make a gaging of the flow from the spring, but a single gaging, or a season's gaging is not sufficient to determine what may be expected through a series of years, even when backed by the assurance of the "oldest inhabitant" that the "spring was never known to run dry." Where the drainage area tributary to a given spring and the rainfall of a locality are known, the problem of yield, year in and year out, is very much simplified, but there still remains the governing geological conditions, especially the character of the material through which the water must flow and the relation of permeable and impermeable strata. These geological conditions may in part be determined by an examination of the surface, but cannot be completely learned without putting down borings or test pits. When all else has been decided there will still remain to be found the percentage of rainfall lost by run-off, by surface evaporation and by plant absorption and evaporation.

So far as we know, very little has ever been published regarding the available yield from springs. Far more has been printed on the yield of wells, a very closely related subject. With the growing demands for pure water supplies, the yield of our mountain and hillside springs, ever popular sources of supply, will become a matter of increasing importance, for however thoroughly it may be possible to purify water most people will prefer that which is naturally pure. In addition, a public water supply is already almost a necessity for the small villages of a few hundred inhabitants, and in some sections these may obtain, as many already are doing, ample supplies of clear, cool and sparkling water at slight expense, where a water purification plant might be considered as entirely out of the question, even if not actually so.

In view of the above facts we give a considerable amount of space elsewhere in this issue, to a paper by Mr. Louis E. Hawes, C. E., on springs as sources of public water supplies. Mr. Hawes has brought together some very interesting matter on this subject which we commend to those interested in the development of springs.

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The practically successful trial, at Portland, Me., of the Hargrave kite, as modified by Mr. Charles H. Lamson, is a marked step forward in solving the solution of aerial navigation. This kite, or aeroplane, was not only the largest ever successfully floated, but it also carried aloft the heaviest weight ever lifted with any similar device. Unfortunately the press accounts do not give the dimensions of Mr. Lamson's kite, other than to state that it took 15 men to carry it. The interesting point in the experiment, however, is the fact that a dummy weighing 150 lbs. was safely and steadily carried by this kite to a height of 600 ft. At this point a sudden gust of wind broke the retaining cord; but after sailing on for about half a mile further the kite descended as steadily and as easily as it ascended. Had a man been upon the kite he would have suffered no injury whatever. Those interested in Mr. Lamson's experiments may see a full account of his smaller kites in "The Aeronautical Annual," for 1896, edited by Mr. James Means, of Boston, Mass. This air-ship is practically made up of two rectangular cells, open at the parallel sides of the longest dimension. Each cell is jointed, or hinged, near the front and back ends, and these smaller hinged cells can be manipulated by levers so as to change the vertical direction of flight. Lateral steering is accomplished by shifting the weight to either side of the center, the vessel turning towards the loaded side. It should be explained that these two main cells are parallel to, but at some distance from each other, being connected by a light and strong framework. In the original kite there are no wings, or movable parts, other than the hinged ends of the main cells; and the especial features of this form of aeroplane are great steadiness in flight and unusual lifting power. The absence of intricate moving parts is especially advantageous, coupled with the general simplicity of form and construction, and further development on these lines will be awaited with interest.

GERMAN EXPORT METHODS.

In our issue of Aug. 13 we commented upon the growing interest in the United States in an increased export of our own manufactures and we also noted the more prominent American organizations now engaged in activily promoting the extension of this foreign trade. In connection with this proposed development of a practically new business it is profitable to study the methods of other countries which have resulted in commercial success, and among these other countries Germany is just now taking a very prominent place as a manufacturing and exporting nation. Methods which have built up a rapidly growing trade in German goods all over England, until lately almost without a rival in manufacturing for the rest of the world, are worth close attention.

A book lately published in England, entitled "Made in Germany," is creating a stir among the manufacturing classes in that country by bluntly proving, by statements and official figures, that England is fast losing her old position as the undisputed mistress of the world of commerce, and is no longer supreme even at home. The law requiring all foreign-made goods sold in England to be plainly marked as "made" in some other country, is having an unexpected reactionary effect. It is opening the eyes of British manufacturers and those interested in British industries to the present and rapidly increasing volume of goods "not made in England" and yet supplied to the consumers of that country. The label, "made in Germany" is appearing on a dangerously widening group of goods, and this means not only a shrinkage in the home market to English producers, but it also implies a perilous competition in the markets outside of Great Britain.

The author of the book quoted shows by figures from Parlimentary reports, that while the proportion per head of exported English products was about $40.24 in 1872, this proportion was only $27.70 in 1894. A reduction in the price of goods exported may account for a part of this decrease, but further figures presented give another and more potent reason in the German increase of trade in the same period. In 1883 the imports into England of goods manufactured in Germany were valued at $83,150,000; in 1893 the value of these German imports was $128,150,000, an increase of about 30 per cent. in ten years, and this in a country that in the near past had a practical monopoly in the supply of manufactured goods to a large part of the trading world.

While American manufacturers may not view this reduction in English trade with any overwhelming amount of sympathy and regret, the alleged causes of this decrease have a direct interest to them in any attempt to extend the introduction of their own products into other lands. And quite as interesting and worthy of study are the means by which Germany has succeeded in introducing her goods into England.

The author of "Made in Germany" frankly tells the manufacturers of Great Britain that under the prestige of the past monopoly of all trade they have grown too careless of the wants and demands of even English consumers. They make what pleases them best; adhere to out-of-date methods, designs and processes; and pay too little attention to the comfort and needs of their labor, a neglect which has a direct and injurious effect upon the quality and character of the product of this labor. In short, while the manufacturer has stuck to the rut marked deep by the wheels of another age of trade, the consumer is being educated to the advantages and possibilities of a more enlightened and intelligent treatment of an old subject. To make plain our meaning, we have only to contrast some of the commonest articles of household use as made in England and "made in Germany." In the one case we too commonly find old forms, clumsy and inartistic design and careless finish; in the other there is very generally a grace, lightness and beauty that can only result from careful study and intelligent attention paid to the minute details and the actual needs, use and appearance of the product, whatever it is. When this better and handsomer article is offered in the market for the same, or often at a lower price, it is not remarkable that the consumer will prefer it and buy it and that his neighbors will gradually do the same.

A late editorial in London "Engineering," treating of the rapidly growing competition of Germany and the United States with England in the Australian trade, incidentally illustrates the indifference of some English manufacturers in attending even to the wants of home customers. It seems that a prominent firm of engineers applied to a famous English tool-building establishment for some suggestions in the improvement of a certain class of machines which would tend to increase their output; and the application was coupled with the promise to purchase all machines from this firm if any substantial gain could be shown in the product. The tool-makers in question sent an aged foreman to look into the matter and he proved to be quite incapable of giving any advice of value. In despair, a German firm was then applied to with quite a different result. A bright young German engineer was at once despatched to the works in question who carefully and intelligently examined the machines in use, sent samples of the finished product to Germany and had the whole matter investigated by competent men there. The outcome was that the German firm supplied machines under a guarantee of saving effected that was much surpassed by the actual working of the tools themselves; and England lost what promises to be a very profitable trade. "Engineering," very properly, charges this English establishment with "sheer crass stupidity," but goes on to say that the workmen are to blame as well as the masters. With the object of keeping as many of their members employed as possible the trade societies resent the introduction of labor-saving machines as an injury; and Mr. Maxim relates that for months after the introduction of a special milling tool for machining parts of the Maxim gun, the men insisted upon taking as long to put the finishing touches to this part, after leaving the machine, as if the whole had been done by chisel and file. A German workman who could not speak English was finally put to work, and he accomplished six times as much work in one day as the Englishman did in 1½ days. These British workmen have yet to learn a fact well understood in American shops; and that is that one man can attend to more than one machine, and that experience shows that an increased and cheapened output usually so affects the demand that more, and not less hands are employed as the result of using labor-saving machines.

The cause for the success of Germany in England and the present rapid spread of German goods into English colonies and into other centers of trade once monopolized by England, is not a thing of yesterday, though the effects are only now being seriously felt. For fifty years or more Germany has been slowly but surely fitting herself to be a great industrial nation, by perfecting her system of technical education, now probably the most perfect in the world. She has studied the progress and methods of every other nation and she has trained men to improve upon these methods; she has sent her agents to all parts of the world that promised trade, and these agents have learned what will and what will not be acceptable to the prospective foreign consumer. She has trained men to extend this trade by establishing schools of trade and commerce, and by tabulating and making accessible all information that can be gathered concerning the products and conditions of the commercial world. She is in a position to meet the demands of other nations better than her old competitors, simply because she has studied them more intelligently. As showing the spirit which animates some of the larger German manufacturing concerns the author of "Made in Germany" notes that one German chemical establishment employs no less than fifty chemical specialists; not in the daily inspection of the products of this establishment, but engaged solely in experimental work and in the attempt to devise new and more economical processes of production. This, says our author, would be regarded as sheer waste of capital by the average British manufacturer; but he also notes that this particular German company pays dividends of 25 per cent.

While Belgium was the first of continental nations, in fact the first among nations, to establish a specially equipped school for the commercial training of young men, Germany soon followed, and has improved upon the Belgian methods. In these schools the study of languages is made a strong feature, and the student is compelled to carry on an "office correspondence" in German, French and English, and he must also select and be proficient in one other language, usually Spanish, Italian or Dutch. He is obliged to study the geography of foreign countries, their history and commercial conditions, and well-filled museums make him familiar with the vegetable, mineral and animal products of other lands. When to this early training is added the progressive spirit that seems to animate every workshop and counting house in Germany, and the wise liberality that is constantly furnishing the means for deeper experimental research into all that might benefit trade, it is little wonder that Germany is making herself felt as an industrial factor.

In this matter of languages the American manufacturer and his agents are notoriously weak, and before any marked success can follow in the extension of our foreign trade we must pay more attention to this important factor. As one of our consuls lately remarks, in discussing prospective trade with the South American States, no American maker of mining machinery would send as his representative to Cripple Creek a Russian wholly unacquainted with English; but the same man will distribute English catalogues among a Spanish-speaking people and send there a man who can only do business through an interpreter. As showing the part familiarity with a language plays in trade, the same consul notes that the United States does more business with 5,000,000 Canadians on its northern border than with the 14,000,000 Mexicans immediately to the South, or in fact with the 35,000,000 Spanish-speaking people in Central and South America. For trade purposes this population is as remote to the average American manufacturer as is China, simply because he does not know them nor their tongue and has not studied their needs and the possibilities of trade. Other nations have been wiser, or went there better equipped and they practically take business from our own doors that naturally belongs to us, and would be ours did we but meet the requisite conditions.

The secret of Germany's commercial success seems to be a careful and intelligent study of the best methods of manufacture and of the conditions, needs and prejudices of the trading world. As before remarked, she has long been preparing herself for the industrial war she is now waging by the technical education and commercial training of her young men. In methods of manufacture and in quantity, character and relative cheapness of products, American manufacturers need take no lessons from Germany; but they can profit by the manner in which Germany has sold her goods outside of her country and in properly equipping men to do this work. It would require a generation of time and a large expenditure of means and effort to accomplish this training by means of commercial schools. But the fact remains that to accomplish the task which many of our manufacturers have now set themselves, proper tools must be used, and the traditions of the past, applicable only to a home market, must be thrown aside. In this connection the several American organizations referred to last week are doing good work by making our manufacturers better acquainted with the conditions and possibilities of trade with other nations. This knowledge is a first requisite, but a second and all important one is the choice of proper agents and of effective methods of taking advantage of the possibilities uncovered. Here these organizations need the active co-operation and moral and financial support of every American manufacturer. And when this broad interest is once awakened we doubt not but that the means will soon be found for educating and supplying the required agents.

LETTERS TO THE EDITOR.

The Section of Electric Railway Tunnels.

Sir: In regard to the much-discussed question of the necessary sectional area in railway tunnels in cities, some late experiences on the Budapest underground railway give endorsement to the unusual dimensions adopted in Boston. The Budapest section was based upon the London tunnels; but it is found to be a great mistake to have two tracks in such a small tube. The ventilation is very bad and the air pressure is a serious trouble to the traffic, and, as experience proves, there may be other reasons for more liberal dimensions.

In one day lately the following accidents occurred on the Budapest railway: (1) A workman in stepping from one track to avoid a train was killed on the other track; (2) A conductor, leaning out to ascertain why the motorman was ringing the bell, was badly injured; (3) A car was set on fire in the tunnel by an accident to the grip-conduit and the six passengers only escaped through the coolness of the men on the burning car and the following car, the latter car being used to push the first rapidly out of the tunnel. Both motormen were badly injured. Some time ago an accident to the grip practically imprisoned in the tunnel, for some time, the Austrian Minister and a number of invited guests.

It is rather surprising that such accidents should occur in the operation of an electric underground railway; and they may be exceptional experiences that will not occur again in regular service. But the fact remains that they do happen; and it is evident that more room is necessary in the tunnel than just enough to pass the cars.

Yours truly, Fr. von Emperger.
Carlsbad, Bohemia, Aug. 2, 1896.

The three underground electric railways of London (one in operation, one nearly completed and one just commenced) are all designed with a separate tunnel, of circular section, for each track. The Budapest tunnel is rectangular, 19.7 ft. wide and 9 ft. high, with a row of columns in the middle. The Boston subway is also rectangular, 24 ft. wide and 15 ft. high, without a central row of columns, except on the four-track section, where the columns support the roof of a tunnel section 48 × 15 ft.—Ed.

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Pooling Freight Equipment.

Sir: Referring to the editorial on my paper on the subject of "Pooling Freight Equipment," in your issue of Aug. 20, I am glad to have your expression on this matter, as "every little helps," and I am satisfied that the proposed scheme will effect a saving in expenses to railways of many millions of dollars per annum, as well as increase their earnings.

I note your remarks relative to a contemplated objection of putting equipment owned by "car trusts" into the pool. I do not see that this will make any difference for the reason that the trust cars will receive their prorata earnings according to their valuation in the pool and they will receive greater earnings on their equipment than at present; so it is to their interest to join in the proposed Co-operative Equipment Co. Yours truly,

Jos. R. Cavanagh,
Supt. of Car Service, C., C., C. & St. L. Ry.
Indianapolis, Ind., Aug. 28, 1896.

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The Preparation of Bridge Specifications.

Sir: Your editorial on "Who should prepare specifications" is a very timely and valuable paper. If the suggestion contained therein, "that the engineer should consult with and profit by the experience of those whose province it is to carry out in practice the ideas which he originates," be followed it would inevitably lead to that most desirable end, a uniformity in best mill and shop practice. A uniformity of practice for the same grade and character of work and not a uniform specification for all grades and characters, without due regard for special duties, etc.; this latter would be manifestly unwise and unnecessary. Under the present method of each consulting and chief engineer preparing his own specification, incorporating his own particular hobbies, without regard to present practice, final costs or results, the manufacturer is compelled to work to numberless requirements; and in one bridge office there are to be found on file 60 different specifications for bridges alone. These special ideas often make it necessary to entirely change shop methods and practice, increasing cost, without any corresponding increased value or efficiency. Every manufacturer has had this experience.

It is with no desire to infringe upon the field of the consulting engineer and chief engineer that manufacturers prepare and publish specifications covering what they believe to be best practice in their specialties. Manufacturers and engineers should work together, and these specifications are prepared for the assistance and guidance of engineers in general practice, who have not the time or opportunity to give all the details of manufacture of each specialty the attention and study which are necessary to prepare a proper specification.

It would be very poor business wisdom on the part of any mill or shop, which cares for its reputation, to send out amongst its clients a specification which could be shown to call for poor grade of material or poor workmanship. I, of course, understand your remarks and suggestions as only referring to those manufacturers and engineers who have a pride in their work and name, are above any mere money getting, and who are continually trying to improve upon past practice, not only from their own experience but the experience of others in the same line. It would be useless to address those who resort to tricks and "wire pulling" to obtain business. Their practice is anything found necessary for the time being.

The field of work of the consulting engineer and the chief engineer of a railway or company is one which cannot be covered by the manufacturer; their work is mainly done before the contract comes before the manufacturer; they study the work in hand in all its bearings and relations, crystallize it into shape, fix the general requirements and divide it under its several classes of special work.

The contract is then in shape to be sent to specialists for prices. These special and detail specifications should not be prepared without conference with manufacturers unless the engineer by special training is entirely familiar with every detail of the work. If the letting can be confined to reputable concerns, it is desirable to give the manufacturer the opportunity of giving the engineer the benefit of his special experience and practice, not binding him to unimportant details at every point. The engineer is simply interested in final results; if these are up to his requirements and standard he should be satisfied.

In recent years there has been a tendency amongst parties who have work in view not to employ the consulting engineer or chief engineer, thinking to save this small expense, but to go direct to the manufacturer. This is poor judgment and a very unwise practice; it throws extra expense into every competition which the buyer must ultimately pay for; he will probably accept the cheapest bid made to him, and as the manufacturer has had no opportunity of judging of the merits of his design in connection with the surrounding conditions, it may be a very bad selection and cost more in the end. Engineering work of any magnitude should have the benefit of the disinterested investigation of a consulting engineer and the general features at least should be determined upon, before it is referred to the manufacturer. The practice above referred to is being discouraged more and more by the more reputable concerns, as it is not to their interest to do consulting work and they welcome heartily the supervision of any able and competent engineer and are glad to work to his requirements and specifications.

John Sterling Deans,
Chief Engineer, The Phoenix Bridge Co.
Phoenixville, Pa., Aug. 26, 1896.

SECTION OF WHEEL AND RAIL; C., M. & ST. P. RY.

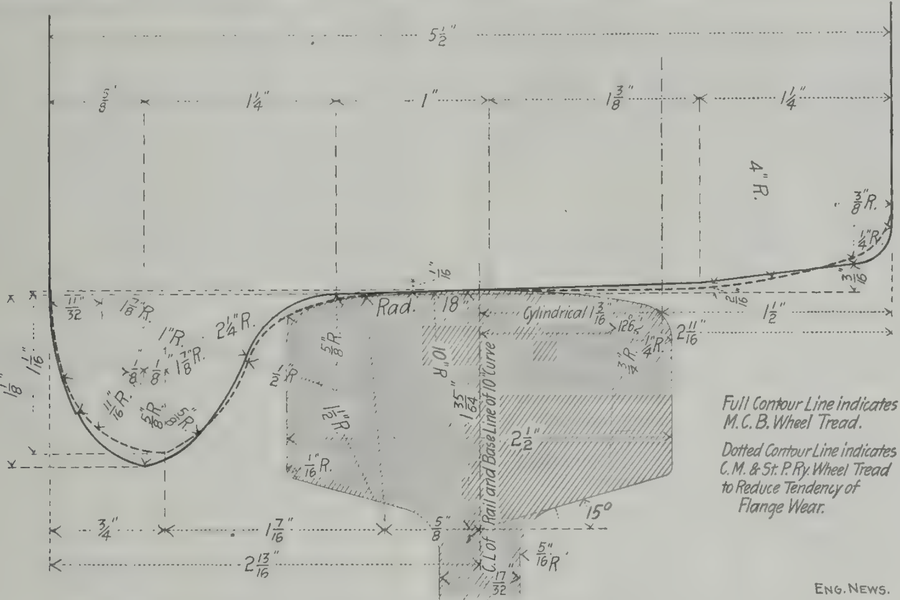
While probably a majority of railways in this country have adopted the M. C. B. standard section for carwheel tread and flange, this section is not universal, and the Chicago, Milwaukee & St. Paul Ry. has modified the section in such a way as to greatly reduce the flange wear. This section is shown herewith, together with the section of the head of the standard 75-lb. rail of the same road.

We are indebted to Mr. J. N. Barr, Superintendent of Motive Power, for a blue print, showing the C., M. & St. P. Ry. and M. C. B. sections of wheels, and we give below the remarks made by Mr. Barr at the recent convention of the Master Car Builders' Association, in discussing the question: "Is the present M. C. B. standard shape of wheel, tread and flange the best that can be designed for service."

> I have a blue print here on an enlarged scale, which reveals the fact that our present adopted dimensions won't go quite together. You have to squeeze them a little bit. In the present standard the fillet in the throat is ⅝-in. radius. We took and started from the center line of the rail with a 10-in. radius, gradually decreasing the radius to ½-in., and that gained in the throat, as shown in the difference between the dotted and full line, quite an amount of metal to wear off. In addition to that we gained the tendency (if the truck runs to one side) to run up on the fillet and guide itself away. The result has been a very decided decrease in flange wear, and that is one of the most serious sources of expense in the use of wheels—the rejections from flange wear. The tread is perfectly horizontal (or cylindrical) for 1 3-16-ins. outside; and from that point it passes off with a curve, which leaves the outside of the thread considerably easier and less projecting than in our present standard, which is a very good thing in going over frogs. These are minor points, but we feel that there is a good deal of money in them. We can very well see that after inspecting it; but the idea of enlarging the fillet here, so as to guide the flange away from the rail, instead of allowing it to run up against it, I think is a good idea, and the trains offer less resistance to the pull. The easing off at the outside has an important relation to frog wear and breakage of wheels.

In answer to these remarks Mr. Higgins stated that the tread of the M. C. B. wheel must necessarily be something of a compromise, from the fact that different engineers have different ideas as to proper rail section; and the rail section used on the C., M. & St. P. Ry. might be one the chief engineer of another road would not use. For that reason he did not think the association could do anything else than propose a tread that may be considered as a compromise.

In sending us the print of the standard rail sections (60, 67 and 75 lbs. per yd.), Mr. D. J. Whittemore, M. Am. Soc. C. E., Chief Engineer of the Chicago, Milwaukee & St. Paul Ry., stated that these were designed before the report of the rail committee of the American Society of Civil Engineers was promulgated, and had this report been issued sooner, it is exceedingly probable that the railway company would have adopted the Am. Soc. C. E. type of section, except in the item of top radius of the head. In the Am. Soc. C. E. sections this radius is 12 ins., but Mr. Whittemore prefers the 18-in. radius of the present rail, and it will be remembered that Mr. Whittemore has been a consistent advocate of flat-topped rails. The 75-lb. rail shown is 4¾ ins. high, with a base 4¾ ins. wide.



SECTION OF WHEEL AND RAIL; CHICAGO, MILWAUKEE & ST. PAUL RY.

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UTILIZING SPRINGS AS SOURCES OF WATER SUPPLIES FOR TOWNS.*

By Louis E. Hawes, C. E.

Exactly why a spring appears at any particular place is not always apparent or subject to conclusive demonstration without investigation on an elaborate and expensive scale. The most plausible and comprehensive reason that is usually given is that "the ground water in moving down a valley by the action of gravity encounters an obstruction or dam in its course which forces the water to the surface, where it appears as a spring." There are other well recognized and fully as important factors which may be mentioned as follows:

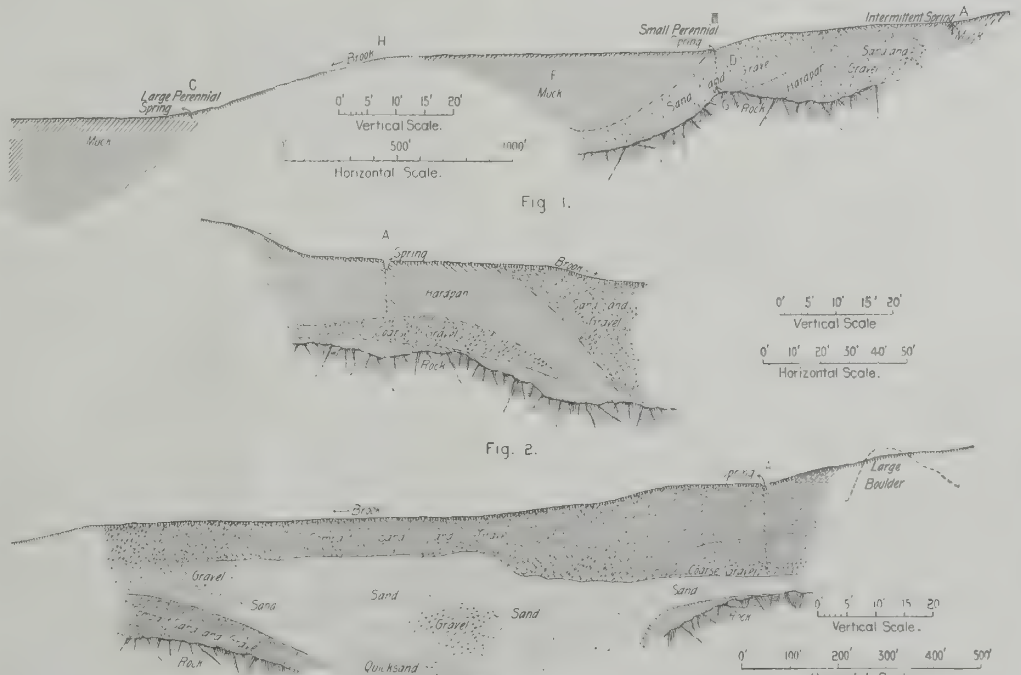
Differences in elevation between the absorbent or reservoir forming portion of the watershed and portions lower down, constituting the head; approach to the surface of the water-bearing strata or vein in which the water moves most rapidly, in consequence of the prominence of the bed rock or impervious strata below, or the rapid inclination of the surface above; the presence of boulders or ledge cropping at a location that is otherwise favorable, with the usual accompaniment of breaks and flurries in the stratification; and the perviousness of the overlying strata at a favorable point which offers little resistance to overcome the head.

As is very well known, the stratification of the glacial drift is decidedly varied and replete with abrupt changes; this is found to be particularly true where springs appear, so that in a consideration of the controlling influences little more than a statement of the general nature of the soil and a suggestion as to the main elements is possible without special data.

The relation of some of these factors in specific cases is shown by the accompanying diagrams which have been prepared from information gained through the aid of test wells and excavations in the regular course of practice, but without reference to its use for the present purpose. They represent the conditions in each place as closely as possible from the data available.

Fig. 1 is a longitudinal profile and section representing a portion of the upper part of the valley of Vine Brook in the town of Lexington, Mass. The watershed of the brook above the point marked C has an area of about ½ sq. mile, and above B, ¼ sq. mile. The valley has no well defined absorbent area of large extent above these points. The porous formation, of which there is a fair quantity, is distributed in small tracts on the main slopes and intervening undulations. Springs occur at the points marked A, B and C, and it is interesting to note their progressiveness as the area of the watershed increases, the one at A being an intermittent spring; the one at B, a small perennial, and the one at C a large perennial. Pervious material is represented as shown at D in the section, impervious as at E, muck as at F, and rock as at G.

The ground water in the valley above appears to be intercepted in its downward course by the impervious strata at E, causing it to find its way into the rock beneath, which is of a seamy, disintegrated nature, offering ample opportunity for the free passage of water and also permitting an outlet below at B, where the rock approaches nearest the surface and where the superimposed sand and gravel offers little resistance against the pressure that is acting upon the water.



SECTIONS SHOWING THE STRATIFICATION AT SEVERAL SPRINGS IN MASSACHUSETTS.

Fig. 1.—Longitudinal Section Through Springs in Upper Part of Valley of Vine Brook, Lexington, Mass. Fig. 2.—Section Through Strata at Porter Spring, Avon, Mass. Fig. 3.—Section Showing Formation at Colborn Spring, Needham, Mass.

The location of this spring appears to be determined also by a natural dam at H, some 1,300 ft. away, for the line of saturation between the two points is only slightly inclined, is practically at the surface, and but little below the elevation of the spring.

A marked feature of this profile is the succession of depressions containing muck deposits. The first one is 400 or 500 ft. long and 5 or 6 ft. deep; the second one about 1,000 ft. across and over 12 ft. in depth; while the third one is a half mile in extent and has a depth of 40 ft., or more. Geologists tell us that these depressions once formed ponds or lakes and that the muck has gradually grown until the basin has become entirely filled. Our observations and soundings show that this growth is in progress in many of the ponds, lakes and reservoirs now used for water supply purposes. Constant alluvium washings, debris, leaves, vegetable growths within the water and upon the bottom accumulate in the muck forming process that promises well for the ultimate conversion of the sheet of water into a meadow.

Fig. 2 is a sectional view at the location of the Porter Spring in the town of Avon, this state. The principal absorbent area is elevated from 15 to 50 ft. above the spring, is of considerable extent not far away, and the brook of the valley is about 450 ft. from the spring. The water issues at the point marked A in the figure and the principal factors determining the location appear to be the head or pressure and the interruption or determination of the strata carrying the water, which is occasioned by the impervious strata.

The water-bearing material is a coarse, reddish gravel 12 ft. below the surface, which disappears beyond the spring and is overlaid by a stratum of hardpan which also dips off a short distance away beneath the sand and gravel that follows. The bed rock is prominent, approaching within 16 ft. of the surface and dropping off below the spring, as in Fig. 1. As boulders occur in the upper strata, weak places were no doubt present which permitted the water under pressure to force its way through. It is significant regarding the head and usual tightness of the hardpan that when the well for utilizing the spring as a source of supply for the town was constructed, the walls were built up so as to store the water 3 ft. higher than before, which was accomplished and the water in the well stood 5 ft. higher than the surface of the meadow 75 ft. away; the site of the original spring having been previously sealed over.

Fig. 3 represents the formation in the vicinity of the Colborn spring at Needham, Mass., which is an unusually large spring. Although hardpan and clayey material exists in parts of the watershed, the major portion is of sand and gravel formation of various degrees of porosity. The principal area suitable for ground storage is ½ to ¾ mile from the spring and elevated 50 to 70 ft. above it. As shown in Fig. 3 the spring appears at A, where the bed rock is prominent, approaching within 19 ft. of the surface, and a very large boulder or ledge cropping occurs a short distance above, which as found by excavations apparently disturbed the regularity of the stratification.

The water bearing material is 14 ft. below the surface, and consists of a mixture of coarse gravel and disintegrated rock or boulders, with a finer material of a somewhat similar nature above and sand beneath, while the surface strata is compact sand and gravel. Small pockets of sand and clay were found irregularly placed at the spring location. In the valley below a decided depression occurs in the sub-formation, which is filled with sand and gravel, varying from quicksand to fair-sized gravel.

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*Condensed from a paper read before the annual meeting of the New England Water-Works Association, June, 1896. The paper will be published in full in the Journal of the New England Water-Works Association.

The main factors in this case are the compactness of the sand and gravel immediately below the spring, the diminution or termination of the coarse strata or vein and the great pressure from the storage reservoir, combined with the nearness of the water bearing strata to the surface and the presence of malformations. There are no indications of influencing obstructions further down the valley, the brook in a distance of 1,400 ft. having a gradual fall of 8.5 ft.

The supply well constructed at this place permitted the water to overflow at an elevation 2½ ft. higher than the average level of the original springs, and ¾-ft. above the bed of the brook adjoining.

Where springs have been taken by right of eminent domain and the damages for so doing determined in court, very interesting questions arise as to their capacity, permanence, possibility of contamination, the value of water, relative value of the spring in question, rights of the owner to the exclusive use of its waters and even questions affecting its genuineness, as in a case recently tried in the Superior Court for Norfolk Co., Mass.

As no two cases are alike, and this one has been settled, no harm can result in describing some of the salient features. The trial resulted from a suit for damages in the sum of $25,000 for the taking by the Commonwealth of Massachusetts of the Blue Hill Silver Spring in the town of Milton, which is located within the Blue Hills Park Reservation. In making an examination of the spring, its surroundings and watershed for the purpose of estimating its value, it was found to be situated upon the southerly side of Great Blue Hill. The watershed has comparatively steep slopes, largely composed of a stony, rocky formation, constituting a quick shed without favorable conditions for producing springs. The spring-well is 43 ft. from the brook draining the valley, is 3½ ft. in diameter and 5½ ft. deep. There is no overflow, but the water moving in the same channel that supplies it issues from the ground 40 ft. away as springs.

The conclusion was early reached that this water was from the surface, escaping from the brook somewhere above the spring-well and finding a channel through the rapidly inclining stony formation to appear below as springs. Measurements and tests were made to determine this, and it was found that at a point on the brook 400 ft. above the springs the quantity of water flowing in the brook equalled the quantity issuing from the springs below, plus the quantity flowing in the brook opposite the springs; showing that the brook lost an amount equal to the flow of the springs, somewhere between the places measured and probably at a comparatively flat portion of the brook just below the uppermost point.

These measurements, together with results of a corroborative nature from other tests, demonstrated that the spring water was simply brook water a little earlier in the day, and from the nature of the intervening formation subject to practically the same influences. However, both the brook water and the water from the well were excellent in quality at the time of the examination, and possibly more suitable for table use than many waters used for that purpose that come from permanent deep-seated springs.

In considering the possibility of utilizing a spring as a source of water supply for a town, the question of purity and freedom from possible future contamination having been settled satisfactorily, considerations of the size or flow of the spring, its permanence, seasonal variations, the area and nature of its watershed and its location and relation to other sources of supply naturally follow. To serve as the entire supply a spring must be of unusual size or the number of inhabitants to supply correspondingly small; when neither of these conditions is fulfilled except in a moderate degree, a spring favorably situated may be made a valuable adjunct to a supply from another source, either as an increase to the existing quantity or for the purpose of imparting an improvement to the quality, which is usually the result of such an admixture.

The number of springs that may be found in nearly every town in New England is almost surprising; no less than seven of fair size were examined by the writer in one town during preliminary investigations for a water supply, so that one almost invariably hears of certain springs that "never go dry," to use a common expression, that are suggested as suitable for public use. Most of them are either too small, isolated or unfavorably situated to be available for a town supply; but all have their enthusiastic admirers, and it is not to be wondered at, for with a spring are ever associated thoughts of an ideal drinking water.

When the possibility of having such water for every day domestic use becomes a reality, to draw it from a faucet like common river or pond water in a large city, and at an expense of less than 0.004 cts. per gallon instead of from 3 to 10 cts., as is paid for table water by the jug or carboy, it is a matter for congratulation, and the community possessing it is indeed fortunate.

The size or flow of a spring depends upon the area of the absorbent surface, the storage capacity in the ground, the head or resultant velocity of the flow, and the capacity of the channels through which the water passes, but it is always subject to direct variation with the rainfall. The main storage reservoir may be near or distant from the spring, but seldom or never surrounds it and is always above and usually at some distance away. The water reaches its outlet through the channel offering the least resistance, which may be a very porous strata, a particularly open portion of such strata, fissures in the rock or through the broken stone resulting from the disintegration of rocks and boulders. Where the water moves most rapidly in such channels it constitutes a vein, whose course may be very irregular and which is, therefore, often difficult or impossible to find from the surface.

The capacity of a spring in its normal condition can be readily ascertained by measuring its natural flow; if these measurements are continued at regular intervals over long periods of time, including seasons of extreme conditions, the seasonal variations will be determined. Such records are rarely kept, however, their importance seldom being realized until the spring is utilized and the normal conditions changed.

The capacity of a spring after its resources have been developed, or rather the capacity of the well or wells constructed for its development, differs materially from its normal capacity. The channel through which the water finds its way to any particular spring may be only one of the various outlets of the storage reservoir; the other outlets may appear at the surface as springs in other parts of the watershed of the stream draining the valley, or may continue underground in other courses to ponds and rivers below. Consequently, when the water is drawn down at any spring to a lower elevation than that at which it naturally appears, the head is increased, causing a corresponding increase in velocity of the inflowing water, which results in a greater discharge.

When the surface of the water is first lowered this increase in quantity may be partly ascribed to the amount stored in the immediate vicinity of the well; after a while this is exhausted, but the changes in inclination of the lines of saturation have become far-reaching and water hitherto moving in other channels is diverted by the changed conditions and follows the new inclination. If the draft is continued the storage reservoir will be affected, its surface lowered or inclination changed and other outlets will lose a part or the whole of their flow, which is thereby contributed to the well being drawn upon. The latter condition was illustrated during continued pumping from the Needham well while in process of construction, with occasional interruptions. The flow of the Hicks spring half a mile away was diminished perceptibly and the action of the hydraulic ram affected, which was particularly noticed to occur when the pump at the well was in operation.

TABLE I.—Yield in Gallons of Porter Spring, Avon, Mass., 1889 to 1895.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.
Rainfall (Chestnut Hill reservoir), ins......	54.79	50.21	49.63	42.27	46.71	38.17	45.93
Daily average for the year..................	.....	12,982	39,945	41,168	55,124	59,728	61,921
Maximum pumping,[1] gallons per 24 hours ..	.....	27,752	44,484	82,807	81,455	101,313	75,945
Maximum for one day, gallons....................		77,589	84,811	120,045	122,974	143,970	135,531
Time pumping max. quantity, hrs. and min.	.....	2:30	2:30	3.25	.......[2]	4:40	.......[2]
Total gallons pumped during year................		4,738,609	14,580,106	15,026,291	20.120,272	21,800,682	22,601,234

[1] Ten consecutive days. [2] While painting stand-pipe.

Note.—The yields given above are from the pumping records after beginning to utilze the springs. Observations of the natural flow in 1889, before beginning to pump, showed a natural flow in gallons per 24 hours, as follows: Minimum, 43,056; average, 49,680; maximum, 70,992; equivalent to 18,133,200 gallons per year. A 53-hour continuous test of pipe wells showed a yield at the rate of 243,000 gallons in 24 hours.

TABLE II.—Yield of Colburn Springs, Needham, Mass., 1890 to 1895.

	1890.	1891.	1892.	1893.	1894.	1895.
Rainfall (Chestnut Hill reservoir), ins.	50.21	49.63	42.27	46.71	38.17	45.93
Daily average, gallons per 24 hours	.....	25,419	64,654	106,149	112,217	139,099
Total gallons pumped during year	.....	9,278,008	23,663,503	38,744,726	40,959,255	50,771,384

Note.—The yields given above are from the pumping records after beginning to utilize the spring. Observations in 1890, before beginning to pump, showed a natural flow in gallons per 24 hours, as follows: Minimum, 246,818; average, 274,320; maximum, 310,532; equivalent to about 100,000,000 gallons for the year. Pumping continuously from the well excavation for 21½ days the yield in gallons per 24 hours was as follows: Minimum, 415,152; average, 440,479; maximum, 519,840.

This spring is in a direction from the well nearly at right angles to the course of the brook. There are two brooks between, and the spring supplies a third and would naturally be considered in a different watershed, although the dividing line is not pronounced. From its location and the circumstance mentioned it is probably fed by the same reservoir. It does not follow, however, that the same or similar conditions always exist concerning any two springs that may be somewhat near each other, or even in the watershed of the same brook, for their particular watersheds may be distinct, separated by a barrier and uncommunicable, as might be the case with two springs on opposite sides of a wide valley.

The location of the Seaverns Spring in Lexington, Mass., is an example of the latter situation, being at the toe of the slope on the opposite side of the valley from the spring-wells and pumping station of the town supply, with a deep muck deposit intervening. No records have been kept that would determine beyond question that long continued pumping on the wells does not affect the flow of the spring, but from such observations as have been made it is probable that the spring is not seriously affected, if at all.

In a preliminary study of the probable quantity to be depended upon, it would be on the safe side to consider a spring-well supply, on the basis of an ordinary ground water, at the place under consideration, and estimate the quantity in accordance with the method described in Mr. Frederick P. Stearns' paper on "The Selections of Sources of Water Supply," under the heading "Quantity of Ground Water," printed in the "Journal" of the Association for March. 1892.

While it is possible that a spring-well as usually situated may not furnish as much water as a well located in open porous material with a direct watershed of the same area, it is very probable that it will furnish more water than could be expected from the same watershed in which it is located, were the spring and its supply channels absent.

Mr. J. T. Fanning, in his treatise on "Hydraulic and Water Supply Engineering," states that, "from springs, with the aid of capacious storage reservoirs, it might be possible to utilize 50% of the above (referring to accompanying table) volume of percolation. From wells, it would rarely be possible to utilize more than from 10 to 20% of the volume."

For the purpose of affording opportunity for comparison with other springs, the following data, compiled from observations made before and during construction, and from the pumping records since, is given concerning two springs that have been utilized for town supplies six and five years respectively.

The Porter spring constitutes the present supply for the town of Avon, Mass., having a population of 1,626. The watershed of the brook draining the valley has an area above the location of the spring of about 0.5 sq. mile, with possibilities for a reserve supply; and the formation of a considerable portion of the territory is of a fairly absorbent nature, 30 or 40 acres tributary to the spring being especially favorable.

The table shows that during the last three years the quantity of water pumped exceeds the average natural flow as observed in 1889, demonstrating that the normal capacity of a spring is not the measure of the capacity of a well at the same location, the difference in quantity being made up from the storage reservoir. In 1894, the year of least rainfall, the quantity pumped was but 6% of the total rainfall, indicating that much water runs to waste during wet seasons.

The minimum natural flow was measured after a period of 19 days when the rainfall was so slight that probably none of it reached the water table; and the maximum, following a fall of 2.44 ins. These figures show the variations springs are subject to in direct consequence of variations in the rainfall.

The quantity pumped during a short preliminary trial of 53 hours was an aid in studying the source, and indicates pumping possibilities in a similar season when the storage reservoir has not been drawn upon for too long a period to permit of it, as does also the quantity pumped at a trial of the permanent pumping plant for determining its capacity per minute and steaming qualities, at which time 103,555 gallons were pumped into the stand-pipe in a run of 2 h. 43 min.

The Colburn spring supplies the town of Needham, Mass., which had a population by the 1895 census of 3,511. The brook nearby has a watershed above the spring of about 0.9 sq. mile, which is particularly adapted for absorbing a fair percentage of the rainfall. The yield of this spring is shown by Table II.

It is evident from the Needham records that the water required in 1895 was a little more than one-half the natural flow of the spring, and that the maximum demand has not required a draft upon the reserve in the main storage reservoir, 251,102 gallons being the maximum pumping for one day in 1894, the year of low rainfall.

The greatest natural flow observed in 1890 was on April 10, nearly 1 in. of rain having fallen the day before, and the least flow on Aug. 25, after nearly three months in which there was a deficiency of rainfall and in a season when it is doubtful if the water table received any replenishment.

The quantities pumped from the well excavation during construction are of interest, as the pumping occurred immediately after the deficiency in rainfall before mentioned and when little or no water was running in the brook above the spring. The pumping covered a space of 2½ months, and during three periods was continuous; one period of 11 days, one of 21.5 days, and the third of 12 days, with a dry spell of two weeks occurring during the longest period. The least quantity pumped was during three days at the end of the dry spell, and as given in the table was 415,152 gallons, which amount represents 20% of the average daily rainfall for the twelve months preceding.

By the third day after pumping ceased at the end of this space of 2½ months, during which time the quantity pumped and the natural flow exceeded 23,000,000 gallons, the spring had resumed nearly its usual flow.

The Colburn spring, originally consisting of three distinct springs, within a radius of 110 ft. of each other, is not far from the Charles River. This locality is near the middle of a long detour which the river makes about the town, almost semi-circular in shape for a distance of about nine miles. The town is practically enclosed by it on three sides, the main villages being situated near the center of the bow on elevated land about a mile from the river. The watershed of the brook is east of the villages and comprises a portion of the Needham Plains before referred to, with an absorbent area of a hundred acres or more where the formation is very porous and the water table 25 or 30 ft. below the surface.

The location of the works is particularly fortunate in possibilities for the future when the town outgrows the supply from the well; not the least of which is the opportunity to obtain a ground supply near the river; legislative right to a daily quantity of 500,000 gallons from it having been obtained by the town.

The supply works are designed with a view to future additions, the pumping station being located nearly midway between the spring and river. This renders the connection between pumps and well longer than ordinarily advisable for a direct suction. It was determined by considerations of the best location for the station, present and future, together with the fact that the extra friction in the suction pipe would be of little consequence in this case, as there is a back head of 2 ft. on the pump discharge valves when the well is full, and the maximum lift is but 19 ft. The suction pipe is 12 ins. in diameter, 970 ft. long and laid on a true grade.

The spring well is circular, 22 ft. in average diameter, 24 ft. deep, built of open-jointed rubble masonry, with a lining of brick laid in cement mortar, for the upper 18 ft., and is surmounted by a conical shingled roof. It was built at the largest and highest of the three springs, and the sites of the other two were sealed over by beds of concrete, while the water was kept down by pumping from the well. The outlet is 1½ ft. below the top of the well, which overflows between times of pumping.

The pumping plant is in a substantial brick building, is operated by steam, the machinery is duplicate throughout, designed for economical operation and has a total capacity of 1,500,000 gallons in 24 hours. The plant is connected with the distribution system ¾ mile away by a 10-in. force main.

PARIS TRAMWAYS, PAST AND PRESENT.

According to a report prepared by Mr. Graham, of the British Embassy at Paris, tramways were introduced into that city in 1853 by Mr. Alphonse Loubat, who had just returned from a trip to the United States and saw them tried in New York. They were at first called "Chemins de Fer Americains." On Aug. 16, 1853, a trial took place in Paris, which was fairly successful, and on Feb. 18, 1854, an imperial decree authorized M. Loubet to establish and operate horse-tramways between Sevres and Vincennes. In 1856 this right was transferred to the Compagnie Generale des Omnibus. The Loubet concession provided for the building of about 18 miles of line, of which 5 miles were not built until about 1874.

In 1893 the urban and extra-mural systems of Paris tramways extended over 230 miles, and they carried annually over 158,000,000 passengers. The city of Paris is not entitled to any portion of the receipts from these lines, except as covered in the following taxes and rents: A ground rent for offices, stations and shelters erected on the highways and a tax of 6 cts. on each car starting from a terminus within Paris. The city receives annually about $23,500 as rent for offices, etc. The State receives nothing from tramway enterprises: not even the 3% wheel-tax levied on ordinary carriages.

A decree of Aug. 6, 1881, fixes special conditions which tramway companies must comply with in the construction and operation of their lines. All plans must be approved by the Minister of Public Works and the Municipal Council, and these plans cannot be modified without the consent of these parties, though the administration may order such changes as will not give grounds for indemnity. The companies are answerable for the conditions of the highways over which the lines pass; and in cases of neglect the streets may be repaired by the city at the users' expense.

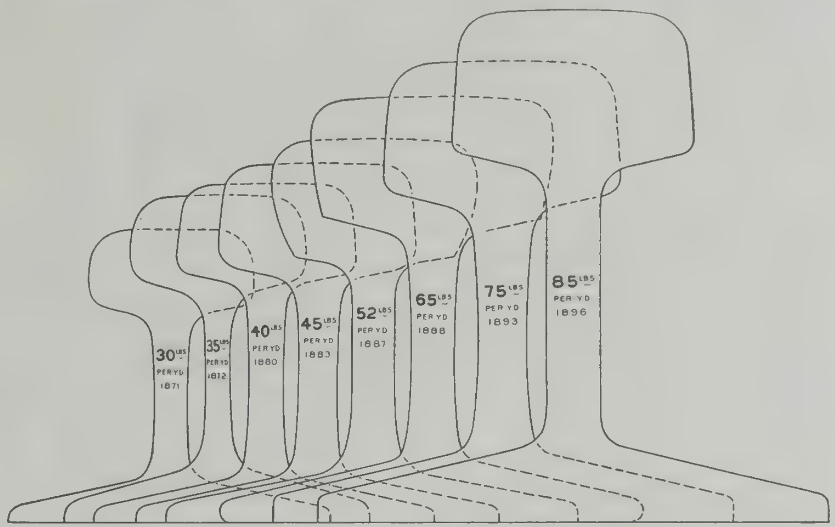
The maximum speed of steam tramways is fixed at 12½ miles per hour; and if there is danger to the public safety from any cause, the working of the line may be stopped or it may be given to a new company to operate. The city has the right to cross any tramway with roads, railways or canals without indemnity to the tramway company; and any concession for a tramway may be withdrawn at any moment if such a step is deemed to be of public benefit. The administration may grant concessions for new lines branching from the lines of old concessions without any indemnity to the original company. The two companies, in such a case, must come to an agreement regarding the use of each others' lines, stations, etc.; and in case of disagreement the decision of the Minister of Public Works is final. In the Department of the Seine control over the construction and operation of tramways is exercised by the Chief Engineer of the department, assisted by two engineers of the "Ponts et Chaussees," and one engineer of mines under the Prefect of the Seine and the Prefect of Police. The Chief Engineer is paid 3,000 francs, or $600, annually for these services, and his assistants are paid each 1,000 francs, or $200 annually—presumably in additions to other salaries.

The tariffs are fixed by the "Cahier des Charges" and must be approved by the Minister of Public Works for all state concessions, and by the prefect in all departmental or communal concessions. In Paris, the usual charges over the whole or any part of a line are 6 cts. for first-class and 3 cts. for second-class passengers. The first class have seats in the interior and are entitled to "correspondence," or transfers on any abutting or intersecting line having transfer offices; the second-class ride on top and have no rights of "correspondence" without an extra charge. Children under 4 years and bundles not exceeding 22 lbs. in weight are carried free. The administration may require, except on Sundays and national holidays, special cheap service for working classes with only second-class fares.

The lines are generally worked by horses, but mechanical power is making rapid progress. Ordinary and fireless steam locomotives, compressed air and electric motors are now used on several lines and the Belleville tramway is operated by a cable. The rails are of the American flange and Broca or Marsillon types.

RAIL SECTIONS OF THE DENVER & RIO GRANDE R. R.

The various forms of rail sections which have been used on any one railway of considerable age and length would make an interesting set for comparison, and we illustrate herewith a comparative set of the sections which have been used on the Denver & Rio Grande R. R. since 1871, when the construction of that road was commenced. There are eight sections, ranging from 30 to 85 lbs. per yd., and dating from 1871 to 1896, and these represent three different types of head. The first two (30 and 35 lbs. per yd.) have heads with round corners and sides, the second approximating somewhat to English sections. The next two (40 and 45 lbs. per yd.) have heads with outward flaring sides and very round corners. The next two (52 and 65 lbs. per yd.) have inward flaring heads, which is a distinctly objectionable form of section, and it will be noted that while the first of these (52 lbs. per yd.) has rounded sides to the head, the second (65 lbs. per yd.) has the sides very nearly plane. In the last two rails (75 and 85 lbs. per yd.) the section approximates to what is now practically the standard type of section, although the top corners of the head are of rather larger radius than is usually considered advisable.



COMPARATIVE SECTIONS OF RAILS USED ON THE DENVER & RIO GRANDE R. R. FROM 1871 TO 1896.

Our cut is reproduced from a page of the tenth annual report of the railway company, being for the year ending June 30, 1896. This report states that during the year 9,255 tons of rails were received and paid for, of which 5,266 tons are of the latest section, 85 lbs. per yd., as the management has deemed it prudent to increase the weight from 75 to 85 lbs. per yd. on these portions of the standard gage main line where the traffic of the system is concentrated and the speed of passenger trains is greatest. The heaviest rails used last year were laid north of Pueblo, Colo., and it is the intention, in the near future, to relay the balance of the 92 miles of single main track between Denver and Pueblo, with 85-lb. rails, provided the earnings permit of the expenditure. The relaying of the 28 miles of double track between these points will be deferred until a later time. The second-hand rails released by the laying of new ones are used upon other parts of the system to replace lighter rails now in use. Upon the standard gage main line between Denver and Grand Junction, 455 miles, and the Trinidad Branch, 91 miles, there are no rails of less than 65 lbs. per yd. carrying standard gage equipment. It is of interest to note that where the 85-lb. rails are used in the three-rail or mixed gage track, which extends from Denver to Leadville, 278 miles, the middle rail for the narrow gage (3-ft. gage) equipment weighs 65 lbs. per yd., making the total weight of steel rail 235 lbs. per yd. In an article on the Erie R. R., in our issue of Jan. 9, 1896, we referred to the use of 80-lb. and 74-lb. rails on opposite sides of the same track, but the Denver & Rio Grande R. R. goes even farther in using the above noted combination of an 85-lb. and a 65-lb. rail. It would be interesting to know whether this affects the riding quality of the track for the narrow gage trains.

WATER DEVELOPMENT ON THE MOJAVE RIVER, NEAR DAGGET, CAL.

By J. B. Lippincott.

The Mojave River rises on the northern slope of the Sierra Madre Mts. in San Bernardino Co., Cal. Its course is semicircular, flowing progressively west, north and then east, and, as is common in the arid region, decreasing in volume as it progresses until the surface flow at last disappears in the sandy bed a short distance below Barstow.

The headwaters of this stream flow from elevations of 5,000 to 8,000 ft.; it sinks at an elevation of 1,900 ft., the foothills of these mountains being 3,000 ft. above the sea.

The basin may be classified in three parts: Mountainous, containing 251 sq. miles; foothills of 219 sq. miles; plains and desert buttes, 1,000 sq. miles; thus making a total drainage area above Dagget of 1,470 sq. miles. These areas were taken by a planimeter from the county map.

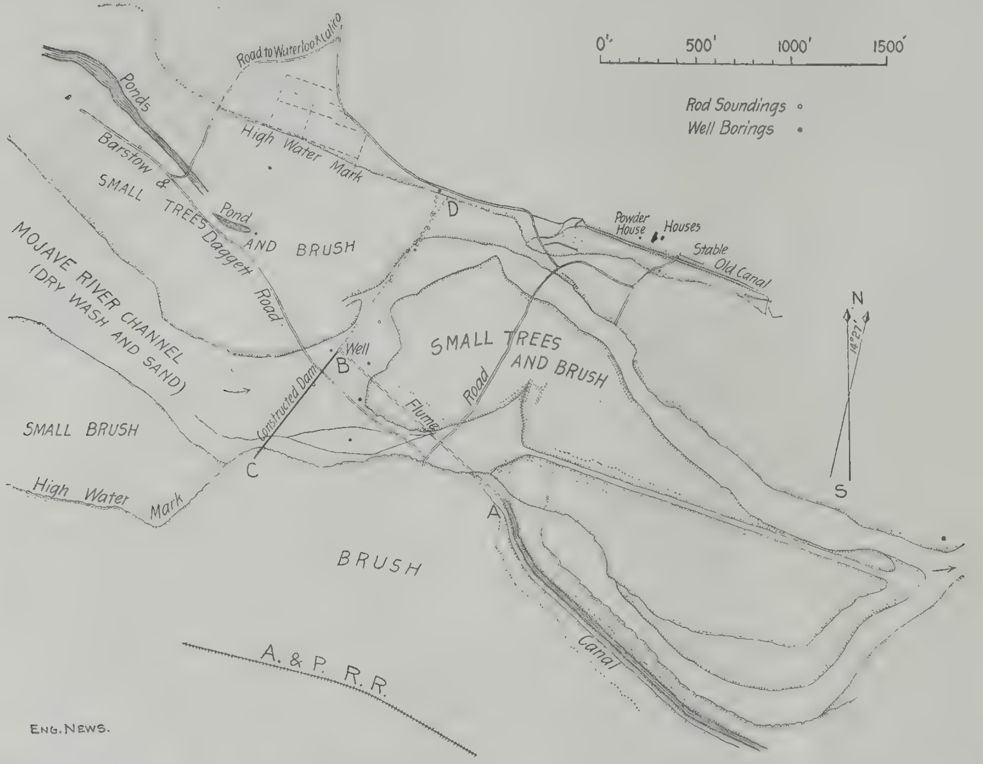


FIG. 1—SUBMERGED DAM SITE ON THE MOJAVE RIVER NEAR DAGGETT, CAL., FOR THE IRRIGATION SYSTEM OF THE SOUTHERN CALIFORNIA IMPROVEMENT CO.

To the west there are many mountains that drain toward the Mojave desert, but the streams, which are small and few in number, disappear as soon as they reach the hot sands of the desert. The general slope of this great valley is toward the Mojave River from the west, at the rate of 2 ft. per mile, but the rainfall is so light, about 3 ins. per annum, and the summer heat so great that the runoff, to say the least, is not on the surface.

The rainfall on the coast ranges of Southern California increases with the elevation of the range on the side toward the sea until the summit is reached, the heaviest precipitation being just over the crest. This increase discontinues, however, above an elevation of from 6,000 to 7,000 ft., at a point not well determined. The rainfall at the heads of this river has been well measured by the Arrowhead Reservoir Co. Just north of the crest and in the basin of the Mojave River the rainfall is 60 ins., and from that maximum it falls rapidly to an average of 2.6 ins. per annum at Barstow. It will be remembered that the storms in southern California occur between October 1 and May 1, the greater portion of the rain falling during the months of December, January and February. They are frequently very violent and the fact that the ground is so dry, provided the storm is very severe, causes a greater flood. The rivers of the southwest attain a violence during these floods that is not readily comprehended until witnessed. Boulders of several feet in diameter are rolled along in the stream bed, producing a noise that may be heard for several miles.

In the mountains of this basin the rains are frequently very heavy, often falling on slopes that are both rugged and steep, thus yielding floods which being shot out from the hills far beyond the ordinary limit of surface flow into the desert, fill up the porous sand and gravel of the river bed as they progress, and from their very nature disappear as rapidly as they began. From 24 hours to a week thereafter will find the bed of the lower portions of the stream again dry at the surface.

This is the general character of the Mojave River. During the summer it flows in places, where the position of the canyon walls or of bed rock force the water to the surface, in a stream of 20 or 30 cu. ft. per sec., rising and sinking on its uncertain journey as it encounters impervious material and finally losing itself in the sand just below the headworks of the Southern California Improvement Co.

The floods that issue from the mountains carry themselves as far out into the plains as their sandy river beds will permit. In addition to these waters are those supplied to the stream perennially and which normally sink at the foothills. These percolate down the channel probably at the rates of from 5 to 20 miles a year, depending on the slope and the character of the voids in the stream bed. It is the water in the voids of the sand and that which percolates in the stream bed that the Southern California Improvement Co. endeavors to obtain.*

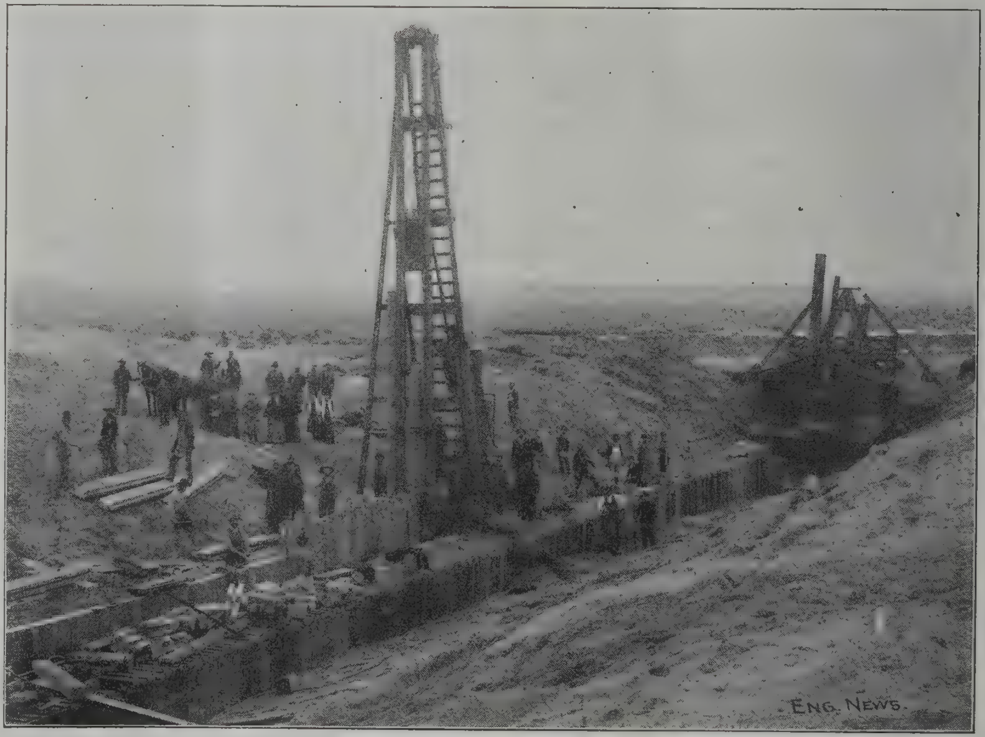


FIG. 2.—VIEW OF DAM AND COLLECTING GALLERY UNDER CONSTRUCTION.

The determining fact in the selection of the point for the construction of the diversion works of the Southern California Improvement Co. was that the bed rock as an impervious stratum was found nearer the surface here than at any other place on the lower portion of the river, and although the river channel is broad and the valley extends in an unrestrained way to the south, from the surface channel, all things being considered, this was chosen as the most feasible place to put in the works of development.

The rock of this locality is favorable to the work. It is a pronounced porphyry and is found in every color. It disintegrates rapidly on exposure to the atmosphere and forms clays on its surface. The exposed rock in the hills is thus melting away into clays, being very soft on top and getting harder as it is penetrated. A foot from the surface the rock is usualy quite solid. As this condition obtains on the side hills next to the river, it is assumed that the clays that are found in much the same condition beneath the sands of the river bed are of the same nature and gradually merge into the porphyry rock, making an ideal condition for the stopping of the underflow of the river with sheet piles, which are here used. The piles are said to be driven from 1½ to 5 ft. into this clay, the latter being covered with a varying depth of river sand. The piling could not have been driven true in case large boulders had been found in the stream bed.

The method of procedure in the construction of this work was to start a canal far enough down in the valley below to permit the water that was developed to flow away from the works as it was encountered. At the point where the canal enters the river bed the conduit is changed into a carrying flume. This is shown as line A B on the map, Fig. 1. This flume is 5⅓ ft. in the clear; the top, sides and bottom are made tight to prevent any escape of the water which has been gathered above. In other respects it is constructed the same as the gathering flume which will be described below. This carrying flume passes through the sheet-piling and into what is called the "well." This is a junction bay into which it is the intention to have all the gathering flumes empty.

The "well" is 10 × 6½ × 6½ ins., and is made of 6 × 8-in. timbers laid flat and bolted together. The bottom is drifted into piling, which are driven into the bed of the river for the purpose of forming a foundation and anchor for the bay; the top is made of the same material, and two large trap doors open through it from above. These doors may be fastened down solidly to the rest of the frame. The top of the well is on the level with the top of the sheet-piling, and is 5 ft. below the bottom of the river bed. The trap door on the top of the well opens into a temporary shaft that extends above the surface of the ground and permits entrance into the flumes. This shaft is made of 2-in. plank and is set on the main well, but is not fastened, so that when the floods come they will roll the shaft away, and the doors of the well being closed the flood will pass over without encountering any obstruction.

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*As many of the conditions in connection with this work were personally investigated by the writer as was feasible, but much of it is of such a nature that this could not be done.

The well being finished, the channel of the river was next opened along the line B C, Fig. 1, with scrapers, to a depth of about 10 ft., the water developed being permitted to pass out through the carrying flume; This scraper work having been excavated well down into the water-bearing gravels, the gates of the well were closed and the open channel allowed to fill with water. The dredger then floated into place and the excavation continued to the desired depth. It was then floated away and beached, and the gates of the well were opened, which by the drawing off of the water permits of the laying of the flume. This same order was followed in the laying of the carrying flume.

The gathering flume is first constructed and placed and then the sheet-piling driven below the flume (down stream), as show in the view, Fig. 2.

It is the intention to drive a row of piling on the line C B D, Fig. 1. These sheet piles are of the ordinary type, being 3-in. Oregon pine plank, 12 ins. wide, firmly bolted together, the lower end being sharpened to an edge. The lap of the plank is 3 ins., which permits the head being rounded to a diameter of 9 ins. These piles are driven with a 2,200-lb. hammer through the sand and gravel into the clay which is said to cover the top of the porphyry bed rock

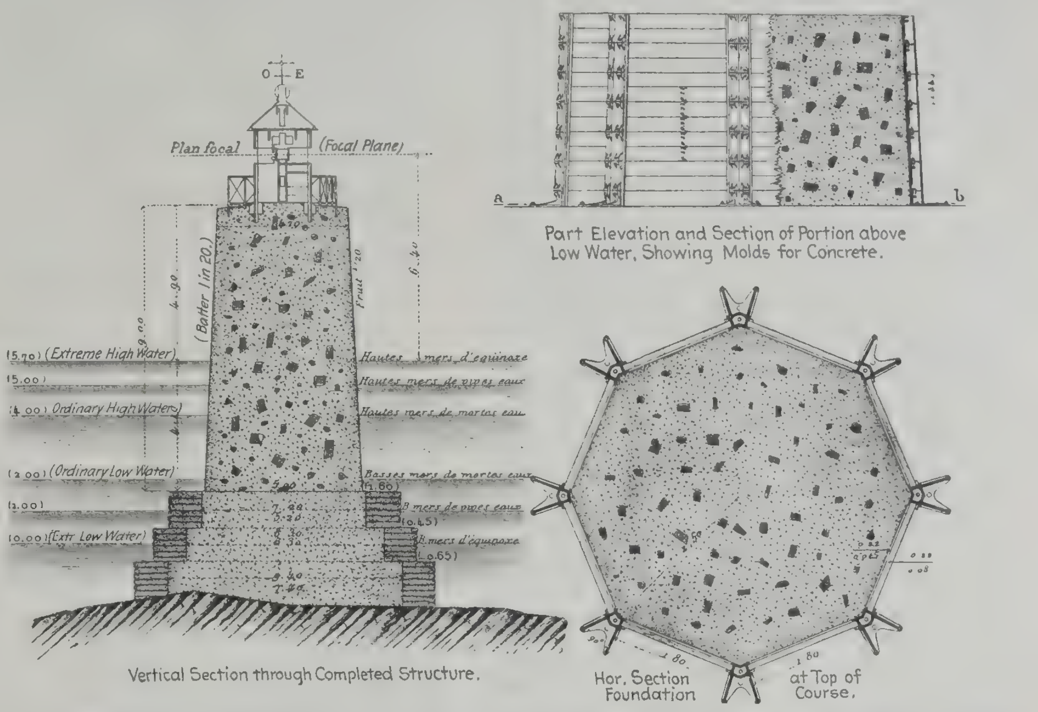
Up to May 1, 1896, the piling had only been driven for about 600 ft. south from the junction bay or well at the center of the channel, as shown by the line B C, Fig. 1. They are sawed off at a depth of 5 ft. below the bed of the stream and below the level where the sand has become stratified. All of the flumes and piling are to be covered with sand, as finished. By this method it is the intention to offer absolutely no resistance to the stream when it is in flood, and in that particular the plan is most wise, for it has been found that in placing the slightest obstruction in a torrential stream bed that obstruction will be subjected to violent attack from both water and boulders. An excavation being made below the obstruction it will be thus undermined and knocked over.

The gathering flume is built from the well 700 ft. south. It is made of 3 × 12-in. Oregon pine plank, except on the top, where they are 4 instead of 3 ins. thick, to support the gravel above. It is built square, 5⅓ ft. in the clear, and in the manner in which timbers are framed for shafting, each being mortised into the other, and all being framed around 6 × 6-in. longitudinal timbers, which are set in the corners inside. A much more convenient form of flume for working purposes after construction, and with no more material in it, would have been 6⅓ × 4⅓ ft.

The bottom of the flume is first made upside down, the plank being nailed on the longitudinal piece, then floated into place and turned over. The sides and top are then built onto it. Openings of ⅝-in. width were left in the sides, and of 1⅛-in. in the bottom of the flume to admit the water. Four 4 × 8-in. sills were placed on the bottom of the cut for the flume to rest on. They were rammed well into the gravel and laid longitudinally.

Numerous water development tunnels have been built in southern California in water-bearing sands and gravels and have been lined by placing lagging on the top and sides on the caps and posts. These posts rest on substantial sills, but frequently no floors are put in them. These tunnels have been successful in obtaining water but they probably lose water by percolation where the grade gets above the water plane. In this case, where the sheet-piling brings the water plane constantly above the flume grade, it would seem that the gathering flume might have been dispensed with. As it is, one-tenth of the bottom is left open, and efforts have to be made to keep these openings clear. The intention of the design was to prevent sand entering the flume too freely and interfering with the flow in other parts. The action of the fine sand in the present case is to work into the openings in small quantities.

It has been found that driving the piling, after the flume was in place and only 2 ft. from it, has been the cause of jamming it out of line and driving the gravel tightly into the openings. In the remaining portions of the channel the piling will be driven as much as 25 ft. from the flume to avoid this undesirable result. The flumes are provided with gates so that they may be kept full of water to prevent rot.



Vertical Section through Completed Structure.

Part Elevation and Section of Portion above Low Water, Showing Molds for Concrete.

Hor. Section Foundation at Top of Course.

SECTIONS SHOWING THE CONSTRUCTION OF A SMALL CONCRETE LIGHTHOUSE AT TROIS PIERRES, FRANCE.

The work of driving the sheet-piling across the river was less than half finished on May 1, the portion B D, Fig. 1, not being completed. It is fair to presume that when the channel is entirely closed to bed rock on either side of the river a greater amount of water will be obtained than a direct proportion of the present amount of water flowing to the portion of the river bed that is now shut off. At the present time there is approximately 7 sec.-ft. of water flowing from the carrying flume.

It is proposed to use this water on the Minneola Valley, which is a desert at the present time, but with the aid of water very favorable results may be obtained in an agricultural line. For the purpose of irrigation a charge of $22.50 per acre for the water right is made and an annual rental of $1.50. The duty of 1 cu. ft. per sec. to 250 acres is made. This is at the rate of $5,625 per sec.-ft. for the water right and $375 annual income from rentals.

There are a large number of mines in this neighborhood, borax, iron, copper, silver and gold being found near here. These mines are paying at the rate of $11.50 a ton for coal. A drop of 100 ft. in the grade of the main canal has been planned for the purpose of developing power which will be offered to the mines and used for general purposes.

Mr. W. E. Robinson is general manager and vice-president of the Southern California Improvement Co. He designed these works and superintended their construction. The work has been well done and is a credit to his ability and energy.

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A MONOLITHIC BEACON TOWER, FRANCE.

We illustrate herewith the beacon tower of Irvis-Pierres, at the entrance to the harbor of Lorient, on the coast of France. The execution of this work presented grave difficulties, owing to its exposed situation and the fact that the rock upon which it was to be founded lay about 6½ ft. below the level of the lowest tide, while the extreme rise of tide was 18.7 ft.

As built, the beacon proper is octagonal in form, with a base diameter of 16.4 ft. and a top diameter of 15.4 ft., 29.5 ft. above the base. The foundation was built in three courses, each presenting an offset of 2.8 ft., the total height of the base being 11.8 ft. The first part of the work consisted of clearing the surface of the rock from a heavy growth of seaweed; this was done by divers, and the roots and the finer mosses were then burned by breaking upon them carboys of hydrochloric acid and finally scrubbing the surface with steel brooms and fine wire brushes.

To define the exact position of the proposed beacon, and to guide the divers, a rectangular mast of wrought iron was fastened to the rock by wedges and spikes and bags of beton placed around the base. The center thus made was utilized in building a wall of bags of beton intended to contain the first layer of the concrete base; a light piece of wood attached to a ring encircling the mast was used to fix the position of the inside bags. It was found that the current was not strong enough to stop the divers from working and the state of the sea itself was the only obstacle, this latter depending on the direction and force of the wind.

When the wind was favorable a tug towed to the work a large barge and two smaller boats, containing all the material necessary for one day's work. The beton was made as it was needed, upon the barge, which was moored to four buoys located with the beacon-mast as a center. The beton was mixed during the passage of the plant from the little harbor of Lamar, and in building the encircling wall each sack of beton was lowered from a derrick on the barge in an iron bucket. The divers received this bucket and by opening the bottom deposited the sack in its place. The washing out of the cement was thus avoided. The sacks were made of a somewhat loose material which permitted their contents to unite closely together; and each empty sack made a rectangle of 4 × 5.2 ft., and 11 filled sacks made 1 cu. m. of wall. When this wall had reached a certain height it was filled with beton of the same character as that in the sacks themselves by dumping it from a cylindrical iron bucket with a bottom door.

The proportions for the beton to be used were only fixed after a special study. At high tide certain wooden boxes, 1 m. square on the sides and located near the experimental station at Lorient, were filled with beton. At the following low tide the sides of the boxes were demolished and it was then easy to watch the effect of the sea upon it. This experiment, continued during three months, convinced the engineers that a mixture of broken stone and a mortar rich in cement would give the best results. Ramming the submerged beton was impossible, as this would have led to a complete separation of its elements by the action of the water. On the other hand, with broken stone as a constituent element of the beton, ramming is indispensable to obtain the intimate mixture of the stone and cement mortar. For this reason the first beton experimented with was generally lacking in compactness and impermeability. This difficulty was finally overcome by using material of small dimensions, or a gravel mixed with sand obtained from a beach near Lorient. The beton then adopted had a definite proportion of 500 kilos. (1,100 lbs.) of Portland cement to 1 cu. m. of the gravel; or, about 3 barrels of cement to 1 cu. yd. of gravel. This beton gave excellent results. The experimental blocks showed no interior voids and, thanks to the precautions taken in depositing it, there was no notable deposit of "milkiness" or "laitance" between the several beds. The mass was perfectly homogeneous throughout its height. The completion of the foundation courses required the three summers of 1891, 1892 and 1893, during which time only 54 days were available for actual work. The cost of the foundation work was 18,016 fr. ($3,603.20) for 195 cu. m.; this was equivalent to 84.60 fr. per cu. m., or about $13.00 per cu. yd.

The beacon tower itself was made of the same beton as the foundation, but the work was executed in the dry at low tides. As a matter of some slight economy, large stones were introduced into the beton, as shown in the illustration, the concrete being well rammed around them. The tower presents the form of a trunk of a pyramid with an octagonal base; a form fixed upon as most convenient for the arrangement of the molds to be used. The base is a regular octagon, 16.4 ft. in diameter, diminishing to 15.4 ft. at the top, which is 29.5 ft. above the foundation and about 16 ft. above the level of the highest equinoctial tides. Upon the upper platform of the tower is a fixed light, adapted to the use of mineral oil, placed in a lantern, 5 ft. 3 ins. in diameter, constituting a light of the fifth order.

The molds used in building this tower were arranged as follows: At each corner of the octagon were placed special castings, the first or lowermost one securely anchored to the foundation, and successive sections were then bolted on as the work of filling progressed. These cast-iron sections had a uniform height of 2.44 ft. corresponding to two mold planks of 1.22 ft. each in width; the castings only weighed about 25 lbs. each, so they could be easily handled, and 3 bolts held them in place. The most delicate and important preliminary operation was the exact location of these castings at the eight corners of the tower. But when this was done the filling of the molds with beton was performed with the same bucket used in building the foundation and operated from a mast on the barge, and finally from a mast planted on the tower itself. The tower was built in the months of July, August, September and October of 1894; though in this period there were only 35 days available for effective work. The actual cost of this portion of the work was 3,570 fr. for material used, and 11,786 fr. for labor and all the accessory expenses of execution, including in this sum the original cleaning of the surface of the rock for the reception of the foundation. The tower contained 119 cu. m., and the item cost was 94.30 fr. per cu. m., or about $14.51 per cu. yd. As the foundation masonry, executed under water, cost only $13 per cu. yd., the cost of the tower seems high. But it must be remembered that in building the foundation the same quantity of beton was used each day, as the tides did not have to be considered. On the contrary, work on the tower was executed according to the stage of the tide, and in the beginning only one hour out of each tide was available for work. The workmen and the tug-service were paid for by the day and consequently the general expenses were constant. The total cost of the beacon tower was about 33,000 fr. or $6,600.

Since the completion of the work in October, 1894, the tower has been subjected to storms of exceptional violence. An examination made after two of these storms shows that the sacks of beton about the foundation are securely united together and none have been displaced; they preserve their original form in every detail. It is interesting to note that the foundation is already covered with a great quantity of small marine shells binding the sacks together and forming an excellent protection against the action of the sea.

The above description is prepared and our illustration is reproduced from a paper in the "Annales des Ponts et Chausees."

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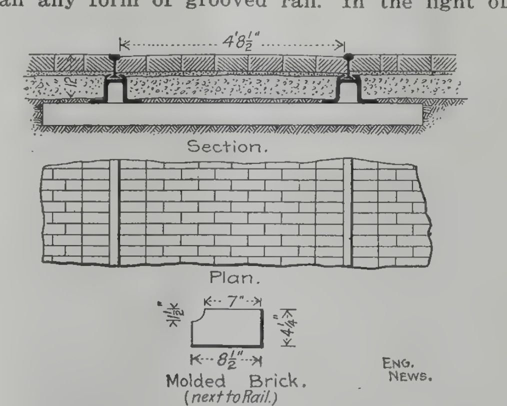
BRICK PAVING ALONG A STREET RAILWAY TRACK.

The city of Cortland, N. Y., is laying a large amount of brick paving this season. The accompanying cut gives a plan and cross-section of an electric railway track, showing the method specified for laying paving next to the rails and the bond adopted for the paving between the rails. It will be seen that the rail is supported on chairs in order to place the tie under the concrete and elevate the rail head to a level with the pavement. That street railway managers prefer the T-rail is well known, but it would seem that special brick forming a groove along the rail head would be better than the method here shown which breaks up the even surface of the street and leaves the inner side of the rail head as an obstruction to traffic. If the paving is laid in the way suggested, as is done in several cases, the T-rail is little more of an injury to the street surface than any form of grooved rail. In the light of these facts it would seem that the statutes and ordinances which have been enacted in various states and cities requiring the use of grooved head rails in the streets might well be reconsidered.



An Electric Railway Track in a Brick Paved Street at Cortland, N. Y.

The work at Cortland is being carried out under the direction of Mr. Wm. B. Landreth, M. Am. Soc. C. E., as Engineer-in-Charge, and Mr. Walter L. Webb, Assoc. M. Am. Soc. C. E., as Assistant Engineer.

SIX TWIN-SCREW STEAMERS for the North German Lloyds' Steamship Co. have been launched at Stettin, Germany. Two of them are to be express steamers and four are intended for the regular passenger and freight service of the company between Bremen and New York. The dimensions are as follows: Length 525 ft. between perpendiculars, or 550 ft. over all; 60 ft. beam, 34 ft. deep, 10,000 tons register, and approximately 20,000 tons displacement, with a draught of 28 ft. The cargo space, including the steerage decks, shows a capacity of 11,000 cu. meters or 10,000 tons measurement. The cabins contain accommodations for 100 first-class and 76 second-class passengers, and 2,300 passengers can be carried on the steerage decks when not needed for cargo. The fore part of the steamer is provided with a turtle-back deck, 80 ft. in length, as a protection against the high seas of the Atlantic, and over the after part there is a poop 66 ft. long. Besides the double bottom, extending the whole length of the steamer, the vessels are divided by twelve transverse bulkheads, extending to the upper deck, into thirteen water-tight compartments. The motive power consists of two quadruple-expansion engines, which in three of the steamers will develop 7,000 I. HP. with a speed of 14 knots; while the others will have engines of 8,000 I. HP., resulting in a speed of 15 knots.

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THE STRAIGHTENING OF A CHIMNEY STACK at the brick and tile works of the Standard Concrete Mfg. Co., Earnest, Pa., was recently accomplished under the supervison of Mr. B. W. Seamans, the company's superintendent. The stack is 122 ft. high, 11 ft. square at the base, tapering somewhat at the top, and weighs 400 tons. The walls are 36 ins. thick. The top was found to be leaning 45 ins. from a vertical line. To sink the side 4½ ins., 10½ ins. of brick work was removed from the foundation on three sides. As the bricks were removed square blocks of wood were inserted, one after the other, until three sides of the stack rested on the blocks. Between the blocks, supporting the stack temporarily, substantial brick piers 6 ins. high were built, leaving a space 4½ ins. between the top of the piers and the bottom of the undermined brickwork. The blocks were then set on fire and all were kept burning briskly. If one burned faster than the others the fire on that particular block was checked, so that all were made to burn uniformly, and as the blocks were being reduced to ashes the stack slowly righted. As the top gradually swung back through the 45-in. arc, small fissures appeared near the base. Into every crevice a steel wedge was driven, maintaining the solidity of the walls. The entire work consumed one day, and the reduction of the wooden blocks to ashes required an hour.

◆

A 24-IN. GAGE RAILWAY is probably to be built as an experiment by the government of the colony of Victoria, Australia. The line will be from Wangaratta to Edi, 24-in. gage, laid with 20 or 24-lb. rails, with engines of about 80 HP., capable of hauling a load of 250 tons on the level, with a passenger car seating 30 passengers, the weight of the cars being 6 tons each.

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A BOILER EXPLOSION occurred at a grist mill at Harrodsburg, Ky., Aug. 29, and several men were hurt and scalded.

WEATHER TABLE FOR JULY, 1896. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Max.	Direction at time of max. velocity.	Precipitation—rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities	Northfield, Vt.	67.0	91	45	46	7.9	30	NW	5.99	2.32	15
	Portland, Me.	68.0	92	52	40	6.5	26	NW	3.10	.76	15
	New York City	73.4	89	59	30	11.8	50	NW	4.45	1.14	16
	Pittsburg, Pa.	73.8	93	53	40	5.7	25	NE	8.96	2.31	17
	Chicago, Ill.	72.2	93	56	37	14.9	36	NE	3.61	1 81	8
	Omaha, Neb.	74.6	96	56	40	7.0	30	NW	4.53	2.08	10
	St. Paul, Minn.	70.8	95	52	43	6.1	28	NW	1.12	.37	7
	Duluth, Minn.	66.5	89	47	42	7.8	34	NW	1 74	....	11
	Bismarck, N. Dak.	68 8	103	43	60	7.4	34	N	1.03	.42	8
	Average	70.6	93	51	42	8.3	33		3.84		12
Southern Cities.	Washington, D. C.	76.7	94	56	38	5.5	26	NW	3.69	0.99	17
	Louisville, Ky.	78.4	98	59	39	7.7	45	W	13.01	5.50	11
	St Louis, Mo.	79.0	98	58	40	9.2	41	SW	4.67	1.80	13
	Savannah, Ga.	82.6	101	70	31	7.0	29	S	4.49	1.64	16
	Kansas City, Mo.	77.4	97	58	39	7.1	40	SW	8.66	5.62	8
	Jacksonville, Fla	82 2	100	70	30	7 8	36	S	4.25	1.43	14
	Chattanooga, Tenn.	78.5	96	57	39	5.7	37	SW	5.80	....	15
	New Orleans, La.	82.8	96	70	26	6.8	35	SE	2.92	.94	12
	Memphis, Tenn.	82.4	101	63	38	8.5	26	SE	.80	.42	5
	Palestine, Tex.	83.4	97	67	30	6.0	22	NE	1.67	....	6
	Average	80 3	98	63	35	7.1	34		5.00	....	12
Western Cities.	Helena, Mont	68.6	95	44	51	6.8	35	SW	0.89	.43	7
	Port Angeles, Wash.	58.9	79	44	35	7.1	23	W	0.00	0.00	0
	San Francisco, Cal.	59 4	72	50	22	14.1	38	W	0.04	0.4	1
	Salt Lake City, Utah.	74 2	97	55	42	5.5	34	E	1.35	.58	8
	Santa Fe, N. Mex.	66.8	82	52	30	5 8	34	SW	3.78	.86	14
	Denver, Colo.	71.9	96	53	43	7.2	45	NW	2 80	....	12
	Yuma, Ariz	91.3	110	68	42	6 9	33	NE	0.41	.33	2
	Average	70.2	90.1	52	38	7·6	35		1.32	....	6

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXVI., No 11.

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RAPID WORK IN RAISING A WRECK was accomplished in the case of the steamer "Rosedale," which was sunk in 16 ft. of water, by a collision in the East River, New York, on Sept. 3. The Chapman Wrecking Co. had the vessel raised within 24 hours after the accident. The "Rosedale" measures 216 ft. over all, 34 ft. beam, 10 ft. draught.

◆

CHAINLESS BICYCLES, in which two pairs of bevel gears are used instead of the chain, are reported to have proved their superiority over the present style of wheel in a test, in which a wheel was run 39,000 miles without adjustment or appreciable wear. Dynamometer tests also show that the bevel gears run with less friction than the chain. It is stated that one of the largest manufacturers will soon put these wheels on the market. An obstacle to their rapid introduction is the time required to construct the machinery necessary for turning out the bevel wheels which must be mathematically accurate in form.

◆

THE NEW YORK & NEW JERSEY BRIDGE CO. held a meeting at 214 Broadway, New York city, last week, at which Gen. J. S. Clarkson was elected President; Louis Windmuller, Vice-President, and Charles H. Swan, Secretary and Treasurer.

◆

FOR THE NORTH SEA AND BALTIC SHIP CANAL a revised tariff of charges on shipping went into operation on Sept. 1. Under the old tariff vessels up to 600 tons net were taxed 60 pfennings, or 15 cts. per ton, and vessels above that tonnage, 40 pfennings, or 10 cts. per ton. Under the new tariff the 10-ct. rate begins with vessels of 400 tons; above 600 tons, the tax is 30 pfennings, or 7½ cts., and beyond 800 tons it is 20 pfennings, or 5 cts. per ton. For vessels empty, or in ballast, the tax is 20% less than the above rates. Besides the above dues sailing vessels using the regulation tugs will be charged as follows: For the first 200 register tons net, 10 cts. per ton; for every additional register ton, 7½ cts. From October to March the charges for tugs will be increased 10%, but these charges include compensation for the use of the entire working arrangement of the canal and for the services of pilots between the ends of the canal.

◆

THE MANCHESTER SHIP CANAL CO. has sent its general manager, Mr. Marshall Stevens, to this country to induce the transportation companies here to make more use of the canal. Mr. Stevens has issued a circular letter setting forth the apparent advantage, at least, of shipping direct to Manchester instead of via Liverpool. He claims that with no reduction upon inland freight in America and with an even sea rate there will be an average saving on the whole New York cargo of 7 cts. per 100 lbs., or $1.56 per ton in favor of Manchester; and $1.17 per ton saving on the New Orleans cargo. He does not explain where this saving comes in, except to say that delivery by cart to destination is included in his figures and that one week is allowed at the Manchester docks for the removal of freight from the quay sheds, as compared with 3 days at Liverpool.

◆

CAST-IRON PROJECTILES are soon to be ordered by the Ordnance Bureau of the War Department, about $50,000 being expended on shells and shrepnel. The latter will be bought for use in the 3.2 and 3.6-in. guns, the projectiles to be fitted with 15 and 28-second fuses. The cast-iron shells are for the siege and seacoast guns; 500 shells of the 7-in. 500-lb. type will be bought for siege projectiles. The shells for use in the seacoast guns are as follows: 100 8-in., 100 10-in., 100 12-in., 100 12-in. 800-lb. mortar, and 50 12-in. 1,000-lb. mortar shells.

◆

ONE OF THE LARGEST GUNS designed in this country is the 16-in. gun which the Watervliet arsenal is now getting ready to build. The United States has built two of larger caliber for its coast defences, but they were old-fashioned 20-in. smooth-bores, 20 ft. long, with a range of between five and six miles. The new gun will be 49.67 ft. long, will have a range of 16 miles and be able to penetrate 27½ ins. of armor at a distance of two miles. The gun will weigh 125 tons, and it will throw a solid armor-piercing projectile weighing 2,370 lbs. The great trouble so far found in the construction of guns of such size has been that they "drooped" at the muzzle after being fired a few times. The Ordnance Board, however, believes that it has succeeded in overcoming this defect. The maximum diameter of the breech of the new gun will be 62 ins., and the diameter of the breech opening 20 ins. To fire this gun will require a charge of 1,060 lbs. of the usual brown prismatic powder.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred, Sept. 7, at Taswell, Ind., on the Louisville, Evansville & St. Louis Consolidated R. R. The wrecked train was an excursion from St. Louis. The baggage car and three coaches jumped the track and rolled down an embankment. Ten people were injured, two fatally.

◆

A THRESHING ENGINE BOILER EXPLODED near Sanilac Center, Mich., Sept. 2. It was carrying 100 lbs. pressure at the time. Three men were killed and two injured. Near Charleston, W. Va., on Sept. 2, a saw mill boiler exploded, killing two men and injuring two others.

◆

A FALLING WALL killed eleven firemen at Benton Harbor, Mich., Sept. 6. The Yore Opera House, a four-story brick building, was not discovered to be on fire until the flames had made considerable headway. The wall fell almost as soon as the firemen arrived.

◆

PROPOSALS FOR THE READING SUBWAY (for the depression of the Philadelphia & Reading R. R. tracks) at Philadelphia, were opened Sept. 1, the bidders being Ryan & Kelly, E. D. Smith & Co., P. H. Flynn & Co., Sullivan Bros., Mason, Hoge & Co., and R. A. Malone & Co. The tunnel will extend from 22d St. to Tavey St., 2,710 ft. In this distance there will be 13 openings in the center of the newly-made street. Each opening in the center of the roadway will be surrounded by a stone coping 3 ft. high, over which twining vines will grow. Outside of this will be a plot covered with trees and shrubs, and surrounded with a highly ornamental picket fence. Each plot will take up a space 10 × 48 ft., and in the narrowest part there will be an asphalted roadway on either side, 27 ft. wide, giving a street on either side at least as wide as Chestnut St. The next contract covers that part of the subway beginning east of 22d St. and running to the grade at 30th St., and includes all of the tunnel work and part of the open subway. The original plan required the erection of fan houses by the city for the purpose of expelling the foul gases from the tunnel, but this has been done away with and the new plans call for openings in the tunnel which will be a great saving in the cost of construction. The work has been described and illustrated in our columns.

◆

THE TAMALPAIS MOUNTAIN RAILWAY was opened Aug. 26. The line starts from Mill Valley, Cal., and rises 2,300 ft. in a straight distance of two miles, although the railway is 8¾ miles long, with grades of 5 to 7%. The line is a very winding one, composed mainly of curves and loops, the sharpest curves being of 72 ft. radius.

◆

A RECORD FOR TRAINS RUNNING ON TIME is claimed by the Chesapeake & Ohio Ry. for its four limited trains running between Washington and Cincinnati, Each train covered the distance of 599 miles 122 times during the months of March, April, May and June, and the four trains were on time 463 times out of a possible 488, or 95%.

◆

AIR MOTORS WERE SUCCESSFULLY TESTED on the night of Sept. 3 on the boulevard line of the Third Avenue Railroad in New York. They ran from the Fort Lee ferry across town, back to Tenth Ave. and up the heavy grade on that avenue to Fort George. The cars were stopped and started up and down on the steepest grades.

◆

AN AIR MOTOR capable of pulling a train of five cars is shortly to be tested on the Sixth and Ninth Avenue lines of the New York elevated railroads. The American Air Power Co. which is to furnish the motor, has leased a building at Greenwich and Rector Sts., where the plant for compressing the air is being erected. A pipe will be run from the motor house to the Rector St. station, where the motor will be charged. The motor is being built at the Rome Locomotive Works, and is to be completed by Nov. 1.

◆

THE "FRAM'S" HIGHEST LATITUDE, says Capt. Sverdrup, in his detailed account, was 85° 57′ North, in 66° East longitude, reached on Oct. 16, 1895. From this point the "Fram," tightly bedded in the ice, drifted southward. Aside from the fact that this expedition reached a point nearer to the North Pole than any preceding it, is the remarkable behavior of this remarkable ship. Capt. Sverdrup, who succeeded to the command after Capt. Nansen left the ship on his expedition over the ice, says that though the ship was repeatedly subjected to enormous pressure from the ice, she was safely and quietly lifted up without undue strain; sometimes being lifted 6 to 9 ft. several times a day. He reported the expedition as an easy one, resulting in no damage to the ship or to the men.

◆

THE PAVING OF CITY STREETS was referred to in a paper on "Highway Legislation," read before the American Social Science Association, at Saratoga, on Sept. 3, by Prof. Francis Wayland, of Yale. For cities he advocated compelling the street car corporations to pay for keeping a certain space on each side of, as well as between, their rails in good order. This is only equitable, because by diminishing the amount of room which can be used by vehicles they add greatly to the wear and tear of the remainder. It was, moreover, suggested that a tax should be levied on vehicles in proportion to the amount of injury which they were capable of doing in their daily use. There seemed no justice in calling on abutter to pay a considerable part of the expense of repairing a street which would have needed almost no repair but for the damage caused by heavy carts. If the amount of this "wagon tax" were used exclusively for street repairs it would go far toward a reasonable solution of the problem. This expedient has been adopted in other countries with good results.

◆

THE STEEL ARMORED CRUISER "BROOKLYN," in her trial trip of Aug. 27, made an average speed of 21.92 knots in a run of 83 knots, and passed over part of the course at the rate of 22.90 knots per hour. She made the run with a boiler pressure of 160 lbs. and an average of 138 revolutions per minute of the screws, with a maximum of 140 revolutions. By her performance she is claimed to earn a bonus of about $350,000 for her builders, the Messrs. Cramp, of Philadelphia. Her contract speed was 20 knots per hour. The cruiser "New York," on her trial trip, made an average of 21 knots; the "Minneapolis" made 23.073 knots; the "Columbia" made 22.81 knots, and the "Olympia" made an average of 21.69 knots per hour.

◆

THE WIRE FOR THE NEW SUSPENSION BRIDGE over the Ohio River between Cincinnati, O., and Covington, Ky., is now being delivered, and the work of stringing the wires and making the cables will soon be commenced. The wire is of No. 6 gage, and is delivered on large spools.

◆

THE NEW BROOKLYN TIMBER DRY-DOCK, now under construction at the Brooklyn Navy Yard, is to be completed for the government about Nov. 30, next, by the present contractors, T. & A. Walsh. This dock was contracted for originally with John Gillies, and it was to cost $575,000. After no practical progress had been made in two years, it was taken from him and on April 30, 1895, it was awarded to the above contractors, and will now cost, complete, about $650,000. The general dimensions are as follows: Length, 658 ft.; width, 64 ft.; width at entrance, 105 ft.; mean draft at high water, 28 ft. More detailed dimensions are as follows:

	Ft.
Length on coping level	560
Length inside head to inner sill	580
Length inside head to outer gate sill	600
Length inside head to outer end of table	625
Length on floor head to inner abutment	516
Length on floor head to outer gate sill	556
Width on coping on head	94
Width on coping on body	151
Width on coping at abutment	105
Width on coping at entrance	105
Width at entrance on high water line	100
Width of coping at outer end of table	154
Width on floor of dock at head	27
Width on floor of dock at head angles	64
Width on floor of dock in body	64
Width on floor of dock at abutment	64
Width on floor at inner abutment	70
Width on floor at outer end of table	116
Depth from top of coping to mean high water	5
Depth from top of coping to inner abutment floor	33
Depth from top of coping to working floor of dock	35

◆

AN INTERESTING CASE OF CORROSION of the metal of marine engines was described at the recent meeting of the Institution of Mechanical Engineers at Belfast, Ireland. A steamer loaded with "burnt ore" was sunk off the coast of Scotland, and was under water for a week. When the vessel was again floated the machinery was found to present an extraordinary appearance, all wrought iron work being deeply corroded, and planed cast iron being so soft as to be easily cut with a knife. As engines are generally little injured by submergence, even for a considerable time, it was evident that there had been some unusual chemical action. The source of this was found in the cargo, burnt ore being the residue from the manufacture of vitriol from sulphur pyrites, and usually containing sulphates of copper and iron. These salts would react on the chloride of sodium of sea water to form sulphate of sodium and chloride of copper, either of which in solution dissolves wrought iron or cast iron.

◆

AN EXHIBITION OF MACHINERY will be held in Munich in 1898. American manufacturers have been invited to participate, according to a letter from U. S. Consul Steiner to the Department of State.

THE SEWERAGE AND SEWAGE DISPOSAL SYSTEMS OF PLAINFIELD, N. J.

By Andrew J. Gavett, Constructing Engineer.

The city of Plainfield, N J., is situated in the western corner of Union Co., hemmed in on two sides by the counties of Somerset and Middlesex. On the Somerset Co. side, only separated from the city by a narrow brook, is the borough of North Plainfield, and its interests are identified in many ways with those of the city.

The population of Plainfield is now about 13,500, that of North Plainfield 3,500. Such a large proportion of the residents of both places are New York business men that the chief occupation of the people is said to be "going to New York."

An excellent water supply system, pumping from wells in the eastern part of the city to a stand-pipe 140 ft. high, has been in use a number of years, but this has only emphasized the urgent need of a system of sewers. The poorer buildings are supplied with outhouses having leaching vaults, and cesspools, also leaching, for sink wastes. The better class of buildings generally have complete and often costly systems of plumbing, but all draining into cesspools on the premises. These were emptied from time to time by "odorless" excavating carts, and the expense of this work was no doubt very much greater than all the extra taxes and interest on the assessments for the sewerage system will be.

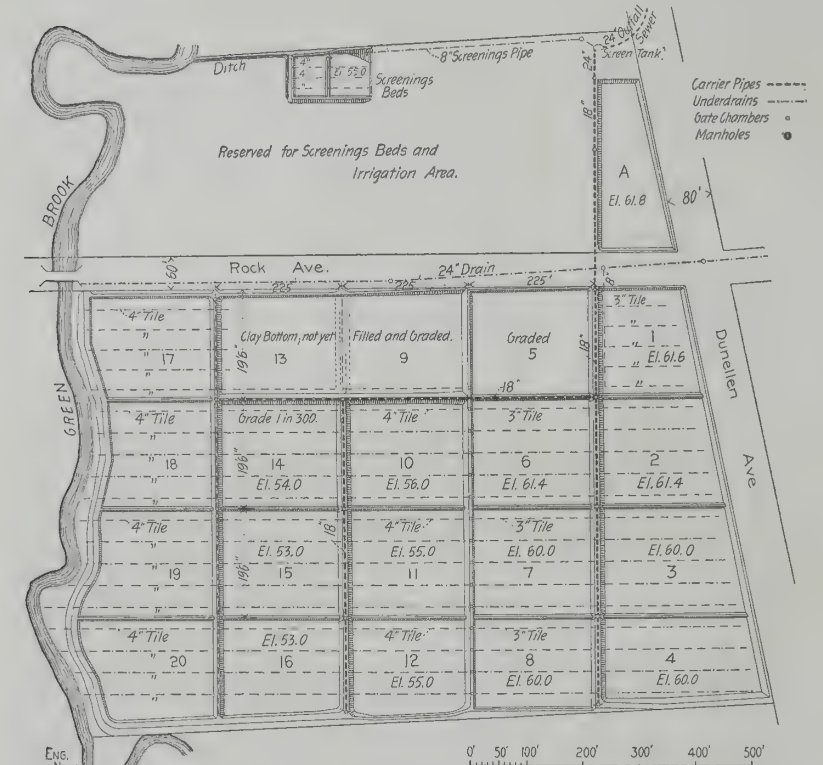

FIG. 1.—PLAN OF SEWAGE DISPOSAL AREA, PLAINFIELD, N. J.

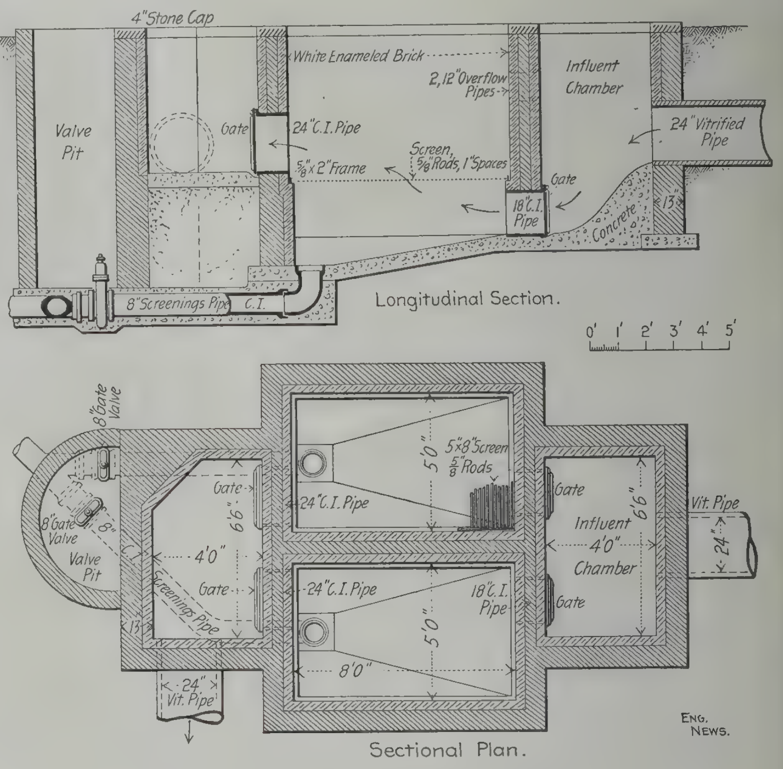

FIG. 4.—DETAILS OF SCREEN CHAMBER.

Topography.

Geologically and topographically, Plainfield has the ice age to thank for her formation. From 40 to 70 ft. below the present level of the city is the Triassic red sandstone and shale; across the eastern end of the city stretches the terminal moraine of the ice sheet, while the underwash from the glacier forms the site of the city. These details are given as they indicate with considerable exactness the character of the material encountered in the construction of the sewerage system and that of the disposal beds as well. The latter are situated in that part of the city farthest from the moraine.

Sewer trenches in the moraine disclose an unstratified mixture of clay, gravel, hardpan, and occasional large boulders. Going west, and descending, a coarse gravel is first found, then stratified sands and gravel, followed by sand alone. The city is underlaid by a flowing sheet of water of great purity and abundance, which furnishes the water supply of the city. At the pumping station the surface of the water is 18½ ft. below the surface of the ground, and it falls toward the southwest at a rate of about 1 in 300, the average inclination of the surface of the ground. At Grant Ave. and Front St. the water was found just below the sewer at a depth of 4 ft., and in the 14-ft. cut at the corner of Central Ave. and Eighth St. the water was also found a few inches below the sewer. But in Ninth and Richmond Sts. the sewer grade was from 6 to 24 ins. below the water level, and the very free flow of water, coming through the open sand and gravel, caused the contractors considerable difficulty and delay.

In all other parts of the city, however, the conditions encountered were extremely favorable, the material being dry and easily handled, no sheeting being required in the more shallow trenches. These conditions explain the very low prices at which the different contracts were let.

Preliminary Work.

The first move for sewers which yielded practical results was made in 1892, when a committee, composed of representative citizens and members of the common council, was appointed by the Mayor, Mr. Alexander Gilbert.

After a thorough investigation and discussion of various methods of disposal, including the popular one of emptying into the Raritan River (for which surveys were made for the committee by Mr. F. A. Dunham, C. E.), the committee reported the estimated cost of several methods of disposal, favoring the plan of intermittent filtration. The report, which included profiles and estimates for the various schemes under consideration, as well as proposed methods of assessment and the providing of funds for the prosecution of the work, was presented to the common council on March 6, 1893, and adopted.

After a careful investigation by the Corporation Counsel, he advised proceeding under the Act of April 7, 1890, which directs that upon the petition of the owners of three-fifths of the real estate valuation of the city, the council shall be empowered to proceed with the construction of a sewer system, issuing, from time to time, temporary obligations of the city in payment for the work, and when completed, commissioners shall be appointed, whose duty it shall be to assess the benefits upon the property benefited, and the excess shall be assessed upon the city at large, and for this excess, bonds shall be issued.

On April 4, 1893, the council decided to proceed under this act, and the work of securing the signatures of the owners of a sufficient valuation was begun. Volunteers made house to house visitations, with copies of the assessor's lists of property-owners, through the remainder of the year 1893 and well into 1894, before the requisite amount was secured.

A general ordinance, specifying all the streets in which it was supposed that sewers would be required, was adopted by the common council on July 25, 1894. Pending the passage of this ordinance, considerable work was done by Mr. George H. Frost, of the sewer committee, in planning the routes for the main sewers, and preliminary levels were run for this purpose by Mr. F. J. Hubbard.

At a meeting held Aug. 6, 1894, the following appointments were made: Committee on Sewers, Messrs. George H. Frost, E. N. Erickson,* S. A. Ginna; Consulting Engineer, F. W. Farquhar, of New York; Constructing Engineer, A. J. Gavett; Assistant Engineers, F. J. Hubbard and H. C. Van Emburgh.

Plans were at once prepared on the lines laid out by Mr. Frost, and on Sept. 10, 1894, the first contract for 5.2 miles of sewers, mostly mains, was let. The first work was begun on Sept. 24, and prosecuted until stopped by cold weather on Dec. 24. During the progress of this work, levels were run over the entire city and a general drainage plan, with profiles, was completed, showing the location and grade of a complete sewer system.

All storm water is excluded from the sewers and flushing is provided for by automatic flush tanks at the head of each sewer. The surface water is carried in the gutters of the streets, directly to the two brooks, or to storm sewers emptying into them. Other storm sewers are planned for future construction, but not many are required, and they will be short ones, from 12 to 24 ins. in diameter. The two brooks are named Green and Cedar, and flow through the entire length of the city, about ¾-mile apart.

Plans for Disposal.

During the winter, the matter of sewage disposal was taken up for final settlement, and estimates of the cost of the various plans which had been under consideration were submitted by Consulting Engineer Farquhar, with the result that all schemes for reaching tidewater were abandoned on account of the great difficulties involved, and the danger of legal complications.

This narrowed the question down to the choice of one of two locations for the disposal beds. One was near Sebring's Mills, a mile below Dunellen, the other in the western corner of the city, 2½ miles nearer the lateral sewer system than the former. Although the Sebring's Mills location possessed a number of advantages, no action could be taken toward securing it for disposal purposes without the consent of the authorities of Piscataway Township, and this consent being refused, the Plainfield site was necessarily decided upon.

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*Upon Mr. Erickson's retirement from the council in December, 1895, Mr. J. B. Dumont succeeded him as a member of the committee on sewers.

The land finally selected lies at an elevation of from 50 to 72 ft. above mean sea level, so that most of the city can be drained to it without pumping. For the most important outlying district, the Cedar Brook Valley, a system has been designed for future construction, draining to a pump well near the junction of Plainfield and Pemberton Aves., from whence it is proposed to raise the sewage by automatic, electric pumps, through a 10-in. cast-iron force main, 1,000 ft. long, into a gravity sewer at Grant and Sherman Avs.

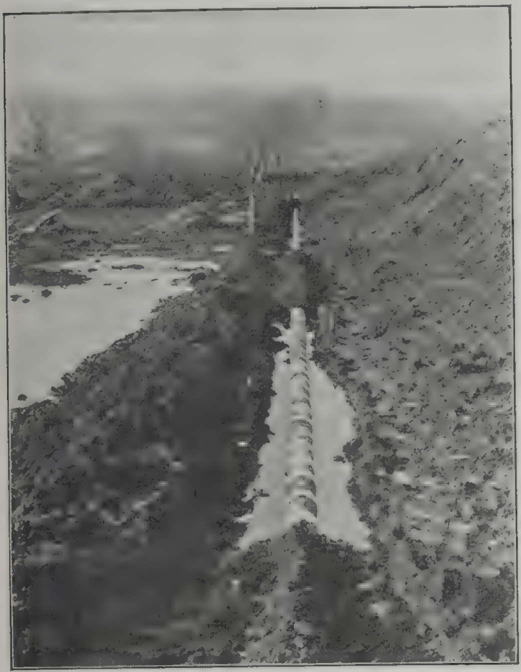


Fig. 2.—View of 4-in. Underdrain in Bed No. 10, During Construction.

Grades.

In order to drain the largest possible area to the disposal beds by gravity, the main sewers have been designed with minimum self-cleansing grades, as follows: For 24-in. sewers, 1 in 1,200; 18-in., 1 in 900; 15-in., 1 in 750; and 12-in., 1 in 600. The 10-in. sewers, and a few of the 8-in. have grades of 1 in 400, but the most of the 8-in. laterals have inclinations of 1 in 300 or more.

Outfall Sewer.

The main outfall sewer is 7,726 ft. in length, from Grant Ave. and Third St. to the screening tank. It is constructed of 24-in. vitrified pipe 1⅝ in. thick, laid on a grade of 1 in 1,200. The greatest depth of cut was 18½ ft., and a length of 2,540 ft. was over 16 ft. deep. At one point it was but 4 ft. deep.

Wherever the cut was less than 5 or more than 15 ft. a concrete foundation and backing was used. A bed of 4 ins. of concrete was first laid and the pipe was then bedded in stiff mortar; when correctly graded and lined, concrete was rammed under and on each side of the pipe. After the concrete had set, the inside joints were cemented on the bottom and more than half way up each side.

Some difficulty was experienced in excavating the trench in the deep cuts, as the sand dried so quickly that it ran out under and between the sheeting planks, loosening the cross braces and causing a cave-in several times, but without serious results. No water was encountered, and where the sheeting was carefully done, the work was ideal for cleanliness and comfort.

Main Sewers.

At Grant Ave. and Third St. the north and south mains enter the outfall sewer. They are respectively of 15 and 18 ins. diameter and the cuts run from 4½ to 14 ft. deep. After traversing circuitous routes and separating some 3,300 ft., they nearly meet again, as 10-in. sewers, on Richmond St.

Lateral Sewers.

The streets running transversely to the main sewers are almost level, and in the center of the city the blocks are generally about 300 ft. square. In order to avoid using an excessive number of flush tanks, which would have been necessary otherwise, many of the cross sewers are continuous for several blocks, crossing the other sewers without connecting.

The necessity of providing sufficient clearance for the different crossings required some sewers to be deeper and others more shallow than the usual depth of about 7½ ft. A 6-ft. length of cast-iron water pipe was used for the upper sewer at all crossings, to prevent settlement.

The least depth of sewers was generally at the flush tanks, in some cases slightly under 5 ft.; the greatest depth, except on the outfall sewer, was 14 ft.

The lines and grades of all sewers were so established that a clear line of sight may be obtained through every part of them, by sighting from one manhole to another, or from manhole to lamphole.

The establishment of this full bore line of sight was one of the requirements of the contracts, but the contractors really had very little to do with securing it, as the inspectors handled the grade rods and plumb lines and were made responsible for accurate work.

Y-Branches and Extensions.

Four-inch Y-branches were located at the most convenient point for each building and wherever else it was thought they would ever be needed, the distances apart varying from 10 to 75 ft. Where the sewers were deep, an extension connection was constructed, consisting of an eighth bend, turned upward, supported by a 12-in. brick pier, with a 2-ft. length of 4-in. pipe added. On the outfall sewer, where the depth would allow, 6-in. T-branches were used on the 24-in. pipe. They were turned upward and were surmounted by a 6 × 4-in. double Y-branch, the branches being turned toward the sides of the street. As the depth increased, lengths of 6-in. pipe were used to raise the double branch to a nearly uniform depth below the surface. In the more shallow cuts, 4-in. Y-branches were used.

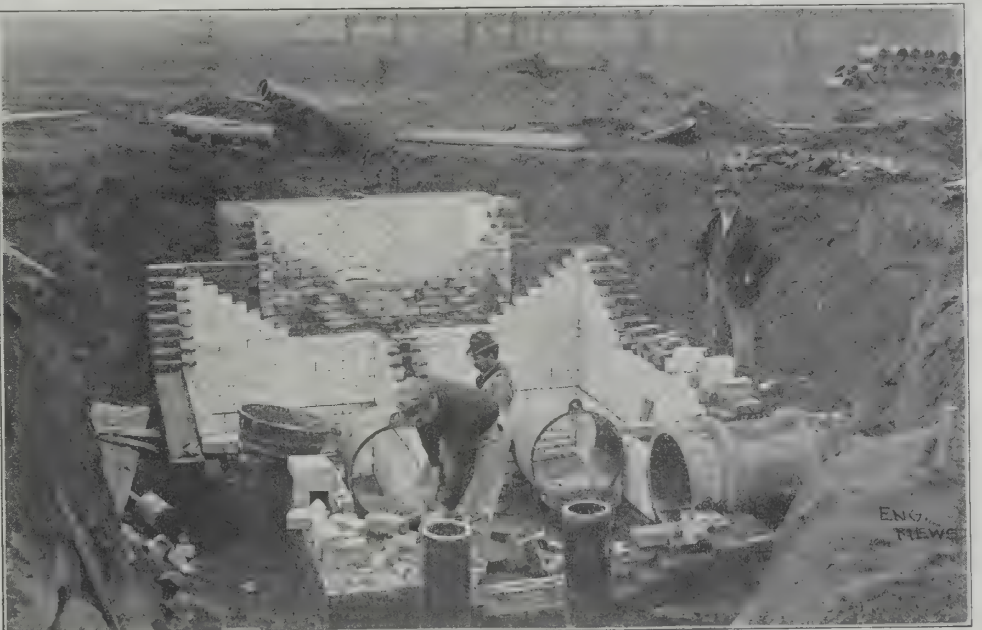


FIG. 3.—VIEW OF SCREEN CHAMBER AT DISPOSAL AREA.

Flush Tanks.

Every lateral sewer is provided with an automatic flush tank at its upper end (except where the sewers are soon to be extended) and little or no hose flushing will probably be needed after the house connections are generally made. The flush tanks are 43 ins. in diameter and of 150 gallons capacity. At first they were set to discharge once in 12 hours but they are now regulated for emptying once in 24 hours. The siphons are of three kinds, Rhoads-Williams, Miller and Van Vranken. A lamphole is constructed adjoining the flush tank and is connected with it by a 6-in. pipe. It is believed that, with occasional inspection, the flush tanks can be trusted to do their work with more certainty, regularity and economy than could be obtained by any system of hand flushing.

The regularity of discharge of the flush tanks is being tested by suspending a "Bristol" counter in the neck of the tank, with a wooden float suspended from the arm. This registers each time the siphon discharges and indicates any failure of the tank to work properly. It will also give assurance to the water company that the tanks are not using more water than is agreed upon. The city pays for the water at the rate of 10 cts. per 1,000 gallons, or about $30 per month at present. In case any flushing with fire hose is needed, it is paid for at the rate of $1 per hour.

In order to ascertain the need and efficiency of the flush tanks, some of them have been shut off for four or five days, and then, when they were turned on again, the flow in the next lower manhole was observed. This experiment showed that the sewers would not keep clean at their upper ends without flushing, as the stream came down black with deposits; also, that the flush-tanks obviated the difficulty, for the last part of the flow ran clear.

It is probable that flushing by hand at considerable intervals would serve to keep the sewers in condition for use, but with disposal beds within the city limits, and in close proximity to dwellings, the periodic washing out of decomposed matter from the sewers would be highly objectionable.

Manholes.

On the main sewers, manholes are placed at all junction points and at all changes of direction or grade, and in general, at distances of from 400 to 500 ft. apart. On the lateral sewers this distance is increased to about 700 ft., lampholes being placed at intervals of 200 to 300 ft. between the manholes. Junction manholes were made 4½ ft. in diameter and intermediate ones 3½ × 4½ ft. in plan. The walls were carried up plumb 3½ ft. and then drawn in to a 2-ft. neck in the next 2½ ft. The walls were 8 ins. in thickness, except where the manholes were over 12 ft. deep, when the thickness was increased to 12 ins.

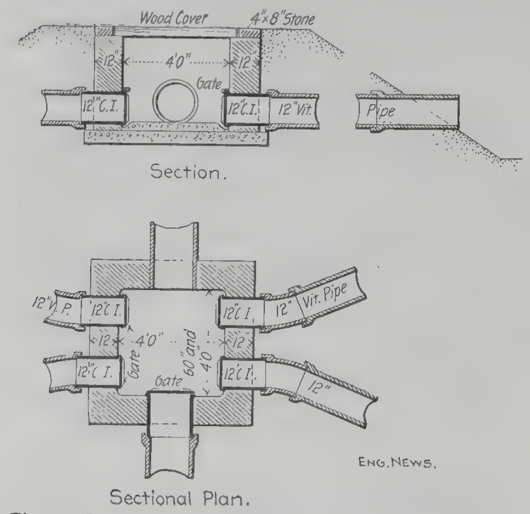
Each lateral sewer, where possible, has a drop into the main sewer equal to the semi-diameter of the latter. Where underdrains were laid with the sewers, an inspection opening was left over the drain in each manhole, the opening being in the platform at one side of the sewer. Stone covers are placed over the openings, and will be cemented on should it be found necessary.

Provision is made for turning the underdrain water into the sewer for flushing purposes, by plugging the drain below the inspection opening and allowing the water to flow through a side opening, into the sewer. When not used for flushing, the underdrain water empties, through two outlets, into Cedar Brook.

Underdrains.

Underdrains are laid in East Ninth and Richmond Sts., in part of Watchung Ave., and in most of the Netherwood district. The sizes are from 3 to 6 ins., with a short section of 8-in. outlet pipe. Hub and spigot vitrified pipe was used for the larger sizes, and agricultural tile for the 3-in. and most of the 4-in.; the underdrains were generally laid 9 ins. below the sewer, and the same distance to the left (going up the sewer).

The drains in the Netherwood section are doing good work, but those in the Cedar Brook Valley are entirely submerged in the ground water every spring, and then only serve as outlets for the Netherwood drains.



Section.

Sectional Plan.

Fig. 5.—Details of Distributing Chambers at Disposal Area.

Materials.

All pipe used in the sewers was from the Ohio Valley, but Akron pipe is being largely used for the 4-in. house connections. All the pipes were in 3-ft. lengths except the 4 and 24-in., which were 2 ft. long.

A careful inspection of the sewer pipe was made at the car while it was being unloaded, and a large quantity was rejected, much of it for crookedness. A regular inspector was detailed for this work, and the payment for pipe was made by the contractor on his reports.

"Hoffman" and "Newark" Rosendale cements were used for all work, and gave entire satisfaction. The specifications called for a cement equal to the "Hoffman" Rosendale, and the contractors decided to use this cement. As its quality was so well known, it was not thought necessary for the city to purchase a cement testing machine, but as a check on the contractors, the constructing engineer had briquettes made occasionally in a standard Riehle mould, and broke them on his own machine, a frame with two levers and 100-lb. spring balance, testing up to 500 lbs.

The cement was used neat, mixed to a stiff paste, for jointing the pipes, and 1 to 1 for mortar for brickwork. Wherever the sewers have since been uncovered, the joints have been found hard and in good condition.

Pipe-laying.

As each pipe was laid, the grade was given by the inspector, using a grade rod with iron shoe reaching into the pipe. A light grade line (braided fish line) was stretched tightly between boards clamped on iron posts. The grade was marked by the engineer on these posts, levels being run each day for the purpose. The iron posts were about $1\frac{1}{2} \times \frac{1}{4}$-in. in section and ordinary cast-iron clamps were used; they were found more convenient than wooden posts, being easily driven and much less liable to wedge off the banks of the trench. They are easily marked with a slate pencil or piece of roofing slate. The inspector kept the pipes in line by plumbing down from the grade line, which was centered on the boards by measuring out from the 4-ft. offset stakes.

A gasket of jute was placed around the spigot end of the pipe before it was lowered into the trench, and the jute was calked into the joint before the latter was cemented. Unless the work was watched, the jute would not be calked into the joint at all, and the cement would be merely beveled over the outside. The other extreme, of having the gasket too small, was also to be guarded against, the general tendency being to use too little jute. The joint room would then be very large on top, sometimes allowing the jute to slip off the end of the pipe and the cement to intrude. The cement was applied to the joints with rubber mittens, being pressed well into the bells, leaving a bevel of cement on the outside.

After a section was cemented, each joint was examined by the inspector, who was also required to see that the earth was solidly packed around the pipe.

The inspectors made daily reports on printed blanks, recording the progress made and force employed, also the location of the Y-branches. These Y notes were recorded the following day on maps drawn to a scale of 1 in. to 100 ft.

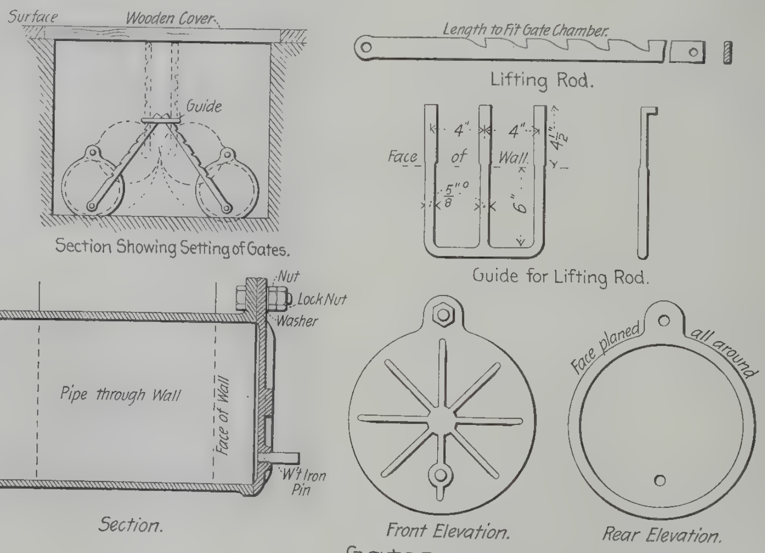
Backfilling and Consolidating Ditches.

The backfilling, except the first covering of the pipe, was done by means of horse scrapers. After filling 3 or 4 ft. in this way the trench was flooded several feet deep with water from a fire hose and the material was dragged by the scrapers into the water. By this means the sand and gravel were so well deposited and settled, that when trenches were afterward excavated crossing those filled in this manner, the latter could hardly be distinguished from the undisturbed material adjoining, except in the lower part of the ditch, where the earth had not been consolidated by falling in the water.

The contractors at first paid the water company $1 per day for flushing trenches, the number not to exceed three at a time; this price was afterward doubled, but even then it was the most economical method for the contractor, and more satisfactory to the city than hand ramming would have been.

Testing.

After completion, all sewers (excepting the 24-in. and those where no water could be obtained) were tested by the contractor, in presence of an engineer or inspector, by flushing wooden balls through them by means of streams of water from hydrants.



Section Showing Setting of Gates.

Lifting Rod.

Guide for Lifting Rod.

Section.

Front Elevation.

Rear Elevation.

Gates.

FIG. 6.—DETAILS OF GATES AT DISPOSAL AREA.

The balls used were of 2 ins. less diameter than the sewers for which they were intended, and were drilled to receive a cord. This cord was long enough to reach between manholes on main sewers and between lampholes and manholes on laterals. By working the ball back and forth, stones, gravel and even whole bricks were forced through the sewer to the next manhole below.

A wire screen of ¼-in. mesh was always placed in the lower manhole, in order to intercept all debris.

At the time of making the test all manholes, lampholes and flush tanks were examined to see that they were complete and in good order, and the flush tanks were filled and discharged. Notes were made of all defects found, and the inspector went around with the masons later to see that the repairs were properly made.

Many of the flush tanks were tested by filling them to nearly their discharging height, and then leaving them filled for several days. As the mains were tested before the lateral sewers were constructed, the testing of the latter brought more sand down into the mains, which were again cleared by flushing the balls through them.

Considerable use was made of small mirrors in examining the interior of the sewers, the sunlight being reflected by one on the street to another in a manhole, and the illumination was sufficient to show the joints for several hundred feet.

The 24-in. outfall sewer was cleaned by men passing through it, the inspectors following with lanterns. This important sewer was found in excellent condition, and showed the care taken in its construction by the contractor, Mr. John Marsden, of Utica, N. Y.

House Connections to Curb.

On July 20, 1895, the contract for laying 4-in. house connections from the sewer to the curb was executed, with Mr. John Siddall as contractor, and work was prosecuted whenever the weather would permit, until their completion, about May 1, 1896.

The work was let at an exceedingly low rate, viz., from 19 cts. per ft. for work in streets with car tracks and telford-macadam pavement, to 14 cts. in unpaved streets. The contractor has, however, put in many private connections from the curb to the buildings for about 30 cts per ft., and so has been compensated, partly, at least, for his low price on the city work.

Before commencing this work on any street, the owners were interviewed again as to their choice of location for the connection at the curb line. The connections to the curb are laid on a grade of 1 in 48; between the curb and the house much steeper grades are often used, though some of the residences are so far back from the street, with fixtures in deep cellars, that only the flattest allowable grades can be used.

The inspector examined the work, recorded the length of the connection, the number of the house, and the distance from the end of the connection at the curb to the line of one side of the building produced. Where there was a curbstone, a V was cut on it over the end of the pipe; in other places a stake was driven.

Ventilation.

The plumbing ordinance of the board of health requires that every plumbing system must be provided with a ventilating pipe extending above the roof, clear, and 4 ins. in diameter. In some cases this is secured by a separate 4-in. pipe carried above the roof from the sewer side of the trap on the main drain, but in most cases the trap is omitted, and the ventilation is secured through the soil pipe.

A Gas Explosion.

On Thanksgiving day, 1895, an explosion of illuminating gas occurred, which did considerable damage to the sewers and appurtenances. A 4-in.

gas main in Richmond St. was broken by some unknown means, and the break was not discovered for several days. The gas found its way to the manholes through the open joints of the 6-in. underdrains, and thence spread through the sewers in that vicinity. It was lighted by a property-owner on La Grande Av., who had a house connection pipe laid into his cellar, but not connected to the plumbing system. Smelling gas in the house, and being of an inquiring turn of mind, he investigated the matter with a light, and a number of explosions occurred in rapid succession, as manhole and lamphole covers were blown high in air, the effect reaching a distance of three-quarters of a mile.

Upon examination, some of the manholes were found cracked, and one of the lampholes was shattered. An examination of the sewers with mirrors and a test with balls failed to show any further damage, but by digging down to the sewer two other injured portions were discovered, one of about 60 ft. in the 12-in. sewer in Richmond St., and the other of 164 ft. in Putnam Ave., near Richmond St. The pipes were found cracked longitudinally, but none of the pieces was displaced.

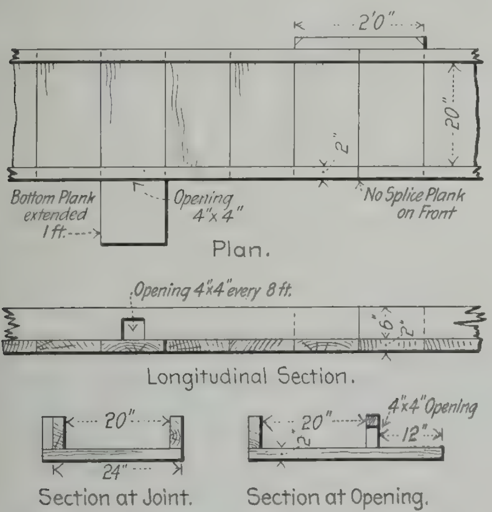


Fig. 7.—Details of Wooden Sewage Carrier.

Disposal Beds.

The outfall sewer reaches the beds, shown by Fig. 1, at an elevation of 63½ ft. above mean sea level, and the grades of the upper beds vary from 61.8 to 60.0, the latter being the ones most distant from the sewer. The elevation of the lower tiers of beds is about 5 ft. less.

The land purchased for the disposal beds comprises three farms of about 17 acres each, bounded at one end by Front St., the main thoroughfare from Plainfield to Dunellen and Bound Brook, and at the other end by Green Brook, the city and county line. The property is intersected by Dunellen Ave., parallel with Front St. and Green Brook, and by Rock Ave. transversely, both public roads.

At present only the two tracts nearest the brook are being graded for beds; the remainder, containing two roomy and substantial houses, is being farmed.

To bring the upper beds to the required grade for delivering the sewage on them by gravity, necessitated the excavation of nearly 60,000 cu. yds. of sand, the deepest cut being 10 ft. About 26,000 cu. yds. were excavated from the beds east of Rock Ave., and the material so excavated was deposited in the lower beds, the grade of which was made as low as the flood level of the brook would warrant.

TABLE II.—Details of the Several Contracts for the Plainfield Sewerage System.

Contractor.	Contract executed.	Work finished.	Character of work.	Total amount.
W. W. Cook & Co., Jamestown, N. Y.	Sept. 14, 1894.	June 1, 1895.	Mostly mains.	$19,608
M. Honan & Sons, Chester, Pa.	April 5, 1895.	Nov. 22, 1895.	Mostly laterals.	43,190
John Marsden, Utica, N. Y.	July 10, 1895.	Nov. 15, 1895.	Outfall sewer.	13,653
John Siddall, Trenton, N. J.	July 20, 1895.	May 15, 1896.	House connect'ns.	5,529
Washburn & Washburn, New York	Oct. 10, 1895.	July 1, 1896.	Disposal beds.	31,212

Mr. Allen Hazen, of Boston, who had been engaged by the common council to report on the availability of the materials in the disposal bed area for the purpose intended, advised that the different grades of sand should be kept separate in filling, the experiments at Lawrence having indicated the danger of placing layers of coarse sand over fine, an impervious layer being formed at the junction. For a similar reason the surface of the beds, when above sub-grade, was ploughed and kept loosened as the fill was made over it.

The top soil, to a depth of at least 1 ft., following the slope down to sub-grade, was removed and placed in the embankments.

In excavating the top-soil, and wherever the haul was short, slip and wheeled scrapers were used, but in the deeper cuts the excavation was made by a steam shovel. West of Rock Ave., a continuous line of carts moved the sand from the shovel to the lower beds; east of Rock Ave., dump cars and a light construction track were used to good advantage.

Underdrains were laid under each bed, 39.2 ft. apart, and from 5 to 7 ft. deep, the grade being 1 in 300.

In the upper beds 3-in. agricultural tile was used, emptying into manholes constructed of 24-in. vitrified pipe. From these manholes, 4-in. tiles continue under the lower beds to the brook, terminating in 12-ft. lengths of cast-iron water pipe.

TABLE I.—Contract Prices for the Plainfield Sewerage System.

John Marsden's Contract.

	Depth, ft.					
	Under 8	8—10	10—12	12—14	14—16	16—18½
24-in. sewer	$1.28	$1.30	$1.50	$1.65	$1.90	$2.28
Manholes	30.00	32.00	35.00	36.00	40.00	45.00

Y and T branches, $2.30 each; double 6 × 4-in. branches, 59 cts.; 6-in. pipe extensions, 12 cts. per ft.; concrete foundation and backing, 20 cts. per lin. ft.

W. W. Cook & Co.'s Contract.

	Depth, ft.				
	Under 8.	8—10	10—12	12—14	Y bnchs.
18-in. sewer	.....	$0.80	$0.90	$1.10	$1.00
15-in. "	$0.54	.60	.70	.93	.75
12-in "	.45	.50	.55	.70	.40
10-in. "	...	.45	.50	...	.38
8-in. "	.28	.35	.40	...	.27

M. Honan & Son's Contract.

24-in. sewer	$1.27	$1.40	$1.51	.....	.....
12-in. "	.47	.54	.....	.....	.....
10-in. "	.41	.44	.48	.56	.....
8-in. "	.29	.32	.42	.52	.....
Junct'n manholes	30.50	32.50	35.00	.....	.....
Plain "	29.00	31.00	33.00	36.00	.....

8-in. drop connections, each	$1.50
Cast-iron pipe sewer, 8 to 12-in., per ft.	2.00
Lampholes, each	7.00
Flush tanks, each	70.00
Y branches on 24-in. sewers, each	2.50
" " " 12-in. " "	.55
" " " 10-in. " "	.35
" " " 8-in. " "	.25
Extensions on same, extra, each	.90
3-in. underdrains, per ft.	.07
4-in. " " "	.09
6-in. " " "	.13

Extra Work—Fixed Prices.

Extra concrete, per cu. yd.	$5.00
Rock excavation, per cu. yd.	3.00
Sheeting or shoring ordered left in place, M. ft.	20.00
Gravel foundation, per cu. yd.	.75

Disposal Beds—Washburn & Washburn, Contractors.

Excavation, low lands to sub-grade, per cu. yd.	$0.125
Excavation—General, per cu. yd.	.17
Overhaul, per cu. yd.	.06
Screening tank, cost, complete	977.76
Gate chambers, 4 × 6 ft.	60.00
" " 4 × 4 ft	50.00
18-in. gates—extra, each	15.00
12-in. gates—extra, each	6.00
18-in. sewer in embankment, per ft.	.66
12-in. pipe outlets from gate-chambers, per ft.	.55
3-in. tile underdrains, per ft.	.15
4-in. tile underdrains, per ft.	.10

Note.—Excavation for 4-in. drains was about 18 ins.; for 3-in. drains, about 6 ft.; manholes (of 24-in. pipe—over underdrains), $20 each; wood distributing channels, tarring extra, 28 cts. per lin. ft.

For a distance of 25 ft. above the manholes, the drains are composed of 4-in. vitrified pipe, laid with cemented joints, to prevent the water from the upper beds from leaching through to the lower.

The drop from one level of the underdrains to the other is made in the manholes; these manholes prove convenient for obtaining samples of the effluent as well as for examining the drains. In bed No. 11, where the material was extremely fine, an extra drain was laid between each of the others. While the underdrain ditches were being excavated, samples of the materials were taken at frequent intervals and kept in numbered bottles; the notes thus obtained were transferred to the profiles of the drains, making an accurate record of the original materials in each bed, which range from coarse to very fine.

The excavated sand which has been filled into the lower beds runs much more even in size than the test pits indicated, so that, while the specifications classified the materials as "fine," "medium" and "coarse" sand, only one bed, No. 12, has been entirely filled with coarse sand, * and one bed, No. 11, naturally fine, has been leveled up with fine sand. The remaining sand is quite uniformly "medium," and the operation of excavating by the steam shovel, emptying into carts and dumping into the fill, served to thoroughly mix any thin layers of fine sand encountered. The medium sand is about 0.20 to 0.25 mm. (0.008 to 0.01 ins.) effective size.

The ordinary dividing embankments between the beds are 2 ft. high and 2 ft. wide on top, with slopes of 1½ to 1; the embankments containing the carrier pipes are 4 ft. wide on top and about 4½ ft. high; those serving as roadways are made 10 ft. wide on top.

Enough of these roadways are provided to give access to all the beds. Along the brook the roadway embankment becomes a levee, which was mainly formed from the stiff clay found in excavating the beds along the brook to sub-grade. The amount of excavation required to bring the lower beds to sub-grade was 5,875 cu. yds.

Contract Prices.

The contract prices for the various parts of the work are given in Table I., and some facts regarding the several contracts in Table II.

Screen Chambers.

The 24-in. outfall sewer terminates, with a curve of 79 ft. radius, in the screen chambers shown on the plan, Fig. 1, and by the view and the details, Figs. 3 and 4, respectively. The sewage is admitted from the influent chamber to either of the two 5 × 8-ft. screen chambers through the 18-in. gates. At first, when the quantity of sewage was very small, both these gates were kept closed until the sewage filled the 24-in. pipe, when the 28,000 gallons thus stored up were run out upon the beds. At present the sewage is allowed to flow continuously through one or the other of the screen chambers, where the sewage rises through the screens, and flows out through the 24-in. gates to the main carrier pipes. The screens are constructed of ⅝-in. galvanized wrought-iron bars, spaced 1 in. apart in the clear, are submerged 0.3 ft., when in use, and can be removed if required.

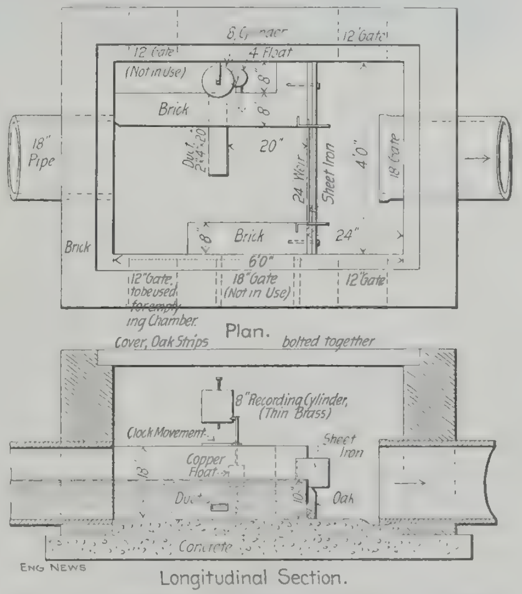


Fig. 10.—Apparatus for Gaging the Flow of Sewage

The entire interior of the screen tank is lined with imported, white enamelled brick, coped with bluestone. The tank is covered by a frame building.

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*Effective size about 0.30 mm. (0.012-in.)

The two chambers are intended to be used alternately, to allow of cleaning one while the other is in operation. The screen chambers are each provided with an 8-in. cast-iron drainage pipe with gate valve, the two pipes converging to a cast iron Y-branch, and then continuing, by an 8-in. vitrified pipe, to the screenings beds on the low land.

The two screenings beds, or sludge beds, are each 75 ft. square, and are located on the swampy land east of Rock Ave.

Sand was excavated from the adjacent hill, and filled to a depth of about 4 ft., to form the beds. Four-inch tile underdrains are laid under the beds, emptying into ditches leading to the brook. These drains are intended to form part of the system of underdrains for the beds east of Rock Ave., when they are needed. The screenings beds may be moved nearer the brook when the area now occupied is needed for filtration beds.

About every three days the screenings are flushed out of the chambers onto these beds, and after the material is sufficiently dry, it is raked up and carted to the farm for fertilizer; this amounts to two or three cart loads each week.

The main carrier pipe is 24 ins. in diameter to the first gate chamber, where it is reduced to 18 ins.; an 18-in. gate is provided at this point for use when the easterly farm tract is graded for beds. The carrier is continued 18 ins. in diameter throughout the work at present completed. The pipes to be laid in the lower beds will be reduced to 15 and 12 ins.

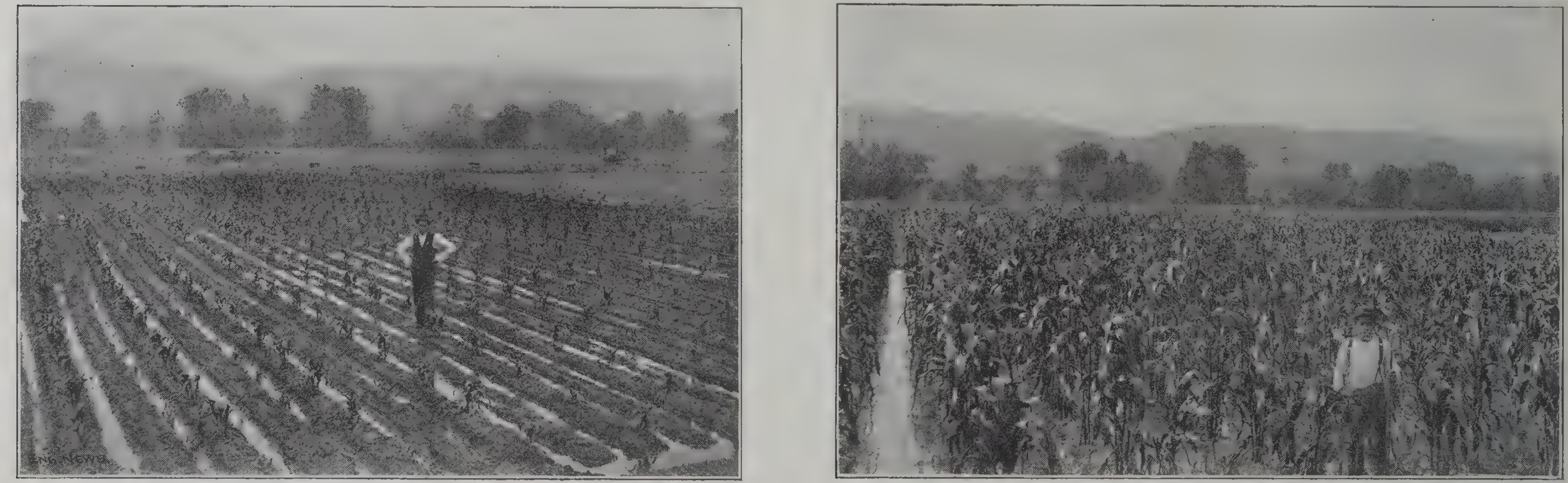

FIG. 8.—IRRIGATING IN JUNE.

FIG. 9.—CORN IN JULY.

FIGS. 8 AND 9.—VIEWS SHOWING CORN GROWING ON BED NO. 8.

Gate chambers are constructed on the main carriers at each embankment, as shown by Fig. 5, the ordinary ones being 4 × 4 ft., and containing one 18-in. gate and from two to four 12-in. gates. At junction points of the main carriers, the gate chambers are 4 × 6 ft., and contain an extra 18-in. gate. The details of the gates are shown by Fig. 6. The guides for sustaining the 18-in. gates are not placed over them, as shown for the 12-in. gates, but in the adjacent side walls, in order to allow more room for opening the gates.

From the gate chambers wooden distributing channels will extend along two sides of each bed, and a few are now in position.

They are constructed, as shown by Fig. 1, of 2-in. spruce planks, are 20 ins. wide in the clear, the sides 6 ins. high (except the section nearest the gate chamber, which is 12 ins. deep) and the bottom planks are 24 ins. long, spiked to the side pieces.

Openings 4 × 4 ins. are provided every 8 ft., and at each opening the bottom plank is extended 12 ins. to spread the flow. Before being used, the channels are covered, inside and out, with coal tar, applied hot.

These tarred distributing channels do not retain accumulations of any kind and give entire satisfaction.

Messrs. Washburn & Washburn, the contractors for constructing the disposal beds, had a large and complete plant and a very efficient force. All their work was done in the most conscientious and satisfactory manner.

Operation.

On December 31, 1895, permission was given to make connections with the sewers, the immediate cause for action at that time being an injunction by the Supreme Court restraining the residents of North Ave. from draining into a storm sewer which emptied into Green Brook. It was supposed that not many others would connect, but 88 applications were received in January, and by the end of April about 450 permits had been granted. All this was before a single bed had been completed, and when but four could be used at all. Up to July 1, 1896, 550 permits had been issued. Eight beds, Nos. 1 to 8, are now planted with corn, in rows 4½ ft. apart. These beds are irrigated about every three days, and the corn is in fine condition, promising a good crop. Two views of Bed No. 8, taken one in June and the other in July, are shown by Figs. 8 and 9.

The beds were planted at different times, as fast as they were finished by the contractors, so the corn varies from that which is "tasseling out" to that only a few inches high. Of course, the corn has no nourishment except the sewage, as the beds were clean sand before use.

The remaining beds, Nos. 10, 11, 12, 14, 15, 16 and 20 are used as filtration beds, being flowed whenever the sewage is not needed on the corn beds.

There is more scum left on the beds than is found in places where the sand is coarser (as at So. Framingham and Marlborough, Mass.), but this dries up without any offense, unless the ground settles, and the sewage "ponds," when considerable odor is caused before the thick deposit dries up. To obviate this trouble the beds are leveled up occasionally by means of a road scraper and rakes, and the aim is to keep the surface as even as possible.

There was a great deal of opposition expressed by the neighboring owners, when the proposal was made to locate the beds so near their property and dwellings, and every odor has been noted and complained of by these men, who make almost daily inspections.

It is probable, however, that the principal objection to the beds is the name of having them located in the vicinity of the property in question, as the odor rarely reaches beyond the beds, and is seldom offensive there.

The completed system includes 23.65 miles of sewers (not including pipes at disposal beds); also over six miles of house connections to the curbs; all of the best materials, and constructed in the most careful manner. These have cost, with all appurtenances and expenses, and with fifty acres of good land, and two good residences about $160,000.

The weir and recording device shown by Fig. 10 has recently been placed in one of the 4 × 6 ft. gate chambers. The apparatus is similar to that at Brockton, Mass.

The float is of copper, 4 ins. in diameter, and weighted with lead. The recording cylinder is made of thin brass, and revolves once in 24 hours. The pen is a V-shaped trough attached to the float spindle by a light steel spring. Dr. Draper's thermograph ink is used. The head on the weir is read occasionally by means of the hook gage to check the diagram.

The flow at present is about 11,000 to 13,000 gallons per hour from 11 a. m. to 7 p. m., diminishing to 5,000 about 4 a. m., and beginning to increase again about 7 a. m. The total for 24 hours is about 230,000 gallons.

It is said that the Pond Machine Tool Co. furnishes between 50,000 and 100,000 gallons of water per day. The remainder would amount to about 55 gallons per head, allowing five persons to each building connected with the sewers.

THE ARTISTIC ELEMENT IN ENGINEERING.*

That the artistic element is not recognized as it might or ought to be in the present American day is natural. The rapid development and growth of our land, the intensive study of science and the concentration of the effort put forth to adapt it to every-day affairs, have exalted one phase of the economic idea, the quick attainment of profitable results, and clouded the truer, broader meaning that looks toward the best things and the highest life of the people. Into the midst of this active, restless, business life entered the engineer, doing more and more of its work and becoming more and more a recognized part of it and an undisputed element in its growth. He has acquired the characteristics of the life about him—zeal, energy, alertness, readiness in meeting quickly changing conditions, and absorption in the work in hand. He plans rapidly, and executes to-day with an eye for to-morrow's profits.

With an engineering practice based solely on immediate results by way of expected profits in dollars and cents the esthetic element has little to do, though even here its absence may mean financial loss. But from the standpoint of this paper, engineering is to be considered in the broader light of Telford's well-known definition, "The art of directing the great sources of power in nature for the use and convenience of man," while the engineer is he who designs and executes engineering works. With an engineering practice based on a generous interpretation of the above, the artistic has much to do.

The engineer is primarily a designer. He works with the materials of Nature as his medium and her powers as his tools wherewith to express his thought and his purpose to serve and benefit man. Just as in the making of a picture the brushes, paint, and canvas are not the chief things, so here it is not the wood, steel and brass, or the powers of gravity, steam, air, and electricity, that are most important, but rather the character and quality of the design and the degree of realization in its execution. The design may be bad or good, according as it ignores or harmonizes with principles underlying all such acts of creation. The result may be a happy one only when the means employed are rightly chosen and properly adapted to the end sought. In this process of creating something of value, something that helps man to a fuller, richer and better life, the artistic cannot be left out. In its absence the design falls far short of its possible perfection, and man is deprived of what is due him, though not perhaps distinctly conscious of the loss. In a certain sense, then, every engineer is an artist, and in some directions at least, as in architecture and other forms of construction and in the making of public parks, the result of his cultured brain may attain to the dignity of a work of "fine art."

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*An address delivered by Frank O. Marvin before Section D of the American Association for the Advancement of Science, at the meeting at Buffalo, N. Y., in August, 1896.

To the superficial or hasty thinker there may appear a conflict here between the utilitarian and the artistic, but there can be no real antagonism. The result of any act of designing is to be judged as a whole and in the light of all the purposes to be fulfilled. The physical conditions imposed by the materials used and the forces of nature employed are to be met. These conditions must be expressed in the design frankly and candidly, and in such a way as to indicate clearly its purpose, and to gratify the observer through its proportions, symmetry, harmony and decoration. The end desired must be attained in the most direct and simple way, so that the expenditure of money may be a minimum. These are the three elements of design. The scientific, the esthetic and the financial. A disregard of the first may mean structural or organic weakness on the one hand, or, on the other, an excess of material that unduly adds to the cost and at the same time may produce heaviness or ugly proportions in the completed work. Non-compliance with the demands of the second makes the design fail in fulfilling its complete mission, and this applies with the same force to those cases where a poorly directed attempt has been made to be artistic in expression, as to those in which no attention whatever has been paid to the matter. Artistic treatment often costs money, yet the mere expenditure of cash will not secure it. On the other hand, the proper display of good taste may often come without the spending of a dollar more than is made necessary by the other conditions surrounding the problem.

The current engineering practice gives great attention to the first and last of these elements, and but little comparatively to the second. There is no branch of it but would be benefited by adding to scientific and business ability a knowledge of the principles of artistic design, and an impulse to give an expression to it. The effect on the life of our communities and the nation by such a change is not easily estimated.

Some recent installations of power plants illustrate a movement that will have considerable influence on engine design. In many of our larger cities there are engine-rooms fitted up in elegance, with marble floors and wainscot, decorated walls and ceilings, brilliantly lighted and with all the appliances of the plant, engines, dynamos, switchboards, and even the smaller accessories in keeping with the surroundings. These plants are used as drawing cards or advertisements. There are other plants, not so used, where there is displayed less elegance, but fully as much artistic sense in adapting the room and its treatment to its purposes. In many of these places only the enclosed type of engine can be employed. In all of them the standard of maintenance must have its influence on the matter of design, which will in turn react on the former. An engine might pound itself to death in a dark basement, but would have its slightest vagary looked after in one of these better planned housings. This result cannot be entirely accounted for by the larger room, the better light, the rules and regulations. There is a refining, educating influence in these artistically planned constructions that makes better men and more efficient workmen of the attendants. Whatever they may cost, there is a credit side to the balance sheet.

Our railways are contributing toward this change. They have found the decoration of passenger trains a profitable thing, and, so stimulated, have carried it to excess. More significant still is the tendency to adopt high standard of maintenance, under which the roadbed is kept trim and neat, flanked by sodded slopes, and bordered by clean and well-kept buildings, and which also requires the rolling stock, the shops, and the yards to be maintained in a high state of efficiency. This is not necessarily in itself artistic, but it furnishes at least a necessary foundation. That the railway management understands to some degree the commercial value of the artistic element in its business is further evidenced by the nature of its advertising, that seizes on any advantage of scenery or artificial effect that is at hand.

Not much can be said in praise of the artistic qualities of our bridges, for these attributes are conspicuous through their absence. The American bridge satisfies the conditions of stability and least cost, but of beauty of line or balanced proportion that makes it fit into and harmonize with the landscape, or even that makes it considered by itself attractive, it has little. And this is to be the more regretted, because an intelligent application of right principles would improve the effect, without adding much, if any, to the cost, or making the structure less safe and durable. It is true that the truss with parallel chords, especially of the through type, does not lend itself readily to artistic treatment, yet even here something can be done. It is not so much of adding ornament as the proper treatment of the organic lines, the length of spans, the relation of length of panel to height of truss, the location of the piers, and the form of their outlines. Ornamentation is not to be used so much for its own sake, but rather where it is needed to accentuate these organic markings. There are some truss bridges of such size that they give pleasure to the observer through their massiveness, though lacking in other desirable qualities. The cantilever, like the Pratt and its relatives, is difficult of treatment, while arch forms, either braced or of the suspension type, are naturally pleasing and best adapted for artistic expression. Of these types we have a few satisfactory examples, like the Eads and the Grand Avenue Bridges at St. Louis, and the Brooklyn and Washington Bridges at New York. In our public parks are to be found many small bridges of good design, while in our cities there are some creditable ones of larger dimensions. There is some tendency toward the use of curved chords in bridges designed for urban use, and a further evidence of interest in the curved line through the introduction of the Melan arch. In some respects it is unfortunate that the economical element has driven out the stone arch, which possesses so many of the features of a beautiful structure for most situations, and it may be that this new form will become a substitute for the old, with added characteristics of its own. However much we may admire the inventive genius and mechanical ingenuity of those who have worked out the types of rolling or lift bridges that cross the Chicago River, the less said about the beauty of the designs the better. Perhaps the environment imposes ugliness on the designer. But that problem is hardly solved yet, and will not be until some man gets hold of it that combines aesthetic with scientific qualities, and has insight keen enough to see the possibilities of the situation and adroitness enough to manage, not only the physical, but also the human elements.

In the entire field of engineering there is no portion of it that includes a greater variety of intricate and difficult problems for solution than that connected with municipalities. Here the engineer has to do with matters touching the home life, the business life and the larger life of the city as a whole.

The engineer here comes in close contact with the people that daily and hourly use the results of his work. He already influences their health and bank accounts for the better, gives them greater ease and convenience at work or play, and saves their time. This is what is asked of him, and he meets the demand well. But what an uplift would come to city life, how much richer it would be, if he could put an artistic quality into his designing, and the people would learn to appreciate it! It is not to be inferred that there is an entire absence of this, but rather that artistic effects have been largely confined to individual cases, and not made manifest in the general life of the city.

For instance, there are numerous examples of suburban dwellings, beautiful internally and externally, and with harmonious settings; there are occasional business blocks whose treatment is satisfactory, but very few public buildings that have an adequate artistic meaning and are so situated as to express this advantageously if they did possess it. Without detracting in the least from the acknowledged merits of the design of Trinity Church, Boston, it must be admitted that its roomy location on one side of an open plaza adds greatly to its effectiveness. Think of its being placed in the middle of a block on Washington Street, or set in the midst of brown stone fronts on Fifth Avenue! All public buildings need both room and appropriate setting. They are the larger and more important pictures in the gallery of city structures; yet under the prevailing system of rectangular blocks, bounded by long, straight, and narrow streets, the hanging committee has nothing but the walls of corridors on which to place them. The worst of the matter is that the exhibition is a permanent one. Along these alleyways must also be hung the narrow, vertically elongated panels that seem to be so popular to-day, in favor because they pay. The observer needs a twenty-story ladder in order to study their details, or even to know if they have any, and can find no point from which they may be seen as entireties. At their sides hang strings of pictures whose horizontality exaggerates their skyward tendency. It is not the modern tall building in itself that is here objected to, but its location on sites that will not admit of a display of its best qualities. With wide, clear spaces about them and effective grouping they may be made agreeable, as is illustrated by the happy combination at the southeast corner of Central Park.

One of the good results of the tall building craze is the bringing closer together of two branches of designers; from the architect the engineer will learn more of art, and he will teach the former better construction. While retaining their separate functions, the collaboration will result in a higher mutual respect and appreciation, and a better grade of work on the part of each.

The rectangular plans of American cities are neither adapted to meet aesthetic conditions nor the demands of traffic. The long streets, without variation in width and direction, and without the breaks afforded by little parks, are tiresome to the eye. They are not placed with any regard for the topography or the natural features of the landscape, or to give prominence to some important structure, nor do they furnish directs lines of travel. But the plan is weighted down to the ground by millions of money. So it is not a question of what it ought to be, but one of mitigating the present evils and avoiding any repetition of these in the future.

Radical treatment must be resorted to by way of diagonal avenues from congested centers, and the widening out of the intersections of important streets into parks and plazas. There must likewise be an heroic struggle with the water fronts and internal water-courses, places full of picturesque possibilities, though usually given over to filth and ugliness. These changes are made imperative not only by esthetic requirements, but also by the demands of health and business.

In the planning of additions to large cities, the designer is hampered by the supposed necessity of tying to the older plan, by the desire of owners and speculators to realize to the largest extent on the sale of lots, or by his uncertainty as to what the future growth and character of the population may be. An examination of the block plan of many of our cities would show a heterogeneous arrangements of streets, especially in outlying districts, without regard to mutual relations, matters of grade and drainage, or artistic position. This irregularity may be more inconvenient and less pleasing than a right-angled plan. Our towns and smaller cities reproduce in miniature the conditions of the larger centers. Here, again, it is a question of improvement, instead of original design, only the problems involved are not so intricate and their solution not so costly. So it is hardly possible for a designer to plan an ideal city, or to have the full swing and liberty of the men who laid out the city of Washington and established its system of grades and drainage. But in spite of difficulties there exist some suburban districts laid out, built up, and adorned on the principles of good taste. Thanks to the systems of rapid transit that are increasing the number of these attractive places!

In the design and maintenance of water supply plants, American practice shows some respect for the artistic element. This is not confined to any particular system or any part of any one plant, but is quite general. The engine houses are not ugly and their interiors are often attractive. Gate-houses, aqueducts, and dams are decoratively treated, and form pleasing features in the landscape. The slopes of reservoirs are kept trim, and the grounds generally turned into lawns with flower beds, and perhaps a fountain. No doubt the sanitary conditions imposed have had much to do with this, but the result is none the less in good taste. We cannot avoid, however, a stray shot at the ugly stand-pipe, with conical cap, sometimes seen in our smaller towns. This is unnecessary. When enclosed it has been made an interesting object, and even the bare pipe can be ornamented in such a way as to relieve its nakedness.

There is much encouragement in the growing appreciation and enjoyment of public parks and boulevards. Cities and towns all over the land are trying to beautify what they already have, and are adding new territory to their park resources. Admirable skill has been shown in utilizing the natural features of the local landscape, the rocks, tree masses, meadows, ravines, ponds and streams, the wide expanse of ocean or glimpses of bright water. The curving roads and paths, with undulating gradients, have a beauty of their own, and lead one from point to point of the ever-changing scene, and yet bind it all into one harmonious whole. While the landscape engineer deserves credit, not so much praise can be given park commissioners for the artificial adornments which they have added to his work. Notwithstanding the fact that these are sometimes labelled as artistic, they do not always fit in appropriately.

The writer firmly believes that there is a latent aesthetic quality in American life that is now struggling to find means for its gratification and methods of expression. Before there can be knowledge of its meaning and power there must be many attempts and many failures. The whole process is one of education, and that largely in the school of experience. This applies to the industrial and constructive arts, as well as to the fine arts. The engineer will share in the general movement, but this is not enough. As a designer of so much that the world needs for daily use he must do more than keep up, he must keep in advance. He must not only have a capacity to enjoy, but also the power to originate and apply. To this end he must give preliminary study and thought to the principles of aesthetic design, so gaining an intellectual knowledge of them. American engineering schools are doing little or nothing to help the young engineer to this. So far as the writer knows, there is but one American textbook, Professor Johnson's book on bridges, that includes any discussion of the matter. A course of study in engineering esthetics near the close of college life would be a great help.

THE MOVING OF A FRAME BUILDING for a distance of 128 ft. was accomplished at Locust Point, Baltimore, Md., on Sept. 1. The building was a two-story frame warehouse of the Baltimore & Ohio R. R., containing a stock of crockery and glassware, and said to weigh 1,500 tons. The work was done by the aid of 1,000 iron pipe rollers and 90 screw jacks.

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The steam turbine is a promising machine which has as yet been but little applied to practical work, and there is therefore special interest attached to the results of the first important test that has been made in this country of a large de Laval steam turbine, which will be found in another column of this issue. The result obtained, 19,275 lbs. of water per electrical horse power hour, equivalent to 17,348 lbs. per brake horse power hour, is so low as to command respectful attention from all those who are considering the installation of new engines for furnishing electric power. The record of steam consumption at variable loads is quite remarkable, only 20.22 lbs. of water per electrical horse-power hour being used at 56 per cent. of full load. Not only in steam consumption does the steam turbine threaten the position of all but the highest type of reciprocating steam engines, but in the simplicity of its mechanism, the smallness of space occupied, and the little attention it requires while running. When a total equipment delivering 266 HP., including the steam turbine, gearing and two dynamos, requires a space of only 13 ft. 3 ins. × 6 ft. 5 ins × 4 ft. 3 ins., the saving of space, as compared with ordinary engines, is a most important matter in cities where space is expensive.

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Without attempting to enter into the theoretical and political situation, some extracts from the 1895 annual on "The Mineral Industry," of the United States would seem to be pertinent, simply as information. Our readers can draw their own deductions. According to this carefully compiled volume of statistics, the value of the total mineral production of the United States, for 1895, was $678,000,734, including in the list 74 separate items. On the basis of a standard of market value at the place of production, coal holds relatively the first place with 31.8 per cent., or nearly one-third of the total value, and pig-iron comes next with 16 per cent.; the two together making nearly one-half of the whole value. There is a very wide gap between the value of these products and the third, which is gold, with 6.9 per cent. But the value of the silver product only amounts to 4.5 per cent. of the total, and is exceeded in value by the production of building stone throughout the country, and it is very little greater than the value of the lime burned last year.

A lately published open letter to Congressman Wilson, in connection with his bill "to organize and increase the efficiency of the personnel of the navy," makes one of the best presentations of the case of the engineer corps, and of the necessity for some speedy and radical measure of relief that has yet been made public. Congress is out of session just now, and things political are much mixed; but as the subject is to be vigorously pushed in the next Congress, and as educational methods are much in vogue at the present time throughout the country, we cannot refrain from some comments on this letter. The writer is Mr. Asa M. Mattice, late of the Engineer Corps, U. S. N., now a consulting engineer with Mr. E. D. Leavitt, and at one time an assistant to Commodore Geo. W. Melville, Chief of the Bureau of Steam Engineering, and highly commended by that department chief as an officer of exceptional qualifications and merit. While the letter of this ex-officer is exceedingly sharp and directly charges all of the existing trouble and contention to the actions of certain line officers who aim to control all legislation relating to the personnel of the navy, the actual conditions stated by Mr. Mattice tell a story of their own that ought to have a marked effect upon those to whom alone the engineers can look for relief. The Naval Register for 1896 gives a list of 714 line officers to 173 engineers; a ratio of 4.13 line officers to each engineer. In 1864, under war conditions, there were 2,846 regular and volunteer officers of the line to 1,728 engineers of the same branches of the service, or a ratio of 1.64 to 1; and in 1866, the regular line officers numbered 395 to 379 regular engineers, or practically equal number in both corps. The significance of this contrast between past and present conditions will be better understood when it is realized that the most powerful steam warship of 1864, the "Minnesota," had engines of 1,000-HP., while the protected cruiser "Columbia," of our new navy, has 18,500 I. HP., 90 engines and 172 steam cylinders, with the mass of varied and complicated machinery this power equipment would imply. Yet the "Minnesota" had nine engineer officers in 1864, and the "Columbia" has only four officers responsible for its vastly more powerful and important engines.

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The original line officer was a sailor, and upon his training, skill and general knowledge depended the efficiency of his ship as a war-machine and its safety at all times, either on a lee-shore or in the face of an enemy. He was directly responsible for the motive power of the vessel and the handling of men and sails. To-day the line officer may direct the movements of his ship as before; but it is steam engines and not sails that do the work; and it is the engineer and not the line officer who is really responsible for the conditions of the machinery upon which the whole efficiency of the ship now depends. We fight as well as move by steam; and in the last thirty years the whole warship has practically been converted into one vast engine-room with an intricate maze of machinery that may make the difference between victory and defeat by failure in any one part of it.

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How in the face of this radical and most important change in fighting and maneuvring conditions any loyal servant of the government can advocate an increase in the number of line officers at the expense of a corresponding decrease in the engineering staff is one of those problems that no man outside of the U. S. Navy can find out. With triple and quadruple engines, twin and triple screws, power for handling battery and ammunition, electric lighting and the multitude of mechanical devices found upon a modern battleship or cruiser, it is engineers we want and must have; and it may happen that the near future of naval warfare will demand that all naval officers be engineers before anything else. But at present each corps has its special and important duties to perform and the engineering staff very properly does not ask for command outside of its own distinct engineering department. This it should have along with the official status that the grave importance of its duties demands. The "warrant officer" scheme proposed by interested line officers is the veriest nonsense, that reflects little credit upon their good sense and would, in an emergency, very possibly react upon themselves and the government in causing the loss of a valuable ship. The demand in the engine-room, even more than upon deck, is for brave, highly educated, skilfully trained officers, with a rank that will ensure respect and obedience from every subordinate; and this can never be secured under any warrant system. Upon the engineer depends the efficiency and safety of government property, amounting to millions of dollars in value, the lives of officers and men and the honor of a nation; and to attempt to reduce this officer to the grade of a gunner or ship's carpenter is to put a premium upon disaster, even though there should be "one engineer" in a divided engineering command on each ship. If, as Mr. Mattice charges, the opposition to much needed reform in the personnel of the whole navy comes from a few bigoted line officers who have assumed control of naval affairs, the sooner Congress sits down very hard upon this fossilized clique the better for the credit and condition of our rapidly growing navy. Time will doubtless compel the reform; but the government cannot afford to await a contingency that may couple with it national disaster, and possibly discredit. Congress has the power to abolish this ring, if it does exist; and the apathy of Congress must be held responsible for any loss that may be sustained as a result of a continuation of not only an unjust but a very unwise treatment of a most worthy and necessary corps of government officers.

THE ARTISTIC ELEMENT IN ENGINEERING.

It is gratifying to note that the artistic possibilities of some branches of engineering are receiving much more attention of late than ever before, although still sorely neglected in most quarters. Some of the attempts to combine the artistic with the utilitarian have been abortive, as might have been expected from persons not possessed of even an elementary knowledge of the principles of art, while others are so creditable as to show conclusively that art and engineering are not incongruous, and to promise even better things for the future.

To those interested in the artistic side of engineering, and we trust all our readers are, we commend the abstract, published in another column, of a paper on "The Artistic Element in Engineering," by Mr. Frank O. Marvin, read before the Association for the Advancement of Science.

The author treats his subject in an interesting and sensible manner, indicating clearly why the matter should be given serious consideration from both the esthetic and financial point of view, and citing many phases of engineering into which the art element should enter.

The points so well made in the paper raise the extremely practical question, How is this artistic element to be introduced? For obviously it is still chiefly conspicuous by its absence in most American engineering works. Evidently the man who has been designing engineering works without a thought as to their artistic features until to-day cannot resolve to-night to introduce the artistic element hereafter and put his resolve into execution to-morrow. Much time and patient study will be required before the principles of art can be grasped by the novice and embodied in his work, but let us hope that in reality there are few engineers so devoid of art knowledge that some improvement in their work may not be expected from the moment their attention is directed to this end and thought and effort given to it.

The engineer has his limitations in this matter. He is not called on to take up the work of either the architect or the landscape engineer, any more that these two are expected to trespass on the domain of the sculptor, or the architect proper on that of the painter. But just as the work of the architect overlaps that of both the sculptor and painter, so does the work of the engineer overlap that of the architect and landscape engineer at some points. This makes it necessary for all to work in harmony, each realizing his own limitations and the possibilities of the other, and not hesitating to call for help when better results can be obtained by co-operation than by individual effort. Such co-operation already exists to a gratifying extent, but there might with advantage be much more of it and it should oftener begin early in the design of the work in hand, instead of waiting until some of its features are fixed which might have just as safely and cheaply been so modified as to lend themselves more kindly to artistic treatment.

But however fully the engineer may work in harmony with the architect, he must himself have some artistic feeling and be able to express it in the broad outlines and even in some of the minute details of his designs, for it will not always be practicable for him to call on an architect, and he should in any event have a sufficient understanding of art to make possible a bond of sympathy between them. The engineer will find it to his credit if he is able to so group and proportion his materials as to get the best effects in grand massiveness and stability, or airy lightness without a suggestion of frailness and perishability. He must realize that ugly details mar structures, no matter how pleasing their general outlines and proportions may be, and he must know what ugly details are, so that in case he is not able to design anything else he may call upon some one who is. He must have an innate sense of the fitness of things, placing ornament only where it belongs, and always using it in a proper degree of richness, such as the character of the work in hand and the material and money at his command will warrant. His means will oftener than not be limited, especially for ornamental purposes, so he must know the artistic capabilities of his materials and be able to make much out of little.

No five words can be more helpful to either engineer or architect than the maxim, "ornament construction, never construct ornamentation." This means simply to make each useful and essential part of a structure as artistic as may be consistent with its object and to stop there in attempts at ornamentation, instead of "sticking on" ornament. For example, a bridge railing would as fully prevent passers from falling into a river or ravine if it consisted of only a flat piece of iron supported by plain iron bars at considerable intervals, but something more pretentious, if not always more artistic, is attempted, and in this one simple detail the engineer too often fails by selecting a design that would look well enough if used to fence in a front yard and was well veiled by shrubbery, but is utterly unsuited to its actual massive and simple surroundings. As an example of what to avoid, there might be mentioned one costly bridge in the city of Philadelphia which is so disguised by galvanized iron applied to the panels that it presents a long arcade of masonry arches of short span supported upon space. The details are carefully carried out in this case, but the original conception is wrong and the general effect is very unpleasing—simply because it tells a structural lie in attempting to conceal the true lines of stress.

If what has preceded is true, it may well be asked, how is such artistic perception and skill as may be necessary or desirable to be obtained by the engineer? As already urged, it is not a mere matter of resolution, although that is the first step. Engineers already in practice will find ways of improving themselves, if once they set about it, making use of the same general methods they would pursue to acquire knowledge in some other lines. They will naturally have recourse to books on art, to lectures on the subject, when possible, and, above all, to a close study of such examples of art in engineering as are available for the purpose. But with the many pressing demands which an engineer in good practice has to meet, any great progress is not to be expected for some years, at least, beyond an appreciation of the artistic element and a realization that, except in minor matters, he must call upon some one with more artistic training and ability than he possesses.

With those looking forward to engineering as a profession the case is quite different. They may pursue the study of art to such an extent as they see fit, provided the advantages of such a course are impressed upon them, and facilities for it are available without such great trouble or expense as to make it impracticable for the majority of engineering students. As a matter of fact, such students are really dependent on their instructors for guidance in this matter, and in many, if not most, cases for even an intimation that such knowledge is desirable, to say nothing of being necessary, for the highest degree of success in most branches of engineering.

There is practically no opportunity for such training in our engineering schools, so that the student must seek it elsewhere or go without it. We will not venture to suggest how the matter should be approached by the engineering schools, nor even to say that they should attempt to provide such training. But we do not hesitate to urge that if art in engineering is to become general the engineer should have some instruction in it, and that this could be obtained most naturally and certainly during his schooldays.

Our engineering courses are already overcrowded with subjects which pertain to the general education and development of the man, rather than the fitting of the man for his chosen calling. In some of these schools the youth is taught, and imperfectly at that, to write English, is given a little history, a smattering of botany, and takes up many other studies which he might very properly have completed before beginning his engineering course.

If these general subjects were studied before entering the engineering school, or, in other words, if the engineering course always followed general collegiate studies, the principles of art might be acquired at the same time, and their practical applications to engineering pointed out in the engineering school. As it is, an attempt is being made to give young men, and in many cases mere boys, a course in engineering and a part of a general college course at the same time, to the greater or less detriment of both courses. We are well aware that there are many reasons for this practice, some of them most excellent, and that otherwise hundreds of engineers to-day would have had no part of a general college training.

But we still contend that for the broad success at which all students aim some fundamental artistic training is essential to all, whether the later chosen profession in life is engineering or any other branch of science or the arts. It is a part of the early mental equipment that is too often neglected, though it is, or should be, a potent factor in both our practical as well as esthetical life.

LETTERS TO THE EDITOR.

Proposed Standard Specifications for Portland Cement.

Sir: In your issue of July 16 appears an interesting review of the standard specifications for Portland cement, proposed by Mr. Wm. J. Donaldson. The need of such a system of standard requirements is certainly very great, as must be apparent to any one who has had occasion to study the extremely variable specifications drawn up from time to time by government engineers. Such a set of official requirements would also serve as a standard for private practice, and would be of inestimable value and convenience to engineers and cement consumers. Mr. Donaldson certainly deserves great credit for having taken the initiative in this important matter, and it is greatly to be hoped that the subject will be taken up by government and private engineers, and an agreement arrived at. It would help the matter along most decidedly if the American Society of Civil Engineers would attack this question anew, and establish a series of cement tests in keeping with modern practice in other countries. The recommendations of the Committee of the Society (1885), are very general and indefinite, and fail to supply the clear and exact rules necessary for uniform work and reliable results. Most other nations have distinct official requirements, which agree, in general, with each other in important matters. Those of Germany undoubtedly represent more careful study and experiment than those of any other country. For many years committees of the Association of German Cement Manufacturers have worked in connection with the officers of the Royal Experiment Station to perfect these official requirements and they consequently embody the latest information which is to be had on the subject.

The writer supposes Mr. Donaldson's recommendations in regard to detailed requirements to be intended chiefly as suggestions, and is not therefore disposed to criticise closely the specifications or methods of tests proposed. A few defects in the specifications given may, however, be briefly pointed out.

Quality.—The requirement that cement should be exposed to air for 30 days before shipment is a new one, and in the opinion of the writer, unnecessary. Well-made cement should be perfectly sound when fresh from the mills. Bad cement may often require several months of seasoning before it is fit for use. The question of soundness can be tested in other ways, and a certain length of time of seasoning is no guarantee of good quality.

Chemical Composition.—A requirement that the cement shall contain lime, silica and alumina within certain limited percentages, seems to the writer to be superfluous and misleading. The limits, if established, must be very wide, and if so, are useless. For given materials the proportions must be nearly exact, but different materials yield cements of widely varying composition. The cause of this difference is chiefly the varying composition of the clays used, a silicious clay requiring far more lime than an aluminous one. Mr. Donaldson's requirement for silica (20 to 22%), is especially narrow, and would exclude Dyckerhoff and the cement Mr. Donaldson is himself interested in manufacturing, which, according to analyses made in the writer's laboratory, showed respectively 19.35 and 22.5% silica.

Fineness.—The proposed requirements of 95% through a No. 100 sieve, and 80% through a No. 200 sieve, are out of all reason, and would exclude more than nine-tenths of the best German and American cements. Within the past month the writer has tested samples of the cement in which Mr. Donaldson is himself interested, obtained from dealers in several of the larger cities, and none of these samples come anywhere near passing these requirements. There are few, if any, cements now on the market which show over 90% through a No. 100 sieve. What the fineness on No. 200 may be the writer cannot say, as he has never seen a correct No. 200 sieve, and doubts if one exists. Samples of best foreign wire cloth proved to be 184 × 187 mesh, and very uneven, when examined under the microscope. None of the leading brands of cement, German or American, showed over 70% through this sieve. The time will doubtless come when a higher degree of fineness will be demanded by the trade. The introduction of the tube-mill is making it possible to obtain such a degree of fineness as Mr. Donaldson describes. From tests of American and foreign cements now in the market, however, it does not appear that the tube-mill has found extensive use up to the present time. In the opinion of the writer, a requirement of 90% through a No. 100 sieve is amply sufficient. This requirement will exclude most English and many German cements, while the leading brands of American cement will pass it satisfactorily.

In all requirements for fineness, the gage or diameter of the wire, as well as the number of meshes, should be distinctly specified, as variation in this respect will make an immense difference in the results. The German official requirements specify that 90% shall pass a sieve of 76 meshes to the linear inch (900 per sq. cm.), in which the diameter of the wire is one-half the width of the opening.

Test for Checking and Cracking.—The writer finds that exposure of the pats to hot steam (after setting over night), instead of placing them in boiling water, gives more satisfactory results. Five hours in hot steam (200° F. or over) will be found sufficient to detect the slightest tendency to expand or crack.

Specific Gravity.—This test is of little value, since even unburned cements usually show a specific gravity of at least three, and the increase due to perfect burning is extremely slight.

Setting.—The temperature of the room and of the water used should be specified, as these exert an immense influence on the time of setting. The pats should also be kept in damp air in a closed metal box. The proportion of water used should also be such as to give a constant consistency, both for tests of setting and tensile strength. The German requirement is that the proportion of water shall be such that when a quantity of the paste is placed on a plate of glass, several taps on the slab will be necessary to cause it to spread to the edges. This may seem a rude method, but practical trial will show it to be simple and fairly definite.

Tensile Strength.—Much more uniform results are obtained by filling the molds, then turning them over and filling again from the other side.

A requirement of a certain strength at one day is very objectionable. Nearly all well-informed engineers have abandoned the practice of making one-day tests.

The mixture for briquettes should be worked a certain definite time. Three minutes is a good minimum. Sand briquettes must be pounded into the molds to give uniform results. The German requirements specify that this shall be done with a spatula of certain size and weight. The writer has obtained the best results by filling the mold above the top, then laying a small block of wood over it and pounding lightly with a mallet, repeating on the other side.

The amount of water for sand tests, as proposed by Mr. Donaldson, namely, one-half the amount used for neat tests, will be found rather high. The Germans use 10% of water for sand tests, 1 to 3, with all cements. Neat tests will generally require 22 to 25%.

The use of crushed quartz instead of sand seems to the writer very objectionable. The Germans use a normal sand, 20 to 30 mesh, from Freienwalde on the Oder River. This shows about 33% of voids, while American standard crushed quartz of the same fineness showed 50% of voids. The quartz is in the form of glossy splinters, while the sand is made up of roughened grains. For these reasons the quartz gives much lower tests than a pure sand, and the results are less indication of the way the cement will work in practice. The crushed quartz is also very costly (about $10 per barrel), an important consideration where many tests are to be made. There is no reason why a good quartz sand, from some one locality, should not be adopted as a standard in this country.

In spite of the above criticisms, it should be said that Mr. Donaldson's suggestions are, on the whole, extremely good, and show careful study of the subject. It is earnestly to be hoped that they may lead the way to further discussion, and to the adoption of a definite standard of cement-testing in this country. S. B. Newberry,

Manager Sandusky Portland Cement Co.

Sandusky, O., July 30, 1896.

Sir: In your issue of July 16, 1896, you give several columns of your valuable space to a "Proposed Standard Specification for Portland Cement," by Mr. W. J. Donaldson, of Philadelphia, the object of which is "to urge the adoption by the United States of a standard specification for Portland cement, the use of which should be required on all work done under the direction of the officers of the Corps of Engineers, and also by the Navy, the Supervising Architect's office, etc."

The formulation of such a specification seems to be a pretty large piece of work for one man to "go it alone" on, and its publication even, by so well considered a scientific journal as your own, may lead to serious results by its use without examination by those who have not perceived its errors and inaccuracies.

The matter of the making of specifications is a grave one. In Germany, committees of the Cement Manufacturers' Association, acting with government co-operation, have been sitting for three years awaiting the results of experiments before merely recommending changes in recognized standards; in France, the Commission des Methodes d'Essai des Materiaux de Construction was constituted in 1891, and did not report until 1893; in this country our American Society of Civil Engineers was several years considering its specifications for cement, and since their adoption in 1885 has made no changes. So that, broadly speaking, the scientific and engineering world, knowing how much the question of reputation of engineers, architects, contractors and even cement manufacturers is involved in any new specifications for cement, or even any change in the same, has ever been slow to recommend and ever slow to adopt new rules or changes in normal standards. Why, therefore, it should have remained for Mr. Donaldson to formulate of his own motion this radical departure from old landmarks, he best can explain; but to those of us engineers or associated with engineering societies here and abroad, it seems to partake of foolhardiness, unless by reason of long experience, great knowledge or deep scientific thought and authority, he can justify his action, or unless his cement has been rejected on present government specifications (Dist. of Columbia, 1895), and he proposes in the future to "make the punishment fit his crime" alone. The proper way, however, to consider such a matter, would seem not to jump off at a haphazard guess or opinion as to what sort of a specification would suit any one cement or class of cements, but to look carefully into the history of Portland cement, its methods of manufacture, its uses, its results on works and the accepted standard specifications of the world before laying down any arbitrary rules.

Now, the use of Portland cement in a large way dates back to the time when John Grant first began to adopt it on the London sewers, and his book, published in London by E. & F. N. Spon, in 1875, gives a summary of his papers read in December, 1865, and April, 1871, before the Institution of Civil Engineers in London. It was an outcome of the tests then described, and of the bold use of cement thus mentioned, that engineers began to have faith in Portland cement, up to that time an article of doubtful engineering utility. Following Grant, the French and German engineers began to employ large quantities of Portland cement, and in the latter part of 1880 it came to be largely used here in America for engineering work; though it was used prior to that for paving. Therefore, as engineering and architectural faith rests on Portland cement, so far as permanence and durability are concerned, on these uses abroad, it behooves him who would make specifications to consider first what were the methods of manufacture in use in England when Grant was working and what requirements he had for Portland cement and what results he obtained. It would be also his duty were he minded to be fair and candid to follow this up by an examination of the figures of Mr. Reginald E. Middleton, published in "The Engineer," Vol. 65, p. 279 (London), giving records of long-time tests on a number of various cements which gave varying results at seven days. It would next become necessary for him to examine the long-time tests of the New York Aqueduct, of the Niagara Tunnel and other large work in this country, and then he would be in a suitable frame of mind judicially to consider the question. To such an one, it would appear that all the Portland cement on which long-time tests by engineers or other unbiassed parties have been made and published, and thereby have become engineering authority, have been cements made in Europe or America by the same methods practically as the cements used by Grant. Clay and chalk, limestone and clay, marl and clay, argillaceous limestone and limestone, have according to their chemical constituents been ground together either wet or dry, and either with the water they contain or with water added, have been made into a mud (slurry) or bricks containing the requisite chemical ingredients of lime, silica and alumina in finely comminuted particles. In every case the result has been to make a new stone, brick or block with the finely subdivided grains of the several chemical ingredients; artificially rearranged and in close mechanical union for the action of the fire of the kiln. In every case these bricks or blocks have been burned in closed or continuous kilns where the material was brought into close contact with the flame of coke or coal, and the uniform distribution of fuels in layers through the mass has caused uniform burning and clinkering. In every case the resultant powder, caused by grinding the clinker, has been shipped to the consumer without the addition of sulphate of lime incorporated with it after grinding, to give it fictitious strength and most dangerous qualities. So much for the process of manufacture, and on this point it seems clear that if engineers and architects are to rely in their work on the experience of other engineers, they should know what process the cement they are offered is manufactured under, and if it varies from the established standards which have given the standard results, on which our knowledge of cements rests, then as a prime requirement of any specification "proposed" or otherwise, the mode of manufacture and the long-time tests of the cement offered should be considered and inquired into regardless of abnormal 7 and 28 day tests and other similar data.

In order to go over the "proposed" standard specification of Mr. Donaldson, I have taken considerable trouble to gather together the leading specifications of this country and Europe, for purposes of comparison and also for the purpose of emphasizing what the world of engineers and not one cement manufacturer alone thinks on this important subject. Some of these specifications formed part of my contribution to a discussion before the Engineers' Club, of Philadelphia, and others recently gathered show a marked swing in the pendulum in favor of the elimination of boiling tests and other uncertain methods, and also in favor of much lower tensile strains, neat at 7 and 28 days.

Taking up the Donaldson specification in detail no careful manufacturer would object to seasoning his cement as this is common practice but why a manufacturer should under Clause 2 furnish "certified tests from the laboratory on every car furnished, which shall in no wise be a guarantee of acceptance by the government, as acceptance or rejection will be made on government tests"—is beyond explanation and seems a work of supererogation. So far as the clauses relating to packing and sampling are concerned they are not new and therefore are unobjectionable.

The matter "of a chemical composition" is too serious a one to lay down arbitrary rules about which would exclude nearly all of the cements used in Europe and America by the best engineering talent for years past. Mr. Donaldson's figures are as follows:

Lime, 62 to 66%.
Silica, 20 to 22%.
Sesquioxide of iron and alumina, 8 to 12%.
Magnesia, not over 3½%.
Sulphuric acid, not over 2% for slow setting cement.
Sulphuric acid, not over ½ of 1 % for quick setting cement.

The proof of the absolute unreliability of such a chemical requirement, as that submitted, is best shown by reference to Candlot's "Ciments and Chaux Hydrauliques," Baudry & Co. Paris, 1891. On p. 76 this leading authority gives analyses of no less than 12 French, 13 English, 6 Belgian and 14 German Portland cements of commerce. Out of this total of 45, no less than 36 exceeded in silica, Mr. Donaldson's requirements; no less than 9 exceeded the requirements of alumina and iron; not a single one contains magnesia up to 3½% ;only 3 exceed 2% magnesia, and only 1 contains sulphuric acid up to 2%. As to the important element of lime, no less than 20 contain less than 62% of lime, and only 6 contain over 64% of lime.

Another eminent French authority, Professor Le Chatelier of the Ecole de Mines, Paris, in a paper read at Chicago, "Trans. Am. Inst. Mining Engineers, International Engineering Congress," August, 1893, p. 14, gives as composition of commercial cement of good quality, a material which would fall "outside the breastworks" of Mr. Donaldson's specifications, in the elements of lime, silica, magnesia and sulphuric acid. Still another, Feret, in his monograph on the addition of plaster (sulphate of lime), to Portland cement, "Librarie des Ponts et Chaussees," Paris, 1890, p. 67, shows conclusively that the presence of anything like 2% of sulphuric acid in cement to be used in salt water would invariably cause the disintegration of the mortar, and yet this point is entirely overlooked in these new specifications. Furthermore, so eminent an authority as Baron Quinette de Rochemont, Inspecteur General des Ponts et Chaussees, in his work on "Portland Cement at Havre," "Institution of Civil Engineers," London, Vol. CVII., 1891-92, p. 9, in describing the disintegration of certain cement,says the cement "now in its worst state" was "analyzed by the laboratory of the Ponts et Chaussees, and showed alumina and iron 9.80, and lime 62.95," or exactly within the lines proposed by Mr. Donaldson. The French government, in the marine service specifications, especially provides that Portland cement must not contain more than 1% of sulphuric acid. Cahier Guillain, Art. 6.

German authorities against such chemical requirements as Mr. Donaldson proposes, are equally weighty—Professor Tetmajer, of the Zurich Polytechnicum, a leading scientist, in his work on "Hydraulischen Bindenmettel," Zurich, 1893, gives on pp. 146 et seq. analyses of 88 German, Austrian, French and Swiss Portland cements, made by 16 leading European chemists. This list of cement includes such well known brands as Stuttgarter, La Farge, Mannheimer, Heidelberger, Dyckerhoff, Vervohler, Shifferdecker and De Grand Champ.

Out of the entire 88 cements, no less than 57 fall outside of the limits of silica, a large number contain alumina and iron in excess of 12%, and, as to lime, no less than 59 contain less than 62% of lime, and only 6 contain lime up to 64%. Of magnesia, only 7 out of 88 contain 3½%. Of sulphuric acid only 13 run up to as high as 1½% when the sulphate of lime (Ca S O_4) Tetmajer gives is reduced to its elements.

To a similar purpose may be quoted Dr. Preussing's table of analyses read before the German Cement Manufacturers' Association at their 1894 meeting (Berlin, Funcke & Co., 1894), where out of 24 cements analyzed only 14 had lime in excess of 62%; only one magnesia in excess of 2.68%, and not a single one had sulphuric acid up to 2%.

The English are no less positive in their chemical determination. Redgrave, "Calcareous Cement," London, 1895, p. 145, quoting Margetts' paper before London Institution of Civil Engineers, 1891, shows that none of the cements there mentioned would have met Mr. Donaldson's proposed specification.

When W. F. Reid wrote on "Portland Cement," Philadelphia, H. C. Baird, 1869, on p. 12 of Lipowitz' paper there printed, he gives analyses of eight Portland cements, not one of which fall within the requirements referred to, and not one of which contain magnesia up to 2½%. In the work by Henry Reid, the eminent authority, London, 1879, p. 50, the "good Portland cement" he gives an analysis of, would likewise have failed if tested by Mr. Donaldson. Another writer and engineer, no less than the late Henry Faija, of London, in his last paper, Trans. Am. Soc. C. E., Oct., 1893, p. 43, knew nothing of these new specifications when he described the elements of Portland cement, entirely outside of the new lines just published. The eminent engineer, Carey, in his paper, "Inst. Civil Engineers," London, Vol. CVII., 1891-92, p. 35, was in a similar state of ignorance when he described as a "good Portland cement" one which would not pass Mr. Donaldson's specifications.

So, too, was Collins in a similar state of darkness when he made his definition of an average composition of a "sound Portland cement" in his book, E. & F. Spon, London, 1888, p. 8.

So much for European authorities,who by reason of their longer use of Portland cement, might be supposed to know something about its chemical constituents; but even the weight of American authority is against Mr. Donaldson. The analyses of Dyckerhoff, Brooks, Shoobridge, Alsen and Giant Portland cement by the late Prof. De Smedt, the well-known authority and for many years Inspector of Cements, U. S. government (Rep. Dist. of Columbia, 1885, p. 47), show that each and everyone of these well-established brands would have been rejected under these new views of chemical elements. Furthermore, not one of them shows sulphuric acid up to 1%, and only 1, magnesia approaching 3%.

As for Prof. Spaulding, of Cornell, in his work published Ithaca, 1893, he is likewise wrong on p. 4, when he describes the requirements of a Portland cement, and the same may be said of Prof. Jameson, who, in his "Monograph," Iowa City, 1895, p. 4, lays down chemical elements outside of Mr. Donaldson's narrow bounds. Finally, to prove our new authority right and the older cement authorities wrong we must also overrule that distinguished writer, Gen. Gillmore, "Cements and Lime Mortars," New York, 1879, p. 65, in his analysis of Portland cement there published.

On the other side, therefore, we have the concensus of the world's authorities, of France, Germany, England and America; on the other side we have Mr. Donaldson. What weight should his opinion carry? What is his chemical and scientific reputation? His first work on cement: "Alpha Portland Cement," Donaldson & Co., Philadelphia, Allen, Lane & Scott Press, 1894, p. 4, contains a description of manufacturing Portland cement, and one paragraph is as follows: "The company find the rotary cylinder process the least expensive of any they can use, it being especially adapted for their raw material, as it is not refractory; the carbonic acid is readily driven off and is then easily ground to a fine powder."

On the strength of a chemical knowledge enabling one to grind "driven off" "carbonic acid to a fine powder," in the process of making cement, Mr. Donaldson may seek to overthrow the weight of the world's chemical opinion, but chemists will hardly permit it, and even he, himself, is doubtful about his own knowledge, for in his second book, the one now under criticism, the amount of magnesia is set down in print at 2½%, and then subsequently changed in ink to 3½%, and he likewise altered the time of setting by a communication to you of July 21, 1896, published July 23, 1896.

Is this, therefore, such a voice as we should listen to, an authority, which, without a single citation or fact, sets up a chemical standard contrary to that which scientists of world wide reputation have fixed, and by whose specifications anywhere from 80 to 90% of the cements of established reputation the world of engineering has been using from 30 to 40 years, would be excluded. On the face of his known chemical knowledge, as shown by his own writing, Mr. Donaldson is condemned.

As to fineness, Mr. Donaldson is again arrayed against the world's scientific opinion; though no careful manufacturer would hesitate to guarantee cement of the fineness he recommends, namely 95% on 10,000 mesh sieve and 80% on a 40,000 mesh sieve. From a careful examination of many specifications, in Europe and this country, the following seem to be the requirements for fineness.

Residue.

Belgium, 15% on a 5,800 mesh sieve (Genie Belge).

Germany, 10% on a 5,800 mesh sieve (Rules Prussian-German Society).

Switzerland, 15% on a 5,800 mesh sieve (Report Tetmajer, Zurich).

France, no fineness specification (Clahier des charges, Ponts et Chaussees), (or in Government Commission Report).

France, 5% on a 5,800 mesh sieve (recommended by Le Chatelier and Candlot, French Chemists).

Roumania, 12% on a 5,800 mesh sieve (government specifications).

England, 8% on a 2,500 mesh sieve (recommended by H. Faija, World's Fair Congress, August 2, 1893).

United States, recommendation American Society of Civil Engineers, June 27, 1893, says: "Cements of better grades are ground so fire that only from 5% to 10% is rejected on a sieve of 2,500 meshes per sq. in.

Under this recommendation are the following specifications in this country:

New York Aqueduct, 80% on a 10,000 mesh sieve.

City of Baltimore, 90% on a 3,000 mesh sieve.

Department of Public Works, New York, 90% on a 2,500 mesh sieve.

Pennsylvania R. R., 90% on a 2,500 mesh sieve.

U. S. government, Dist. of Columbia, 95% on a 2,500 mesh sieve.

U. S. government, District of Columbia, 85% on a 10,000 mesh sieve.

U. S. government, Supervising Architect, no fineness specified.

Niagara Falls tunnel, 80% on a 10,000 mesh sieve.

Reading Terminal, 95% on a 2,500 mesh sieve, 75% on 10,000 mesh sieve.

U. S. government, Board of Engineers, 95% on a 2,500 mesh sieve.

City of Philadelphia, 90% on a 10,000 mesh sieve.

City of Philadelphia, 70% on a 40,000 mesh sieve.

New York Central R. R., 97% on a 2,500 mesh sieve.

Under the head of Cracking and Checking volumes might be written on the subject of hot tests or boiling tests and no conclusion arrived at; no two sets of scientists, no two sets of engineers, no two sets of experts have yet been able to agree as to these tests, their utility and their practical methods of use. The last report of the committee of the German Association of Cement Manufacturers presented at the 1896 meeting on this subject asks until 1898 to report, and meanwhile the normal cold water tests remains unassailed. On the other hand, the French commission, above referred to, recommends a moderate boiling test for slow-setting cement only, and this only in a tentative way. On this point the consensus of opinion all over the world seems to be against Mr. Donaldson and his recommended violent boiling test. It may be summed up as follows:

Germany—After three years' discussion, the boiling test was finally reported against at the session of 1893, by the German Cement Association, operating in conjunction with the Prussian Minister (Gary's paper, World's Fair Congress, Aug., 1893; Trans. Am. Soc. C. E., Oct., 1893, p. 13), and subsequently a committee to further investigate was appointed.

French Government—Conference of engineers Ponts et Chaussees, Cahier Guillain, Service de la Marine, Service de Colonie. None of these contain boiling tests. The French commission report is above referred to.

England—Faija's paper, World's Fair Congress, Aug. 2, 1893, Trans. Am. Soc. C. E., Oct., 1893, p. 59, recommends steaming tests only, and immersion at 116°, and requires no boiling test, which he admits he has abandoned as unreliable, though first proposed by himself.

United States—U. S. government, District of Columbia, specification, 1896, abandons boiling test. F. H. Lewis (Booth, Garrett & Blair testing laboratory), Philadelphia Engineering Club, Vol. XI., 5, 1895, p. 345, abandons boiling as "unreliable in indicating quality of cement." Am. Soc. C. E. specification recommends cold water and air tests only.

Under the head of tensile strength, Mr. Donaldson again runs his head against the requirements of the leading authorities here and in Europe. He requires:

Neat briquettes shall stand a minimum strain per sq. in. 12 hours in air, 12 hours in water, 200 lbs; 1 day in air, 6 days in water, 500 lbs; 1 day in air, 27 days in water, 650 lbs.; and briquettes of of 3 sand and 1 cement: 1 day in air, 6 days in water, 150 lbs.; 1 day in air, 27 days in water, 250 lbs.

In order to show the absolute inaccuracy of such specifications, I have gathered in Europe and this country the principal specifications for purposes of comparison, and there will be found below, a summary of requirements and tests under the branch of testing. In the case of European specifications, kilogrammes and centimeters have been roughly reduced to pounds and inches.

Neat Tests.

	7 days. lbs.	28 days. lbs.
France	284	497 (Cahier Guillain)
Russia	255	(Russian public works.)
Belgium	255	497 (Genie Belge.)
England	350 (Faija)	550 (Carey.)
Germany	No neat requirements.	

American Society of C. E. (250 to 550 lbs. at 7 days, 350 to 700 lbs. at 28 days tests recommended).

Under these recommendations are the following American specifications:

	7 days. lbs.	28 days. lbs.
U. S. Govt., Lighthouse Engineers, 1893	400	...
U. S. Govt., Army Engineers, 1893	450	...
U. S. Govt., Supervising Architect	300	...
U. S. Govt., District of Columbia, 1895	400	500
City of Philadelphia	450	550
City of New York	300	...
City of Baltimore	400	...
New Croton Aqueduct	300	400
Niagara Falls tunnel	300	400
Pennsylvania R. R. Co.	303	412
New York Central R. R.	300	500
Reading Terminal	350	...
Baltimore & Ohio	300	...
Lehigh Valley R. R.	300	...
New York city, Third Ave. bridge	300	500
Metropolitan R. R., New York	300	...
East River bridge, N. Y. (A. Corbin's)	303	...
City of Brooklyn	400	600
U. S. Govt., Lighthouse Engineer, 1896	300	...
U. S. Govt., Army Engineers, 1896	350	...
U. S. Govt., District of Columbia, 1896	375	500

Sand Test—(3 sand to 1 cement).

	7 days.	28 days.
France	...	215
Germany	...	227
Russia	...	142
Belgium	...	215
England (Carey)	...	200
Am. Soc. C. E. recommends	80—125	120—200

Under these recommendations are the following specifications:

	7 days. lbs.	28 days. lbs.
U. S. Govt., Lighthouse Engineers	100	...
U. S. Govt., Army Engineers, 1894	125	...
U. S. Govt., District of Columbia, 1895	100	150
Niagara Falls tunnel	90	...
New York aqueduct	100	...
City of Baltimore	...	150
City of Philadelphia	160	220
U. S. Govt., Lighthouse Engineers, 1896	80	...
U. S. Govt., Army Engineers, 1896	100	...
U. S. Govt., District of Columbia, 1896	125	175

These records all show modern requirements at 7 and 28 days neat, and a swing of the pendulum on the part of government engineers towards lower neat tests.

The reasons for this have been briefly set out in the early part of my letter, as following in the line of the long-time tests of John Grant, of the London drainage, above referred to. His figures from his papers above quoted are as follows; on a section of 2¼ sq. ins. (not 1 sq. in. as now practiced):

Age.	Neat cement. lbs.	1 cement to 1 sand. lbs.
7 days	817.1	353.2
1 month	935.8	452.5
3 months	1,055.9	547.5
6 months	1,176.6	640.3
9 months	1,219.5	692.4
12 months	1,229.7	716.6
2 years	1,324.9	790.3
3 years	1,314.4	784.7
4 years	1,312.6	818.1
5 years	1,306.0	821.0
6 years	1,308.0	819.5
7 years	1,327.3	863.6

These figures, which show about 350 lbs. per sq. in. at 7 days neat corroborate in their long-time continuing gains, the results of tests of cement now used by the New York Aqueduct under a specification of 300 lbs. at 7 days neat.

New York Aqueduct Tests. ("Trans. Am. Soc. C. E.," March. 1893, p. 191.)

Age.	Neat cement. lbs.	1 cement to 2 sand. lbs.
7 days	348	166
1 month	422	280
3 months	540	364
6 months	634	468
9 months	638	468
12 months	682	490
2 years	694	564
3 years	736	680
4 years	771	674
5 years	840	700

That a 300 to 350 lbs. specifications at 7 days neat will give good results the writer thinks is amply substantiated by the figures above given, and this is further corroborated by a paper read a number of years ago before the Institution of Civil Engineers, London, by Mr. Reginald E. Middleton (quoted above), where taking a series of cement tests that had broken at figures between 240 to 300, 300 and 350, 350 and 400, 400 and 450, 450 and 500, and 500 lbs. and over at 7 days neat, he found that those in the first three classes gained largely for a period three years and over, while those in the last three classes showed in the first two cases a slight gain, while in the other case a marked falling off at periods of three years and over, thus proving conclusively that such a specification as Mr. Donaldson recommends of tests of 500 lbs. at 7 days would lead to dangerous results in work.

On the whole, therefore, Mr. Donaldson's specifications may be divided into two classes of subjects. Those which are true are not new, and those which are new are not true.

But for the harm, the expression of such crude and ill-digested specifications as these to the community at large by their publication in scientific journals and their subsequent possible use by inexperienced engineers and architects I would not have trespassed on your columns to such length, nor have gone into so exhaustive an analysis of Mr. Donaldson's paper. It is to prevent this possible harm that I have written and I trust you will pardon the necessary length of my communication.

Robert W. Lesley,
Assoc. Am. Soc. C. E.
22 South 15th St., Philadelphia, Pa., Aug. 7, 1896.

(In accordance with our usual custom we submitted proofs of the above communications to Mr. Donaldson, who has replied as follows:)

Sir: The writer begs to apologize for the delay in answering your favor of the 18th ult., and replying to criticisms enclosed from Prof. S. B. Newberry and Mr. Robt. W. Lesley, as he has been away from the city for several weeks. Taking up the discussion of Prof. Newberry, the writer is pleased to note that this capable authority on cement agrees with him on the importance and need of formulating new requirements, and adopting a more specific system for the testing of Portland cements. Referring to his criticism on quality, to which it is proposed aeration for thirty days, the writer would state that this provision was not made as a guarantee of good quality, but rather to properly regulate the time of setting.

The criticism on chemical composition appears to be well founded. There have been, however, so many specifications drawn up lately, giving the limits of the various elements, showing the wide divergence of opinion on this subject, that it appears necessary to call attention to this and invite discussion. The writer agrees with Prof. Newberry that different raw materials will yield cements of different compositions, for, as he says, the varying composition of clays require different treatment, but would it not be well to establish limits for the several constituent elements and not have so many widely varying limits, which appear to be misleading? Such limits would detect any base properties, or adulterants in the cement. In the requirements for lime, silica, alumina and iron, although narrow, the writer bases his requirements on the average results of the analysis of the best German, French and American brands, with a few Belgian and English cements. Only the highest grade of tri-calcic silicate cements were considered. For magnesia, the reports of the Commission appointed by the German cement manufacturers to investigate the effects of magnesia on cement, made at frequent intervals, in the series of investigations, have gradually increased the permissable percentage since 1891, and in the last report, February, 1895, Drs. Schott, Meyer and Arendt, report the presence of magnesia up to 10% caused no harmful expansion, or cracking even after seven years. Dyckerhoff, as a minority, reported no change with magnesia up to 3%, but recommended the continuance of the allowable 5% limit of the previous year. The Commission agreed to continue the 5% limit, and make further experiments which would show whether a higher limit would be advisable. In the sulphuric acid requirements the writer has been guided solely by the experiments of the German cement manufacturers.

Adhering to the specific gravity test, the writer still thinks this important, as exposing slag and ground silica in adulterated cements, and not so much as determining the relative or apparent density. As to the fineness, the writer's sole intention in establishing such high limits for the No. 100 and No. 200 sieves was to increase the intrinsic value of the cements, and thereby to increase its effectiveness in the work. The prime object in grinding a Portland cement is not only to increase its adhesive strength, but what is of more importance, to cause the mortar to attain its maximum strength in the shortest possible time, which is being looked upon as a principle in high engineering work. From actual experience it has been shown in some of our leading cement manufacturing establishments, there are other mills besides the tube mill capable of producing such a high degree of fineness. Although experience has shown the number of meshes per square inch will vary in a No. 200 sieve, Prof. Newberry is correct in saying that the gage of the wire, as well as the number of meshes to the linear inch, should be specified. The writer has seen and obtained determinations for fineness on a No. 200 sieve, having 200 meshes per linear inch; such a sieve is to be found in the testing laboratory of Messrs. Lathbury & Anderson, Philadelphia. Sieves which do not show 200 meshes to the linear inch are not No. 200 sieves, and if so designated are incorrectly marked by the manufacturers.

In the matter of setting, although the temperature of the air and water do exert an influence on the cement, the writer does not think that in a laboratory, abnormal ranges of temperateure, which would materially affect the cement, are likely to occur. It might be well to specify 70° F. for the water, but as to the air, the influence being much less, the writer does not think, in view of summer heats, a limit could be specified. The provision specifying 24-hour tests was made in order to regulate the manner and method of performing same, in view of the various methods put forward in each case where it is specified. Personally the writer is opposed to this test, and thinks seven days the shortest time that should be specified. Recently on quite a large contract, the writer noticed the provision which called for the 24-hour test on Portland cement, one hour in air and 23 hours in water. A Portland cement of this character is inferior in quality. If, as Prof. Newberry suggests, a good quartz sand could be obtained, from some locality and in sufficient quantities, to supply the testing laboratories, in view of the great cost of crushed quartz, it might be well to specify it as standard, instead of crushed quartz. The chief consideration being a uniform sand, which necessarily will give uniform results.

After carefully reading Mr. R. W. Lesley's discussion on standard specifications for cement, the writer was much surprised by its tone, for, instead of being a criticism on technical lines, it delves into personalities wholly unsuited to the high scientific character of your valuable paper. As presumed by Prof. S. B. Newberry, in his interesting criticisms, the writer had no intention to "go it alone" on a subject requiring such careful consideration and deep scientific investigation as the adoption of a new and standard specification for Portland cements, but rather to present the subject in the light of suggestions and thereby open up the scientific discussion which would naturally follow. It is a well-known fact that the recommendations of the committee of the American Society of Civil Engineers are indefinite and altogether incapable of producing uniform results. The requirements are, on the whole, too low and inadequate, which allow of second grade cements going into work where the highest grade Portland cements are intended.

Mr. Lesley has always advocated low standards, following out the English ideas on the subject. Naturally to sustain his argument he introduces the wholly irrelevant subject of the history of Portland cement in England and cites certain well known authorities in that country whose opinions at best are hardly to be considered abreast of the times. It is generally conceded that the continental countries, notably Germany, have made more rapid strides in the investigation and manufacture of cements than in England where Portland cement had its birth. In the conventions held in Munich, Dresden, Berlin and Vienna to promote the adoption of uniform standards and methods for the testing of structural materials, the proceedings of which have been published by Prof. J. Bauschinger, of Munich, and later translated by Capt. O. M. Carter, Corps of Engineers, U. S. A., and Mr. E. A. Giessler, U. S. Assistant Engineer, it appears that the only country conspicuous by its absence was England.

The investigation of the results of long time tests, made on important engineering works in this country, as suggested by Mr. Lesley, would undoubtedly enter largely into the consideration of this subject, but it is doubtful whether any commission or body of experts appointed for such a purpose would pick out the only two works mentioned by Mr. Lesley, namely the New York aqueduct and the Niagara tunnel, admitting, as the writer does, the magnitude of those works, and draw their conclusions on a standard system from the performance noted on the one brand of cement used exclusively on the two pieces of work. As to the process of manufacture, entered into so largely by Mr. Lesley, it does not appear to the writer what connection it may have with the subject under discussion and his energetic defence of the method or "process of manufacture" would appear to the unbiased reader, as though he assumed that his methods of manufacture had been assailed and his equipment for grinding and burning the raw material had become obsolete and altogether incapable of producing a cement which would pass severe requirements drawn up to distinguish between the first and second grade Portland cements. Mr. Lesley apparently overlooks the progress made in the manufacture of Portland cement, and the improvements made in the grinding machinery and methods of burning, all of which are adapted to the various conditions of the materials. With few exceptions the cement manufacturers in this country have made rapid strides and introduced new machinery which would facilitate and at the same time better their product. Taking up Mr. Lesley's criticism on the furnishing by the manufacturer of certified tests, which he characterizes as "work of supererogation," it would be well to explain that this provision was made for the purpose of acting as a guide to those using the cement, whether it was to be tested or not. Such a provision would prevent delays on the work in cases where the cement was to be tested, as from such manufacturers tests it would be shown at once whether the cement was unlikely to pass the prescribed tests.

As to the criticisms on the "chemical composition," the writer has explained his purpose most fully in the discussion by Prof. Newberry, but it might be well to add that the changes noted and made so much of by Mr. Lesley, in the magnesia was a typographical error in the first pamphlet printed. It read 2½% magnesia and should have been 3½% magnesia. Mr. Lesley is wrong in saying that no provision is made for cement to be used in salt water. The second provision for sulphuric acid, calling for ½ of 1% was inserted to cover this contingency.

Throughout Mr. Lesley's discussion appears a vein of facetiousness which is wholly in keeping with the character of his criticisms on such a scientific subject as cement. It appears to the writer unprofessional, claiming as he does to belong to the engineering profession, to question one's reputation in the most insulting language. It appears like a similar attack Mr. Lesley made on Capt. W. W. Maclay some years ago, when the latter gentleman was engineer of the department of docks, New York, and in which he questioned the ability of Captain Maclay to correctly translate an article written in French on the subject of cement. No attempt has been made by the writer to place his authority on this subject against those well known authorities of the world as stated by Mr. Lesley. The subject was brought up for discussion and even Mr. Lesley, "Assoc. Am. Soc. C. E.," is welcome to criticise in the spirit of scientific investigation. The ludicrous attempt of Mr. Lesley to twist the meaning of a sentence in the small pamphlet by the writer of "Alpha Portland Cement," and cited in detail by Mr. Lesley, seems too childlike to answer, but for his benefit it might be well to explain that it was a typographical error in the punctuation.

Under the head of "Fineness" the writer is pleased to note that Mr. Lesley concedes the fact that manufacturers could guarantee the fineness specified and simply cites old specifications to show that no such high requirements were ever asked for, notwithstanding the fact that it is now the best practice among engineers to specify the finest ground cements. The value of fine grinding is known and why should the manufacturer not better the product by almost eliminating the coarser particles which only act as so much sand in the mortar composition.

Mr. Henry Faija, "Portland Cement for Users," London, 1890, says: In the manufacture of Portland cement it is impossible that the clinkers should all be burned to an equal degree of hardness, and in passing through the mill stones it is the softer pieces, or those which have received the least calcination, that are ground finest. and the thoroughly and well-burned clinker is only reduced to granules, not to powder, and as it is the best burned clinker that will produce the best cement, the value of fine grinding of the well-burned clinker is apparent." The writer admits that by increasing the fineness you thereby increase the cost of manufacture and it may be this item which influences Mr. Lesley's criticism on higher standards.

Upon the subject of hot tests Mr. Lesley brings forward authorities who condemn the reliability of this test; but taking up the first country, Germany, he admits that investigations are still being made on its reliability and in the meantime the test is still made. Although Mr. Lesley cites the French Commission's report, conference of engineers Ponts et Chaussees, Cahier Guillain, Service de la Marine, Service de Colonie, in which the "boiling tests" are not included, he does not indicate any of the well-known French authorities as being opposed to this test. In the paper of Prof. H. Le Chatelier, "Tests of Hydraulic Materials" read before the International Engineering Congress, Chicago, Aug., 1893, p. 31, under the heading, "Conclusion," this expert says: "For practical tests, it may be sought to accelerate and exaggerate the expansion due to the slaking of lime. For this purpose it is sufficient to elevate the temperature. If the briquettes, as soon as they have set under water, are plunged into boiling water, the swelling takes place in a few hours, instead of many days, and is besides considerably exaggerated. The products which when cold merely crack disintegrate when hot; those which swell cold split hot; and those which contain too little lime to swell cold do so very distinctly when treated hot. . . . . This test for invariability of volume, when made cold has but little interest, since it detects only exceptionally bad products." Thus it is seen that so eminent an authority as Prof. Le Chatelier, whom Mr. Lesley quotes on other points, thoroughly believes in the "Hot Test." For England he quotes the paper read by Mr. Henry Faija before the International Engineering Congress, Chicago, Aug. 1893, who, although he does not reject the steam vapor or hot-water tests, immerses the specimens in water at a temperature of 116°, thereby showing that he must still have faith in the hot-water test. In quoting his American authorities he states that "U. S. Government, District of Columbia, specifications, 1896, abandons boiling test," without stating on whose recommendation or authority. Next, Mr. F. H. Lewis, of Booth, Garrett & Blair, Philadelphia, who in conjunction with Mr. Edward Whitfield, also of the same firm, made a few experiments on the hot-bath test covering a period less than one year and drew their conclusions from the results obtained. This paper, read before the American Society of Civil Engineers in 1894, appears to be the only contribution on cement literature furnished by Mr. Lewis, whom Mr. Lesley quotes as an authority. From a brief summary of the above it will be seen that the Germans, French and English authorities still adhere to the hot test, while the only two doubtful authorities are quoted for the United States.

Such well-known authorities in this country as Captain W. W. Maclay, Professors Newberry, Spaulding and Sondericker still advocate the hot test. Mr. Lesley has always combated this test for possibly the reason that he desires to protect a certain class of cements which cannot meet this requirement.

Taking up the consideration of tensile strength, the writer cannot agree with Mr. Lesley in advocating such low standards. While recognizing the fact that abnormally high tests at short periods of time are not to be desired, the minimum limits advised by the writer are not considered high under scientific testing in well-equipped laboratories, following out societies' rules and regulations. The two principal reasons favoring high tensile requirements are: 1st. In order to keep out inferior and low grade cements. 2d. Maximum strength in short periods of time. Taking up the first reason, laboratory results show that all the best brands of both foreign and American Portland cements will meet the requirements advocated, while the doubtful brands are unable to develop such strengths in the periods of time allotted. Not only the second grade Portland cements, both foreign and domestic, are capable of passing the low requirements of strength in all the European countries and America, as quoted by Mr. Lesley, but even the so-called "Improved" cements, manufactured at some of the American mills and which are neither Portland or Rosendale cements, can pass them. 'Tis true that some of these low grade cements would fail in other requirements than the tensile test, but why should they not be barred in this respect? Considering the second reason, engineers at the present time demand a cement which when used in concrete or mortar will develop a high strength in a corresponding short period of time. This demand has been caused by the rapid growth in this country of massive monolithic structures in which cement is used, and furthered to a greater degree by the necessity of rapid construction, which makes it imperative to concentrate massive weights on concrete footings and on masonry work where cement mortar is used. Rapid hardening coupled with slow setting is desired by engineers in both mortars and concrete. Fine grinding promotes this feature at the same time causing the cement to attain its maximum strength in the shortest period of time.

M. Candlot, "Strength of Cement," Paris, 1891, p. 100, says: "If we observe in a general way the progress in strength of cement gaged neat or mixed with sand, we see that there are two kinds of Portland. Some cements, which give rather low tests during the first period of hardening, finally attain great strength at the end of two months, or even a few years. Other cements, on the contrary, show a very rapid increase in strength, and their maximum is attained in a few weeks or a few months. Nearly all the cements of good quality belong to the second kind; in the first are found the cements of inferior quality.

It is quite evident that, even leaving out the question of quality in the cement, resulting from a more or less careful manufacture, it is preferable to use those cements which acquire a great hardness in a short time. It is always an advantage when the hardening of mortar is not too slow because the structure is thus placed in a short time beyond all dangers. In works in sea water, for instance, a rapid hardening is an essential condition. When testing the cement, the briquettes are kept in pans protected from all causes of deterioration, and this makes it possible for those cements of little strength at the beginning to attain ultimately their maximum strength. But it is not so in practical works, where many outside circumstances are unfavorable to the mortar, and may spoil it more or less seriously, thus preventing it from ever developing all its energy. A mortar will all the more surely attain its maximum hardness as its initial strength is greater.

It is often said that the cements which harden slowly acquire an ultimate strength superior to those cements which attain great hardness in a few days. This is what M. Bonnami has formulated in this way: "What is gained in initial strength is lost in final strength." This is probably true in the case of common cements which contain some ingredients capable of swelling in time, but it is not absolutely true in the case of Portland cements. Whether the hardening is rapid or slow, the final strength is always about the same. "The hardening is gaged neat or when it is mixed with sand. In the first case, the maximum strength is attained in a few months; in the second case the hardening goes on more slowly, and the maximum strength, it appears, is only attained after a few years."

Mr. Lesley cites many specifications, in which with one or two exceptions the requirements for both neat and sand tests are all much below those advocated by the writer. The majority are old specifications whose requirements were favored some ten years ago, when Portland cement as an industry was still in its infancy. No specifications are quoted among the number from such great users as architects. In the city of Philadelphia alone five of the leading architects, using large quantities of Portland cement, have specifications equally as high as those recommended by the writer. while the same can be said of architects in the cities of New York, Boston and Chicago. Mr. Lesley quotes U. S. Government Army Engineers and U. S. Government Lighthouse Engineers as having a single requirement for tensile strength and leads one to believe that cement must pass the same specifications when advertised for from any or all U. S. Engineer Offices. This is a misstatement of facts, for this is one of the principal reasons that led the writer to formulate the "Proposed Standard Specifications for Portland Cement." From the specifications of the U. S. Army and Lighthouse Engineers, nearly all of which are in the possession of the writer, it is to be seen that each has his own individual requirements, thus precluding any single standard requirements as Mr. Lesley leads one to believe. In some of these the requirements are above those recommended by the writer.

Considering the long time tests of John Grant, of the London Drainage Board, Mr. Lesley seeks to place them alongside of the tests made at the present time. They were valuable at the time they were made, but in view of the betterment in quality of all the German manufacturers and a few of the English, these results are useless as a means of comparison at the present time.

To those ignorant of the true facts, the exhaustive discussion by Mr. Lesley appears full of scientific merit. His advocacy of low standards and continued aggressiveness against higher standards are well known; but the writer cannot allow the statement in the latter part of his argument to pass unchallenged. He refers to the harm accruing from such "crude and ill-digested specifications as these to the community at large by their publication in scientific journals and their subsequent possible use by inexperienced engineers and architects." In all fairness to the public, would it not be well for Mr. Lesley to state in what manner the "crude specifications" would prove harmful to "inexperienced engineers and architects?" If Mr. Lesley was writing as a cement manufacturer instead of an "Assoc. Am. Soc. C. E.," possibly these same "inexperienced engineers and architects" might fancy Mr. Lesley was interested in a cement or cements which would not pass the writer's advocated requirements. Let us hope such is not the case and that Mr. Lesley will soon become a convert to the necessity of constantly increasing the quality of American Portland cements and likewise seeing the need of a more uniform and specific standard of tests in this country. Yours very truly,

Wm. J. Donaldson.

Philadelphia, Pa., Sept. 1, 1896.

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THE MINERAL WEALTH OF THE UNITED STATES.

From the fourth annual issue of "The Mineral Industry" of the United States and other countries, for 1895, the following abstract is made of some of the more prominent industries tabulated and discussed in this most valuable statistical publication:

The total value of the mineral and metal production of the United States, in 1895, was $678,000,734, an increase of $96,789,496, or 16.6% over the product for 1894. In this total the metals represent $240,617,370, and the non-metallic products, $43,383,364, including in the latter $5,000,000 for various unspecified products. The chief gain has been in the mining of coal and iron ore, in the production of coke, lime, petroleum, evaporated salt, copper, etc., and these gains, as compared with 1894, may be set down as follows:

	1894.	1895.
Coal, anthracite, short tons	52,010,433	58,362,985
Coal, bituminous, short tons	117,865,348	137,398,347
Iron ore, long tons	11,880,000	16,950,000
Coke, short tons	8,495,295	9,927,348
Lime, bbls.	56,750,000	60,000,000
Petroleum (crude), bbls.	48,527,336	50,652,025
Evaporated salt, bbls.	11,798,659	12,521,498
Copper, lbs.	353,504,314	386,453,850
Pig-iron, long tons	6,657,388	9,446,308

The amount and value of gold and silver produced, at the commercial value of the latter, are thus set down for the two years:

	1894.		1895.	
	Amount, fine ozs.	Value.	Amount, fine ozs.	Value.
Gold	1,923,619	$39,761,205	2,265,612	$46,830,200
Silver	49,846,875	31,403,531	46,331,235	30,254,296

In 1895, metals to the value of $29,593,543 were produced from foreign ores and bullion, including chiefly silver from Mexico, valued at $18,380,232, gold from British North America and nickel from the Ludbury mines in Ontario; the latter valued at $970,000. The amount of iron smelted from foreign ores is insignificant and not included, while it should be noted that the pig-iron product of the United States, for 1895, exceeds the highest record of any previous year, or 9,202,702 long tons in 1890. This advance again makes this country the leading iron-producing nation of the world; and taking our output as 100, the other leading nations would stand as follows: Great Britain, 79; Germany, 60, and France, 21. Our steel production was over 6,000,000 metric tons, of which approximately five-sixths were Bessemer and one-sixth open hearth steel. The total steel product was 20% greater than that previously reported for any one year.

In the relative importance of mineral products, coal stands first by a standard of value, with a total of 31.8% of the value of the entire mineral productions; and pig-iron holds the second place, with 16% of the total. Gold only represents 6.9% of the total value here referred to; petroleum is next, with 6.3%, and copper holds the fifth place, with 5.5%. Silver production represents only 4.5%, or less than the value of building stone, and but little greater than that of lime, in the column of total values. Among mineral productions petroleum and copper form our chief articles of mineral export. As a mineral producing nation the United States, in 1895, took the first rank as a producer of gold, iron and copper; Mexico exceeded it in the silver output, and Great Britain as a coal producer.

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TESTS OF A 300-HP. DE LAVAL STEAM TURBINE.

We have received through the courtesy of Mr. J. W. Lieb, Jr., general manager of the Edison Electric Illuminating Co., of New York, a copy of the results of the acceptance tests of one of the 300-HP. De Laval steam turbines installed in the Twelfth Street station of that company. The results of a six-hour test, made on April 2, 1896, during which independent readings of volt and ampere meters were taken by two observers every five minutes showed a water consumption of 19.275 lbs. per electrical horse-power hour, or 17.348 lbs. per brake horse-power hour, on the assumption that the commercial efficiency of the 100 K-W. dynamos driven by the turbine was 90%.

The turbine tested was one of two supplied to the Edison Electric Illuminating Co., of New York, by the Societe de Laval, both of which were built by the Maison Breguet, of Paris. Each 300-HP. turbine drives, by means of gearing, two 100 K-W. Desrozier's dynamos, one on each side of the turbine shaft.

Operating with a steam pressure of 145 lbs. per sq. in., and a vacuum of 26 ins. the guaranteed steam consumption, when operating condensing, was to be not over 18.7 lbs. per brake HP. hour. The turbine disk has a diameter of about 0.75 meters (29.5 ins.), and a thickness through the blades of about 10 mm. (0.4-in.). The disk runs at a speed of about 9,000 revolutions per minute; the dynamos at 750 revolutions per minute.

The total equipment, comprising steam turbine, gearing and dynamos, occupies a space 4.05 meters (13 ft. 3 ins.) long, 1.97 meters (6 ft. 5⅝ ins.) wide, and 1.31 meters (4ft. 3 ins.) high.

The tests were made under the supervision of Mr. J. Van Vleck constructing engineer of the Edison Electric Illuminating Co. and M. Pare, engineer of the Societe de Laval. The following are the principal results of the six-hour test:

	+ side.	— side.
Average volts	127.25	128.26
Average amperes	708.56	725.47
Deduct amperes field circuit	16.08	16.29
Net amperes	692.48	709.18
Average watts	88,118.10	90,959.40
Average watts, both sides	179,077.5	

This last figure is 90% of 198.475 watts, equivalent to 266.72 brake HP.; horse-power hours, 1,600.32; weight of water condensed and discharged by the air pump in six hours, 27.763 lbs.

Lbs. of water per B. HP. hour	17.348 lbs.
Lbs. of water per B. HP. hour.	19.275 lbs.

The uniformity of operation is shown by the five-minute volt and ampere readings. . The volts ranged during the six hours from 126 to 128.5, and the amperes from 672 to 765. The vacuum ranged from 25½ to 26 ins, averaging 25.74 ins; the temperature of the inlet averaging 79.7° F., and that of the discharge 103.5° F. The steam pressure averaged 155 lbs. in the pipe, 150 lbs. at the throttle, and 147 lbs. below the throttle. The temperature of the dynamos after the six-hour run was as follows:

	+ dynamo.	— dynamo.
Armature	120° F.	129° F.
Average of fields	98° F.	107° F.
Commutator	144° F.	132° F.
Temperature of room	82° F.	

On April 3 a series of tests was made of the turbine with different loads, when operated with 2, 4, 6 and 7 jets. The duration of each test was one hour. The following are the principal results:

	Average load —amperes—		Average —watts.—		P. c. of full load.	Vacuum.	Lbs. st'm. per E. HP.
	+	—	+	—			
2 jets used	153.78	147.15	18.707	18.283	18.50	27.00	27.35
4 " "	433.60	455.80	54.156	57.886	56.02	26.43	20.22
6 " "	700.85	718.65	87.746	91.268	89.51	26.07	19.75
7 " "	771.94	787.33	97.418	100.86	99.14	25.79	19.95

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J. F. HOLLOWAY.

In our last week's issue we published a brief note of the death of Mr. J. F. Holloway, the news of which, without any particulars, we received just before going to press. We have since learned that he died at his summer home at Cuyahoga Falls, O., on the evening of Sept. 1. On Aug. 20, while in Buffalo, he took cold, which brought on an attack of congestion of the kidneys. After receiving medical advice to the effect that his condition was serious he hastened home, reaching there Aug. 22. From then until his death he was, for most of the time, in a semi-conscious state.

Mr. Holloway was born in Uniontown, O., Jan. 18, 1825. When about six years of age his father moved to the Western Reserve and built a house on the banks of the Cuyahoga River, where afterward grew the town of Cuyahoga Falls. He served an apprenticeship with the firm of Bill Brothers, engine builders, and then was employed in the shop of the Cuyahoga Steam Furnace Co., of Cleveland. He was for a time in New England, and afterward went to Cumberland, Md., were he was superintendent of a coal mining company for some years. Later he was several years at Shawneetown, Ill., as general manager of an iron and coal company, organized by Sellers & Co., of Philadelphia. About 1860 he returned to the Cuyahoga Steam Furnace Co., at Cleveland, where he remained for 26 years as superintendent and president. This works was one of the most noted of the west for the building of blowing engines for blast furnaces, marine engines for lake steamers and heavy engine work generally. After the death of the old owners of the works Mr. Holloway was its sole guiding spirit, managing it as trustee for the heirs. It was a shop of the olden time, dating from 1834, without the modern appliances considered necessary for heavy work, but nevertheless it continued to do its share of the heavy work for the west until 1886, when the plant was sold entire to the Cleveland Shipbuilding Co. One side of Mr. Holloway's finely rounded character is shown in the address he made to his men on the last day of the year 1886, when the shop was turned over to the new concern. We quote an extract, as follows:

> With the closing hours of this, the last day of the year, will come the end of the business of the Cuyahoga works within these walls and under my management. Among the many thoughts which have come to me at the end of over 25 years of my supervision of its business and of my personal association with you none gave me more concern than did the thought what will become of our long-tried faithful men. And nothing gives me more pleasure than the assurance I have received from the new owners that they intend to make no changes in this respect and that they hope every man will continue to occupy his place in the future as he has in the past. As I could not bear the thought that on this last day of the year you should go to your homes and to your families full of doubt and uncertainty as to what might be in store for you in the opening year, so I cannot bear to let this, the last opportunity I shall ever have of seeing you together pass without endeavoring to express to you my appreciation of the fidelity and honesty with which you have all done your part toward making the record of the Cuyahoga Works what it now is. For myself I want to say that working here as a boy and alongside of some who are now present, coming back later on to be your superintendent, and for many years past the president of the company as well, I have had many a difficult task to perform. While it was but just and proper that every man from the lowest to the highest grade should have all that he could earn, it was also necessary that I should have a regard for the interests of those whose money furnished you with employment, and who were entitled to a fair return for its use. Now that all this has come to an end, it is great satisfaction to know that during all these years there has never been a difference between the employees and the company that we could not and did not settle among ourselves, and I hope to the advantage of both.

After leaving the Cuyahoga Works in 1887, Mr. Holloway removed to New York, and was connected with the firm of H. R. Worthington, pump manufacturers, for seven years as consulting engineer. About two years ago he left this position and became consulting engineer for the Snow Pump Co., of Buffalo, N. Y.

Mr. Holloway was for several terms president of the Civil Engineers Club, of Cleveland; vice-president for two terms of the American Institute of Mining Engineers, and president for the year 1885-6 of the American Society of Mechanical Engineers, of which he was one of the charter members. He was also a member of the Engineers' Club in New York.

While Mr. Holloway was a constructing engineer of marked ability, and a most efficient manager of works, he is best known and will be best remembered by the profession for his remarkable charm of manners and of speech. He was a fluent popular speaker and a ready writer. Probably no member of the profession had a larger circle of intimate personal friends. Another ex-president of the Mechanical Engineers' Society in a private letter says of him: "I think he was the most lovable man I ever knew." The local members of the American Society of Mechanical Engineers at their meeting in Cleveland on Sept. 3 adopted a resolution regarding the personal loss of each of them, caused by Mr. Holloway's death, as well as the loss to the profession at large.. At the next monthly meeting of the Engineers' Club of New York on Oct. 1, addresses of tribute to Mr. Holloway's memory will be made by some of his friends.

◆

A BICYCLE FIRE-ENGINE, propelled by cycling firemen, is being tried in Paris. The engine rests upon two tandem bicycles coupled together and having a single steering post. The engine is simply a rotary pump, operated by the men, and the machine complete, with hose, weighs "only 140 lbs." The pumping power is applied by raising the two hind wheels from the ground, by a supporting leg, coupling the pump to these wheels, and then placing two men in the saddles to do the work. The capacity of the pump is reported as being 4,500 gallons of water per hour, thrown 75 to 100 ft. into the air. It is to be chiefly applied in small towns or in the country.

◆

THE GREENLEAF CENTER-BEARING TURNTABLE.

(With inset.)

The turntable, like all other permanent way and track structures on railways, has had to undergo a material modification in design and construction to suit the increased weight and size of the locomotives which modern traffic demands. In the earlier days of railways, and indeed up to the time not so very many years past, turntable design was not considered a serious problem. For the light weight engines of those times turntables of wood or a combined wood and iron construction amply served all ordinary purposes, for although their lives were short (usually from five to eight years only) they were comparatively inexpensive to repair and replace. The turntable of the present day is quite a different structure, for, constructed as it is of iron or steel from 65 to 70 ft. long and with a capacity of from 100 tons to 170 tons, it is necessarily expensive, and durability in respect to repairs and reconstruction is a very important feature. We find consequently a correspondingly greater attention being given by railway engineers to the careful study of structural principles and constructive details in all parts of such structures. A study of the drawings on our inset sheet with the following description of their more prominent features illustrates the fact very forcibly, and as we shall take occasion to show in a later issue, a similar careful consideration is shown by the work of designers other than the one whose design is illustrated here.

In turntable designing theoretical considerations have to be modified by empirical rules which experience has developed, and before describing the construction illustrated herewith some of these may be stated to great advantage. Theoretically a center-bearing, single beam construction is considered preferable. By this it is meant that the center bearing carries the entire weight of the table and its load leaving the end bearings free from load, and that the whole table acts as a single beam to resist strains. A moment's thought will show that if such a construction can be made theoretically perfect all the frictional resistance to turning is brought at the point where the greater leverage is available to overcome it, and that diagonal deflection with its various concomitant troubles is avoided. Of course, only a more or less close approach to either of these desiderata is possible.

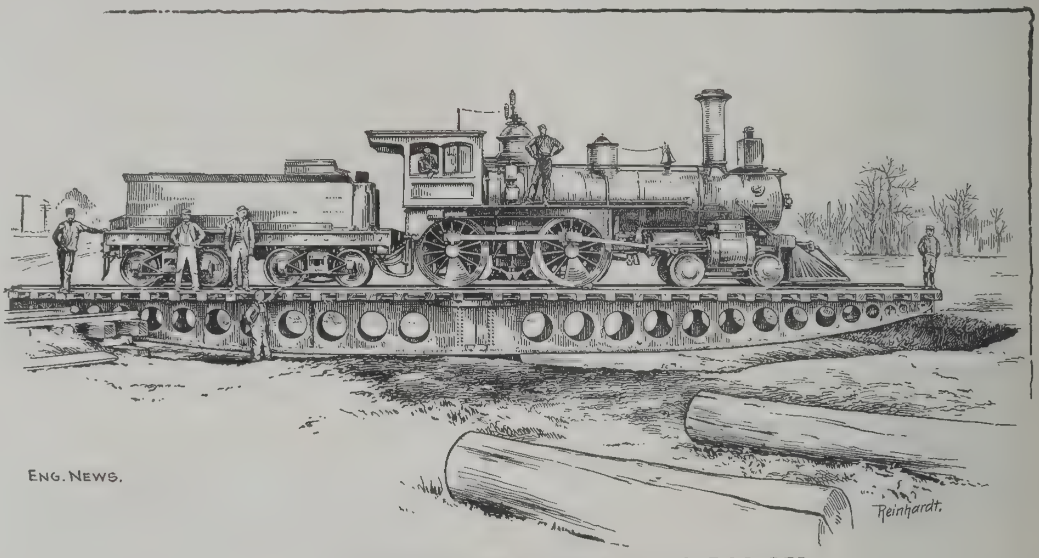

FIG. 7.—VIEW OF CAST-IRON GIRDER TURNTABLE LOADED.

Some of the factors which experience as well as theory have shown to be desirable are the following: (1) Necessarily the tables must be long enough to receive and balance the largest locomotive and tender in use; (2) it should turn easily under all conditions of weather, i. e., snow and ice, and freezing or thawing should not disturb its adjustment or make it turn hard; (3) its wearing bearings need to be of such material and construction as to withstand the load, and not to be disturbed or thrown out of position by shocks or the end thrusts of locomotives entering and leaving the tables; (4) it should swing true to center and preserve its adjustment horizontally and vertically; (5) it should be sufficiently rigid to swing under the heaviest loads with the outer ends of the table clear, and yet be so flexible that the shock of the locomotive will not dangerously strain or perhaps break it; (6) all these features must be obtained with a minimum of first cost and cost in repairs and operation.

How these various requirements come to be demanded will be seen if the operation of the table for the use intended is examined. It must tip to a firm end bearing to receive the locomotive, revert to a horizontal position with both ends clear, when the locomotive is fully balanced on the table, and remain so while the turning is in progress; tip to a bearing at the opposite end when the locomotive leaves the table; and finally revert to its original horizontal position. The variation in the character and intensity of the strains to which the table and its bearings are subjected during these manoeuvres is evident, but it will become definitely apparent if the strain diagram shown by Fig. 1 be examined. This diagram shows the calculable strains in a 65-ft. turntable with a locomotive and tender load of 170-tons, and was calculated by Prof. W. V. Brown, of De Pauw University. Three positions of the live load were assumed: (1) Locomotive balanced over center of table, end rollers not bearing; (2) locomotive moving over one arm of table, and load on other arm neglected; (3) one pair of drivers resting at end of table and remainder of load neglected. Only one side of the engine and table are considered. Of course this diagram does not cover the incalculable strains induced by thrusts and shocks, as these, as in bridge work, are allowed for by excess metal and strength and such construction, as experience has shown to be desirable.

Enough has now been stated to show that the proper design of the center bearing is a problem requiring considerable attention and to show how it has been solved by one designer the improved standard turntable made by the Greenleaf Turntable Co., of Greencastle, Ind., Mr. C. A. Greenleaf, proprietor, is illustrated. Fig. 2 is a general elevation of this table, and Figs. 3, 4 and 5 show details of various parts. Fig. 6 shows the details of a riveted girder table and will be referred to later, but Figs. 2 to 5 will be used to describe the construction and operation. It should be noted that the dimensions given are for a 100 tons capacity table.

The center post A is of cast gun metal 3 ft. 7 ins. high, 15 ins. diameter at the top, 19 ins. diameter at the base, and with flange base 2½ × 2½ ft. square and 4 ins. thick. Near the base is a roller path hardened and ground to a surface 19 ins. diameter and 9 ins. high. At the top is a spherical socket 12¼ ins. diameter, chilled and ground to a true surface and less than a hemispherical segment. In this socket rests a steel sphere, H, 12 ins. in diameter. Sitting over this the center post is a box consisting of a cap B, and a sleeve C, connected by bolts. Both cap and sleeve are cast gun metal. The cap is 26 ins. in diameter, 5 ins. average thickness, faced on the lower side, and having a spherical socket forming the upper bearing for the ball H. The sleeve is 26 × 26 ins. horizontally and 3 ft. 2 ins. vertically. On its outside are four 3½-in. vertical flanges to which the cross struts D are riveted, and at the bottom is an inside annular groove E, 24 ins. in diameter to receive the bearing balls 2 7-16 ins. in diameter. This groove is chilled and ground to exact size, and the bearing balls are of hardened and ground steel.

It will be noticed that the box is substantially prevented from lateral movement at the bottom by the close bearing of the ring of balls, E, and also that the spherical sockets for the ball H are of slightly greater diameter than the ball. The platform of the table is fastened to the cross struts D. Now when the platform tips at one end to receive the locomotive, the ball H rolls slightly toward that end, but as soon as the locomotive is once balanced on the table the ball seeks its original position, or in other words the table becomes horizontal. The tip of the table is of course controlled in amount by suitable end bearing. At the same time that the ball H is rolling to one side and back again the balls E undergo a slight vertical movement. Enough has now been said to show the theory of separation of the center bearing.

For 60-ft. turntables of 100 tons capacity the builders consider that girders of cast gun metal are preferable, but for tables of greater length or capacity cast gun metal is not so satisfactory. Assuming a table of the above capacity, four girder arms 44 ins. deep at the widest part and 30 ft. long are used. Both the bottom and top flanges narrow in width from the center toward the end of the girder, this taper being from 9½ ins. to 6 ins. for the top flange and from 8 ins. to 4½ ins. for the bottom flange. The thickness of the top flange is 2½ ins., and of the bottom flange 1¾ ins. The girder web is 1½ ins. thick at the large end and ⅞-in. thick at the small end, and is perforated with 12 holes of suitable size to relieve the shrinkage strains, but yet to have ample strength. The top flange of the girder is straight but the bottom flange has the line of a parabola.

Two girder arms coupled together at the center

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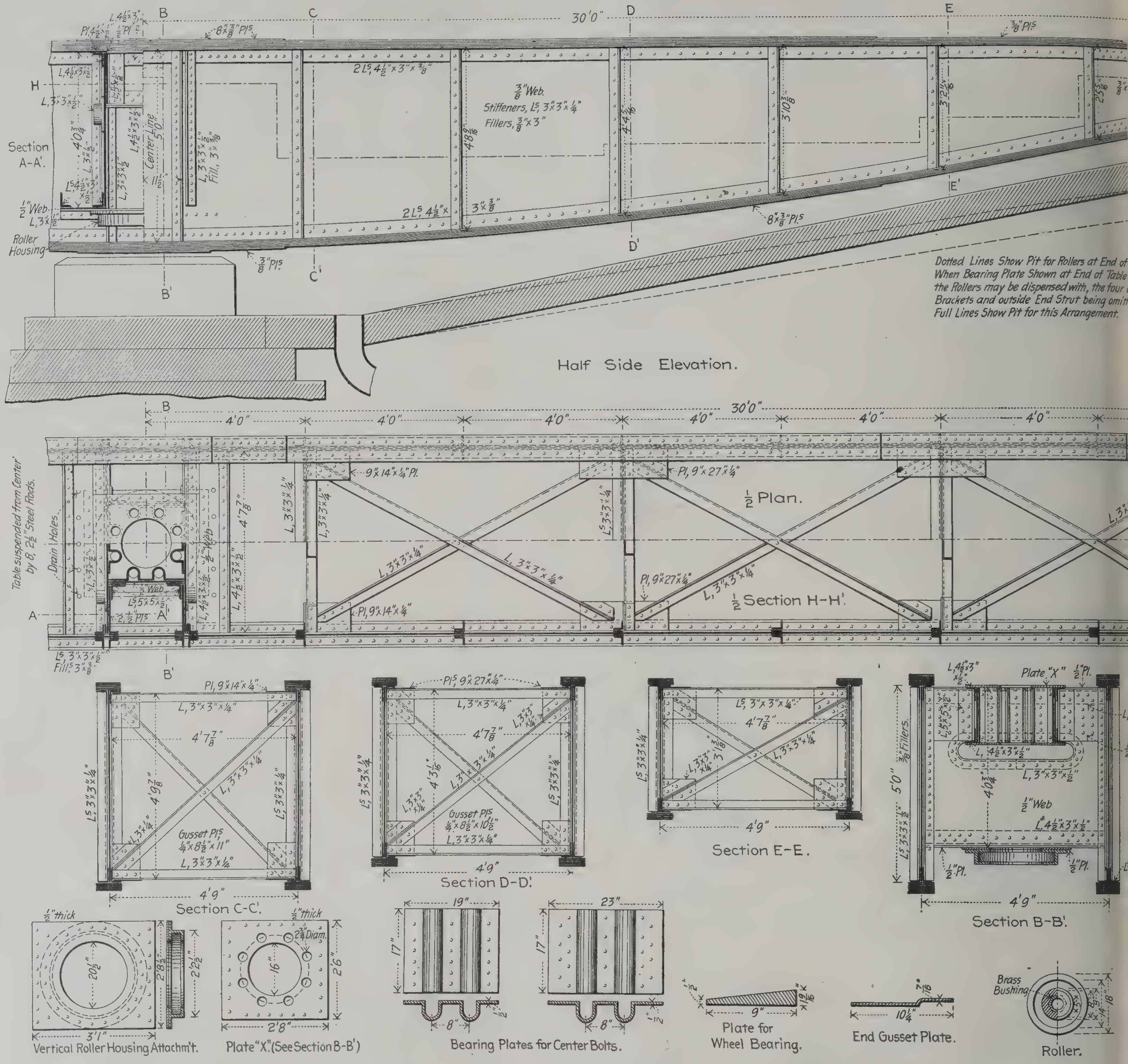

Half Side Elevation.
Section A-A'.
½" Web.
Roller Housing
Center Line
⅜" Web.
Stiffeners, L^s 3"×3"×¼"
Fillers, ⅜"×3"
30'0"
B
C
D
E
H
B'
C'
D'
E'
Dotted Lines Show Pit for Rollers at End of
When Bearing Plate Shown at End of Table
the Rollers may be dispensed with, the four
Brackets and outside End Strut being omit
Full Lines Show Pit for this Arrangement.
½ Plan.
½ Section H-H'.
Table suspended from Center by 8, 2½" Steel Rods.
Drain Holes
4'0"
Section C-C'.
Section D-D'.
Section E-E.
Section B-B'.
Plate "X"
Gusset Pl^s
4'9"
4'7⅞"
Vertical Roller Housing Attachm't.
Plate "X". (See Section B-B')
Bearing Plates for Center Bolts.
Plate for Wheel Bearing.
End Gusset Plate.
Brass Bushing
Roller.

FIG. 6. DETAILS OF RIVETED STEEL GIRDER TURNTABLE.

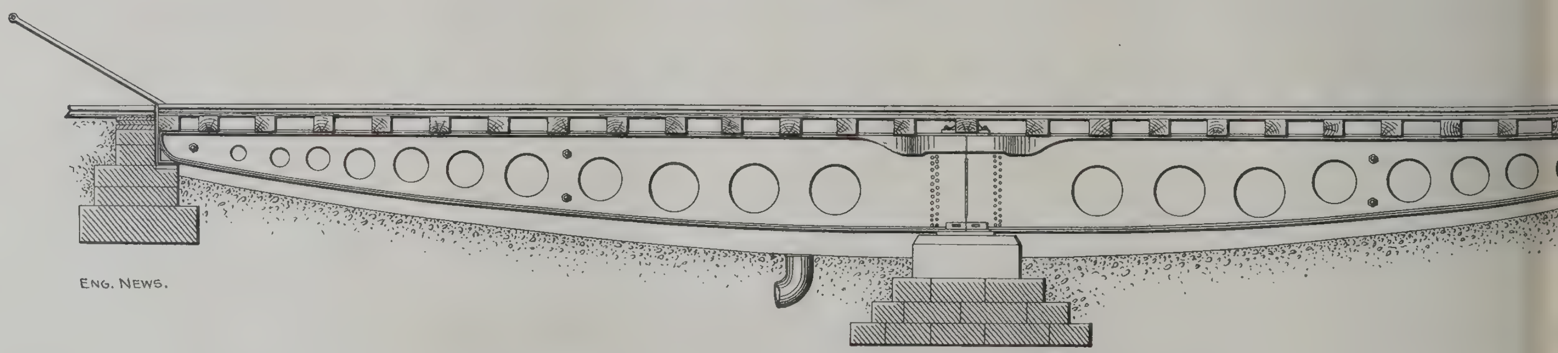
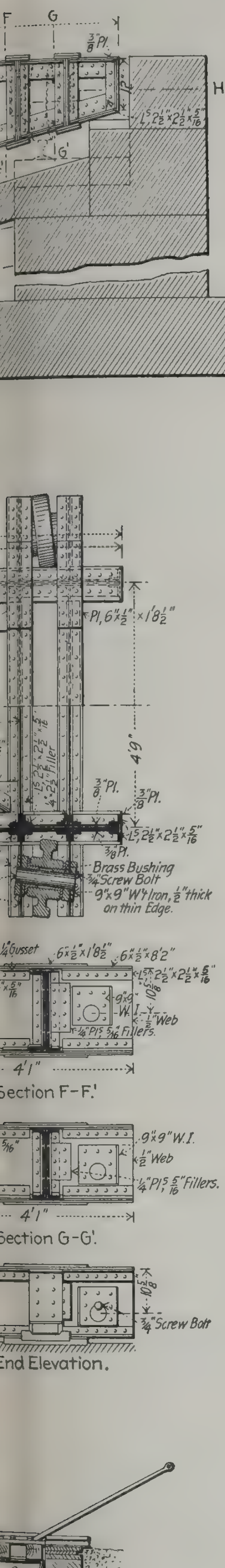


FIG. 2. ELEVATION OF CAST IRON TURNTABLE.

GREENLEAF CENT

Greenleaf Turntable Co., Greencastle, Ind., Builders.



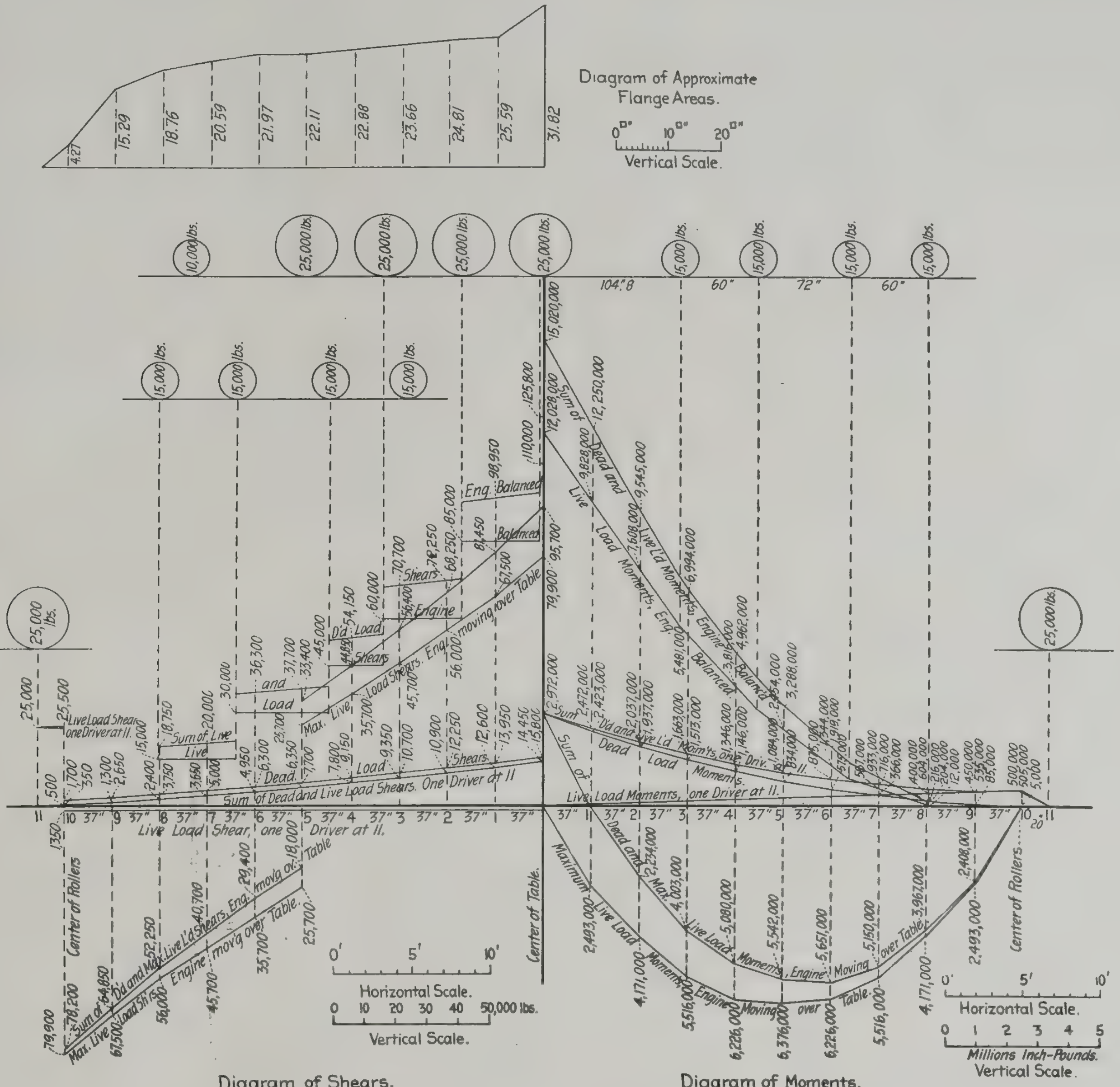


Diagram of Approximate Flange Areas.
0□" 10□" 20□"
Vertical Scale.
4.27
15.29
18.76
20.59
21.97
22.11
22.88
23.66
24.61
25.59
31.82
10,000 lbs.
25,000 lbs.
25,000 lbs.
25,000 lbs.
25,000 lbs.
15,000 lbs.
15,000 lbs.
15,000 lbs.
15,000 lbs.
104.8"
60"
72"
60"
15,000 lbs.
15,000 lbs.
15,000 lbs.
15,000 lbs.
25,000 lbs.
25,000 lbs.
Live Load Shear, one Driver at II.
Sum of Live Load
Sum of Dead and Live Load Shears. One Driver at II
Max. Live and Dead Load Shears
Max. Live Load Shears, Eng. moving over Table
Eng. Balanced
Balanced
Shears
Engine
Live Load Shear, one Driver at II.
Sum of Dd and Max. Live L'd Shears, Eng. mov'g ov. Table
Max. Live Load Sh. Engine mov'g over Table.
Center of Rollers
Center of Table.
0' 5' 10'
Horizontal Scale.
0 10 20 30 40 50,000 lbs.
Vertical Scale.
Sum of Dead and Live Load Moments
Live Load Moments, End Balanced
Dd and Live L'd Mom'ts, one Driv. at II.
Dead Load Moments.
Live Load Moments, one Driver at II.
Maximum Live Load Moments, Engine Moving over Table.
Dead and Max. Live Load Moments, Engine Moving over Table
Center of Rollers
0' 5' 10'
Horizontal Scale.
0 1 2 3 4 5
Millions Inch-Pounds.
Vertical Scale.
Diagram of Shears.
Diagram of Moments.

FIG. 1. STRAIN DIAGRAM FOR 65-FT. TURNTABLE OF 170 TONS CAPACITY

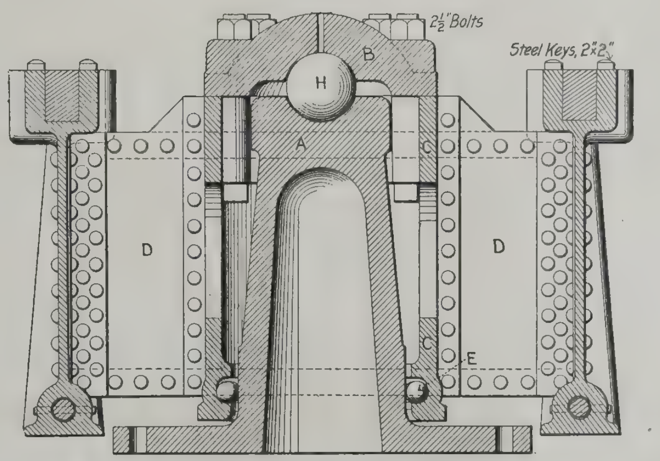


FIG. 3. TRANSVERSE SECTION CENTER BEARING.

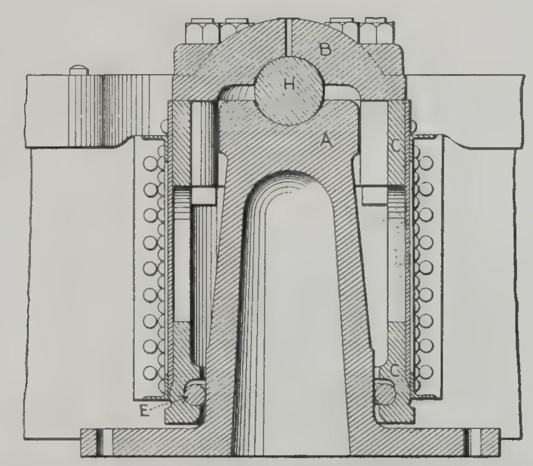


FIG. 4. LONGITUDINAL SECTION CENTER BEARING.

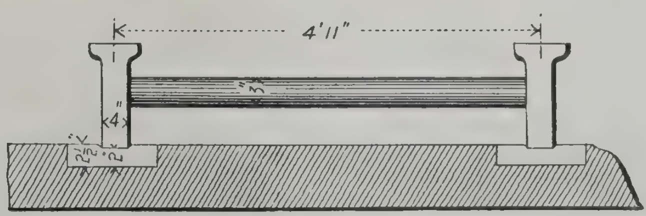


FIG. 5. DETAILS OF END LOCKING DEVICE.

NG TURNTABLE.

A. W. Greenleaf, M.E., Designing Engineer.

form a single girder for the table. These couplings are made by forged steel tie bars, fitting into suitable sockets cored out of the girder flanges. The atachment of the girders to the center box is shown by Figs. 3 and 4. Besides this lateral bracing there are cross braces about midway of each arm and at the end, and also a cast diagonal bracing. The lock, Fig. 5, consists simply of gun metal castings notched to receive the ends of the girders. The foundation masonry work is sufficiently shown by Fig. 1, and of course this is amenable to modification to suit conditions so long as it is maintained of sufficient solidity and strength.

It will be noticed that the intention of this design in all respects is to conform to the requirements laid down in a previous paragraph. It is entirely center bearing, there being no end rollers at all; by a thorough system of lateral bracing, the whole platform is designed to act as nearly as possible like a single beam; combined rigidity to carry load and flexibility to take up shock is provided by the coupled girders and by the center bearings and perfect and easy adjustment is sought through the ball bearings. In respect to the practical success of this construction toward the end sought we have the statement of the designer who expresses his faith from a long experience in building turntables.

It will be noted that the turntable described has cast-iron girders, but frequently riveted girders of wrought iron or steel are preferred. Fig. 6 illustrates one of these built a few years ago for the Lehigh Valley R. R. This is a 60-ft. table designed for the Lehigh heavy-grade engine, and calculated with the same assumed positions of the live load as is described above in connection with Fig. 1. The structural details are so clearly shown by the drawings that no further description is necessary. It should be noted, however, that the center bearing for which these girders were designed differs considerably from the one illustrated in Figs. 3 to 5, but, of course, this does not affect the girder design except at its connection with the center bearing.

Fig. 7 is a view of a cast girder turntable of the Greenleaf pattern, 66 ft. long and of 120 tons capacity. It will be noticed that the ends swing clear of any bearings when the table is loaded. For the matter from which this and the other illustrations have been prepared we are indebted to the Greenleaf Turntable Co., of Greencastle, Ind.

NATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.

The fourth annual meeting was held at the Tremont House, Chicago, Ill., September 1, 2 and 3, 1896. The meeting was called to order by President S. Uren (So. Pac. Ry.), of Sacramento, Cal., and the Mayor, Mr. George B. Swift, welcomed the delegates (who numbered 65) to the city. The Secretary, Mr. G. F. Hinkens (St. P. & D. Ry.), read his report, showing a membership of 150, 24 new members having joined at the present meeting. The Treasurer's report showed the following state of finances: Receipts, 1895-6, $464; expenses, $303; balance, $161. The President then read his address.

Report on Forges and Tuyeres.

The common square or round forge, of brick or iron, is good enough for all ordinary blacksmith work. The position of the tuyere, however, varies. Some smiths prefer the old style, solid or hollow for water, which is placed horizontally in the forge, and through which the blast is discharged to the center of the fire. This is not so effective in heating as when the blast enters the fire from the bottom of the forge, through a square iron blast box, which is provided with an opening in the top, fitted with a cast-iron grating having from one to four oblong holes, ⅜ × 2 ins., the grating with a single hole being large enough for very light work. These gratings can be removed and replaced by new ones, though if the blast box is kept clear of cinders and dirt they do not burn out. In the bottom of the blast box is a slide, which, when pulled out, allows all dirt and cinders to be removed. Such blast boxes or tuyeres are the only kind in use in the Southern Pacific shops at Sacramento.

Mr. Looker (Toledo & Ann Arbor) described a tuyere iron used in connection with the round forge. For a deep fire he had a box 12 ins. long, 9 ins. wide, and 5 ins. deep, with a double blast, and a long lid to cover it. In the center of one lid are two slots, ⅝ × 3 ins., and there is another lid with four slots. One lid could be taken off and another put on, according as it was desired to get a long or short heat.

Mr. Coleman (C. & N. W.): We use a common tuyere iron with a cast-iron box underneath. We have the side blast at our common forges, and underneath the tuyere iron we have the box, which is about 7 ins. square, and 6 or 7 ins. deep, with a slide in the bottom, and we find it very convenient in dumping the fire and saving coal. When we come to clean out we do not mix the loose coal with the dirt that drops through. I think we save at least one quarter in coal over the old plan of shovelling out the fires with the solid bottom. There is also a considerable saving in time in cleaning the fires; we clean them in from three to five minutes. I use a double blast also in the big fire, where we weld frames and do large work.

Mr. Robbins (Fitchburg R. R.): I have been using a tuyere having a cone-shaped top, with an oblong hole, about 2 × 1½ ins., with a ball that works into it, fitted with a lever. In the center of the ball is a hole about ¾-in. diameter. When it is desired to run a small fire, by bearing down on the lever, it throws the ball up, closes the large hole, and allows the blast to circulate through the small hole in the ball. At the bottom of the tuyere is a clapper, which we lift out, which allows all dirt and ashes that pass down through the tuyere into the ash box to be cleaned out very readily. The advantage of the cone-shaped top of the tuyere is that all slack and cinders run off below the outlet of the tuyere, which prevents all clogging.

Report on the Best Method of Manufacturing Axles.

To make a good wrought-iron axle we must have a good reverberatory furnace, clean gaseous coal, good scrap, steam hammer, suitable tools and the necessary help required to do the work. Use such scrap as old archbars, bridge plates, bridge rods, small car axles, etc. All scrap should be milled so that no foreign matter remains upon the iron. Cut the scrap into lengths of 18 ins., having piling boards cut from any rejected lumber. Also have a quantity of some iron that is nearest muck iron, such as splice bars, fish plates, etc., well milled and cut to lengths as above, and add about 30% of this muck iron to each pile you put up, well distributed. The slabs will not be so dry and there will be less danger of fire cracks, as the amount of flux will be greater. In piling your scrap use Beattie's system of piling.

The iron so piled and worked into slabs and then into axles will stand severe tests, as the fibers are entwined about each other in such a manner that when the axle is completed it seems almost impossible to break it, provided the iron has been properly heated. Some of our committee favor a two-slab axle, while others favor a three-slab axle, but this is a question that will have to be left with the railway companies that use them to determine what material will be best for a car axle; for the question of the iron axle and the best method of making it so as to give the best service is a matter of tests.

A great many of our leading railways have had made for their own use a muck bar axle under specifications of their own. This axle has proven to be very good and has given good service. The question may be asked: "Why do they want a muck bar axle?" The answer is that we cannot get wrought-iron scrap that is free from steel, as there is so much steel in use now by car manufacturers that it is impossible to get miscellaneous wrought scrap without there being steel scrap in it. You will have more or less soft pieces mixed through the scrap pile and it cannot be detected. So it will be worked and the result will be a weak place inside of the slab. The slabs will be piled together, the axle forged, and you still have the steel in the axle. If the piece of steel gets into a pile of wrought scrap, and the pile is worked into a slab, you will find if you break the slab that the iron has all been worked into one mass, or changed from a lot of small pieces into one piece, but you will find that piece of steel in about the same shape or condition as when it went into the pile. With such contingencies how can we build an iron axle that will stand the M. C. B. test, as was recommended by the committee at the last meeting of that association?

Mr. Mick: In taking scrap iron, old archbars, etc., and making slabs out of these, and putting them into the axle, they are too homogeneous to make a good axle, and he found that it was necessary to put something in there to assist this dry iron, and in the manner of piling it is intertwined in such manner that fire cracks were out of the question, as far as his experience had gone, and he had made a good many axles.

Mr. Williams (C., A. & C.): He would not test an axle in the middle, because that is the best part of it; anywhere from 10 to 18 ins. from the end is the place to test the axle; they always break in that place; he never saw an axle break in the middle from actual wear and tear; anything that breaks an axle in the middle generally breaks up the whole train.

Mr. Judy (B. & S. Car Co.): To say that axles do not break in the center is a mistake; he had seen five axles break inside of one week within 3 ins. of the center, supposed to be first-class axles, both iron and steel. The thing is to prepare an axle that will meet the specifications of the railway companies; they are the people who know whether the axle does the work or not; they discover this from tests and trials in service. Axles will break in the center and in the journal and back of the wheel seat; the companies have found out that the place to test them is in the middle or they would not do it.

Mr. Uren: The center is worked down to a blood red heat, and no iron retains its strength until it is worked to that heat. The end of the axle is finished at a white heat, and then placed in water for the purpose of cooling it. Consequently, the 5-in. part of the axle has not had the same working as the 4¼-in. part, and for that reason it is more crystalline, and my experience is that 25% more axles break at the wheel fit than in the center. Any iron finished at white heat is almost useless.

Mr. Mick: The difficulty arises from the fact that the workman does not have the fire bridge in the proper shape, and the heat is greater where the wheel fit is than it is where the center is, and it becomes fire cracked, and after the axle is in service it will break behind the wheel because the axle was injured in heating.

Mr. Burgess (C. & E. J.): It is almost invariably the journal that breaks. Car axles when running will get overheated and are cooled off with water, and that process goes on, and it is easy to see why the axle breaks at the journal.

Mr. Judy: There are some specifications that call for an axle to be made of muck bar. I know of one company which requires a piece of bar iron right in the middle between two scrap slabs. I do not think you can pile up old rails and work them over the hammer and expect a good job.

Mr. Norris: The greatest percentage of steel axles break in the periphery. It starts on the outside, and gradually breaks down until it comes within an inch of the center, and then it parts, and that occurs when the dead weight comes on the axle in the stopping or starting. There is one thing about steel and iron axles. The M. C. B. requirements say that an iron axle, 4⅝ ins. center, shall stand two blows at 15 ft. and three blows at 10 ft. The same axle in steel shall stand five blows without any fracture at 29 ft. If the M. C. B. do not know that steel is better than iron why do they put such specifications for them to fulfill?

Mr. Fitzgerald (C., M. & St. P.): The experience on our road has been that most of the axles break behind the wheel seat. The great objection to the steel axles which are on the road is that they break off quick, whereas the iron axles commence to crack, and the man who examines them has a chance to see the cracks in time to take the axles out, so as to avoid a wreck. I experimented a good deal with scrap last spring, and the result of my experiments was that the best scrap to make axles out of is old coupling links and some round iron to fill in with; it gave the best satisfaction.

Mr. Robbins: I claim an axle will break where vibration ceases and crystalization takes place, which is right back of the wheel fit, provided the wheel is forced up on to the shoulder. On the train on which I came to Chicago they had a hot journal, and when the train stopped the journal was red hot; and the trainmen used eight or ten pails of water to cool it off, and in running the 200 miles the journal was cooled off five times in that way. What condition is that journal in to-day?

Mr. Mould (N. Y., L. E. & W.): I think the day may come when we as blacksmiths may say that a steel axle is better than an iron axle, but I doubt if we are in a position to-day to say so. If a steel axle has been used and run its service what is there left in it for the railway company? With the iron axle we make almost everything on the locomotive. What will you do with the old steel axles?

Mr. Uren: We are manufacturing in the Sacramento shops 30 axles daily, and have been doing so for the last 25 years. We make these axles from ordinary scrap. As to getting steel into the axle, sometimes, undoubtedly, it will get in, but we avoid that as much as possible. The percentage of broken steel axles is far greater than that of iron axles on our road.

Mr. Norris: The company which I represent make more steel axles than any other in the United States. Some railways do not specify what the freight axles shall be made of, but only what the passenger axles shall be made of. One prominent road in the East says that it cannot afford to make any distinction. The only road in the country that can afford to make a distinction is a single track road, where trains are not passing each other continuously.

Report of the Best Methods of Constructing and Repairing Locomotive Frames.

In view of selecting the scrap for frame work, can it be said that we know the condition of this material, or what it contains, or how often it has been reworked? Very evidently in most cases it must be an unknown quality of material. In the selection of scrap much care should be exercised in selecting a good, clear iron free from corrosion to be sheared suitable for piling. Steel and other foreign material should be avoided. In preparing the piles for the heating furnace, muck bar iron should be at hand and mixed in among the scrap, this will increase the amount of slag, making the iron more fibrous. The doubled refined iron is still better than the raw muck bar. The good, sound judgment of a heater is of great importance, as the properties of the iron in the finished state can be rendered useless by the inability of a heater. Likewise with the hammerman; he must understand thoroughly the manipulating of the iron under the hammer to obtain first-class welding. The iron should be handled as quickly as possible, while in a welding state. The hammer should be heavy for shingling purposes, as in the blows alone rendered by the hammer depends the compactness and the welding of the iron; also the removing of any unavoidable foreign substance that may be located in among the iron. No weld should exist or be recommended in the construction of a new frame back. The frame limbs and braces should be forged at the hammer. When the different forgings have been completed at the hammer and the forging in question turned over to the blacksmith for final construction, too much skill cannot be displayed by the workman in welding the different parts together. The fires should be clean, it being most important that every condition necessary for welding should be in the highest state of perfection. This requires that the iron should be at the right welding heat to obtain the required results. A great deal depends, however, in the preparing for the weld. The frame back should be V-shaped at an angle of 45° or 50°, the limb should be split; the angle should be well open in order to secure the union at the apex of the angle, and provision be made for the necessary amount of stock required to make the weld. The welding should be executed under the steam hammer. In all railway shops of importance, repairing locomotive frames is a frequent occurrence, and to obtain the necessary results, skill and good judgment is required on the part of those supervising the work. Some foremen may be of the opinion that when part of a frame is broken it should be cut out and replaced by a new piece. That this method is economical and good practice is unquestioned, when the frame is not up to the standard dimension, as the case may call for, on account of having been repaired or welded previous, or some other defect. But when the frame is of full size. it is quite possible to replace it at an advantage with less expense and quite satisfactory. Very frequently we have a frame broken through the back, the frame being otherwise in good condition; it is quite practical to cut out of the frame a V-shaped section at the point of fracture, making provision for the amount of material it will require for welding. The parts should be firmly clamped together in view of holding them in the proper position. Weld in a piece that has been prepared for that purpose, the frame then turned over and the same operation of welding repeated, and, no doubt, if the proper care is exercised, the repairing of a fracture of this kind will meet with good results. In cases where frames are badly bent or kinked, it requires skill to straighten them in good shape. To do this, it is advisable to cut the brace, then the frame can be straightened to an advantage, and in rewelding the brace, care must be taken in keeping the frame straight.

Report on Furnaces and Fuel.

The soft coal sand bottom furnace has been discussed at a previous meeting, and also the coke furnace, most commonly used in railway shops. The usual forging furnaces are only used in large shops, and then mostly for axles, shingling or heavy forging. Small shops, as a rule, do not have hammer power enough to operate them economically, as it costs from $19 to $22 per day to operate such a furnace, and small shops cannot keep it going. Hence, to be economical, the coke furnace comes into more general use. This furnace may be improved in having an outer wall with 3 ins. space for the circulation of air with a few holes 3 or 4 ins. on the side to make it more comfortable to work at. Water jackets and other methods are used to serve this purpose, but the double wall is preferable. As this era of machine forging is advancing, we all meet the problem, how are we to keep the machine busy? Here is really where the output is gaged. The different locations in which we are placed has somewhat settled what fuel we will use in the great gas belt, in a coal region or oil region. For small furnaces, such as bolt forging or bending on car work, oil is the best fuel both as to economy and efficiency. Some use compressed air to atomize the oil; some only use fan blast of about 6 to 7 ounces per sq. in.; others use steam as an atomizer. The efficiency of oil furnaces is very much improved when the blast pipe is brought in contact with the flame after it has done its work in the furnace. By this means the blast may be heated quite hot, and in that order the oil may be conducted along the steam pipe of the steam hammer. By this method the oil also is heated and becomes very fluid. Various methods are also used for conducting the oil to the furnace. Some use a pressure of air to force the oil to the furnace; if this be done the pressure should not exceed the blast pressure, as the opening of the needle valve is so small when high pressure is used, it is liable to get clogged up. Gravity is in common use, the oil being pumped into a stand-pipe, it being always kept overflowing; 10 or 12 ft. high will generally be head enough. Oil is also a very suitable fuel for spring work. In a spring furnace some prefer to put the burner in the side, others on the end, but in either case there should be a space of about 6 or 8 ins. from the nozzle of the burner to a bevel brick bridge placed so that the oil and blast will strike. This will spray the oil, and then the course of the flame should not be obstructed by square corners, as it will be easily understood that striking squarely into a brick wall will stop its heating capacity. The flame should have a rolling motion, going to every nook inside the furnace and heating it evenly throughout. If the burner be placed on the end the same bevel bridge of brick is used and throws the oil to the roof of the furnace where it strikes a reverse bevel brick, throwing the flame down to the bottom of the furnace, thence along to the small stack 4½ ins. square, 24 ins. high, located about 8 ins. from the opening. A furnace of this class on spring work will run 20 to 24 hours on 50 gallons of oil, and can be kept at the proper heat very easily. Another very good spring furnace is used on spring work on the same principle as the sand bottom soft coal furnace, where soft coal is the fuel wished for. For flue work oil has also been in use in some places, but a small brick fire with feeders for the fuel at both sides is better. The mandril on which the flue is welded enters the furnace so that we do not require to lift the flue out of the fire but only push it through. By this method we have a sleeve or thimble to fit the various lengths and upset against this and the die of the machine, then raising the upper die allows the flue and sleeve to pass to the proper position to be welded. In some places they mix hard coal with coke, but hard anthracite coal is best for this purpose. A certain rolling mill is using gas made from an inferior coal, and this works very well. They have a producer built about 20 or 30 ft. from the furnace into which they put this poor class of coal. They force the fire by steam, driving the gas from this retort or producer to the furnace, which is a large one, having four doors. They run 60 blooms to a heat and 7 heats per day, making some 25 tons of finished iron. They get the fuel for the cost of freight and by this method they can make good iron from fuel that could not be otherwise used.

Mr. Judy: I have seen the oil furnaces working as fine as possible. They say they are doing double the work, and are working the oil with compressed air. I have seen them work their bolt machines in Cleveland, where the oil is carried to the furnace by gravity; also at Altoona. As to the coal furnace, it is nothing more than a reverberatory furnace and works well; but there is more loss of time with coal than with oil. The beauty of the oil furnace is that they can start the furnace and in 20 minutes get a hot furnace; whereas coal furnaces have to be kept going all night. Gas works well after you get the furnace hot, but it takes too much time to get the furnace hot.

Mr. Boyle (C., B. & Q.): We have been using oil in our furnaces for the last six years; furnaces for heating bolts, and also for bending iron and all shapes for car work. We consider them to be much cheaper than either coal or coke. We have an oil furnace which costs from $15 to $20, with which we can turn out four to five thousand ¾-in. bolts in ten hours, at a cost of about two cts. per hundred for fuel. For bending arch bars and all other kinds of car work, we use a furnace that was originally built for soft coal, Indiana block, that used to cost us in the neighborhood of $8 or $10 a day. With the oil we can bend five to six hundred archbars for about $2 cost of fuel. Our oil burners are of our own construction, and cost very little more than the cast iron, with the exception of the patternmaker's time to make the pattern, which will do for all the furnaces. The furnace which we use for bolt making is constructed with four legs, about 25 ins. high, the proper height for a man to stand at, with a common frog plate, 22 × 54 ins., placed on top of the four legs for a foundation body. We have two burners, one in each end of the furnace. The furnace is built on this frog plate. The front of the furnace has one brick standing on end about 9 ins. high. The end of the furnace where the burners come in has one brick laid flatwise, 4 ins. The back of the furnace has one brick laid endwise, and then these bricks are crossed and recrossed up to about 22 or 23 ins., with a top of brick laid edgewise, and compressed with a band of iron 3 × ¾ in. It is a very cheap furnace and does not cost much to operate.

Report on Machine Forging.

It used to be the rule to forge a piece of work at the hammer and then take it to the blacksmith, who would trim and finish it, allowing about ⅛-in. for the machine to take off. For work that has to be finished in a machine shop, this is an expensive way of doing work, for the very part that the smith took so much pains to make smooth and nice is cut off by the machinist, and the smith's nice work is thrown in the bins as scrap from the lathe and planes cuttings. All this should, and must be done away with if we expect to keep pace with the times and keep our shops up to the standard.

As to locomotive and car forgings, money can be saved by the use of machine tools such as steam hammers, and with plenty of suitable dies much of the work can be completed at the hammer without any blacksmith's labor. Such work will include main rods, parallel rods, T-ends for frame brace, pedestal caps, cross-head guides, cross-head guide yokes, frame clamp and pads, cross frame braces, back and front frame braces, solid links, crow feet, many boiler brace ends, link hangers, valve ends, etc. The majority of these must not go to a blacksmith, except when a weld has to be made. Large sized bolt machines can be used for much light locomotive forgings. Hydraulic forge machines and drop hammers are used in many shops, doing a great amount of work at very low cost.

In car forgings, bulldosers, large bolt forging machines, together with steam and power hammer are indispensable in producing good, cheap work. In fact, we do not know where the work with dies will stop in a car or locomotive shop, for every day develops something new.

At Thursday morning's session the first business was the report of the Committee on "Tool Steel, Tool Making and Dressing." The report was chiefly a discussion of the proper method of tempering steel for tools. Concerning quality of steel it says:

We are now getting as good steel as we ever did, but it is called upon to do from 25 to 40% more work in ten hours than it did formerly. The new machines are now built larger and stronger, and run with increased speed, from which fact the tool must cut off more metal.

Mr. Uren presented a supplemental report, in which he favored one uniformly good quality of steel for all purposes. He said:

We use an enormous quantity of steel; we carry in stock from 40 to 50 tons. We are 2,500 miles away from any steel manufacturer, and it is impossible for us to get special steel for each special job; but if it is a good quality of steel it will answer for almost any purpose. There are cases where we know ahead what we are going to use steel for, such as special sizes of taps, dies and reamers, and we use special steel for those purposes. A good quality of steel should always be used, and it will, in my opinion, answer for almost any purpose. If you use good steel in your tools when they are worn out they will go into something else. We always work our cold steel into something else.

Mr. Uren's ideas were combated by Mr. Burgess, who said:

I would just as soon expect to get one grade of steel to answer all purposes as I would to get one blacksmith that was equally good at spring-making, tool-dressing, and, to carry the thing further, as a frame maker. We have not only one, but quite a number of steel makers in this country that can turn out as good a quality of steel as anywhere on the globe. The American manufacturers have reached a point, where if you will tell them the use for which the steel is intended, they will send you a steel which will do the work satisfactorily.

After an extended discussion on the report on "Tool Steel," in which many differences of opinion were shown, the report of the Committee on "Flue Welding," by Mr. H. G. Finn (West Shore Ry.) was then read, as follows:

On our road we have been butt flue-welding for the past year (since June, 1895). We have about 100 engines on the road with butt-welded flues, and have not had one give out or leak. It is my opinion that it is the best way to weld them. We cut the safe ends 6½ ins. long off No. 10 flues, and our flues are No. 12, cut square off. We put the safe end on the mandril, with the collar about 3 ins. from the end, and they are put in a small furnace. We use hard coke. We butt them together, and when they get hot enough to stick, give the mandril one sharp blow with a 4-lb. hammer. Then it is ready to weld. When the heat comes up give the mandril three good blows with the hammer and it is welded. Then take it out of the fire and swedge it to size. In this way you will make a perfect weld every time, and the flue is full thickness at the weld. In this way we can weld 250 flues in ten hours.

Some discussion followed the report, two of the members believing that butt welding was not as good as scarf welding. We quote the remarks of two members:

Mr. Judy: It has been proven that a butt weld with a tensile strain is all right, but when it comes to vibration it is a question whether it will stand. I believe the butt weld will be a failure, but hope not.

Mr. McLelland: In Colorado, during the past year, we have welded 26,000 flues, which cost us, from the time they were taken out of the boiler until they were put back, an average of 10 cts. each. I went to the shops at Horton, Kansas, last Friday. The flues had been prepared for welding. They were scarfed and put together. The furnace was there, and machine alongside of it. At 8:24 a. m. the man who was welding laid a welded flue on the floor, and at 9:24 there were 110 more welded flues lying alongside of it. The cost of welding flues this month in Horton will be 6.02 cts. I am not certain that it is what would be called first-class welding, but it answers the purpose. There is no doubt that you can weld 100 flues in an hour and not overwork yourself. The fire can be cleaned out in about 20 minutes, and is ready for another 100.

On Thursday afternoon the report of the committee on "The Best Method of Handling and Disciplining a Shop," H. A. Folk (Pennsylvania R. R.), chairman, was read. He said:

In the first place, you do not want too many rules; secondly, do not make any rules that you cannot consistently carry out or that might place you at a disadvantage under some circumstances. Always remember that men have hearts and feelings, that they are just as sensitive to unkind remarks as you are; hence, it is very necessary that when any of your men are taken to task for neglect of duty, that you keep your temper. There is nothing cuts so deeply into the human heart as when a man is corrected for a fault in a kind yet firm manner, unless the man is so hardened that he cannot realize his offense, in which case you have no room in your shop for him. Do not argue any question of discipline with your men; do not become too familiar with your men; make them all your friends, but do not joke with them; many are too apt to presume on your friendship and you also invite too much familiarity. The employee should be made to feel his responsibility; that he is part and parcel of the shop and to a certain extent responsible for its success. Foremen should grade their men and pay them according to grade. If a difference is made and it is properly understood it will be an inducement to the inferior workman to try to improve. In our shop all the work is done on the contract or piecework system. We have an inspector who approves or disapproves of the work and accepts only such as is manufactured properly. The balance is thrown back on the workman's hands and is his loss. As a consequence there is very little iron spoiled, as men do not care to work without compensation. A firm, able, judicious administration will be felt by all of your subordinates, and a foreman who embodies these three principles is a good executive officer.

The next report was that of the committee on "Case Hardening," John Buckley (Illinois Central Ry.), chairman. The report is as follows:

We place the work to be case hardened in a cast or wrought iron box, putting about 2 ins. of granulated raw bone in the bottom of the box, and placing the pieces to be hardened about 2 ins. apart, filling in the vacancies between the pieces until you have covered them with 2 ins. of bone. Then place in the box another layer of work to be hardened, and continue in this manner until the box is full, being careful to have the work on the top of the box covered with not less than 2 ins. of bone; then place a cover on the box, and lute with yellow mud or fire clay. Then put the box in a furnace or open fire (furnace preferred) and subject the box to a strong heat from 8 to 16 hours according to the size of the box, and the bulk of iron to be hardened. Then remove the pieces one by one, clean them with a broom, and chill in clear cold water, and then there will be a uniform coat of steel on the entire surface from 1-16 to ⅛-in., as may be required according to the time it is left in the fire; the longer it is left in the fire the deeper will be the coating of steel.

To case harden large pieces of iron, such as guides and crank pins, it is not necessary to harden the ends of the guides nor the wheel seat end of crank pins. When hardening guides, we cover the ends with a small piece of sheet iron, ⅛-in. thick, then fill the ends of the box with sand. The sheet iron will absorb the liquid substance produced by the bone. When the guides have been chilled the ends will be soft. To harden crank pins we place two pins in a box, the wheel seat end of the pins to the end of the box, cover the wheel seat collar of pin with yellow mud, and fill the ends of box with sand, the center with bone. If the pins are large it will require 18 to 20 hours to give them a good coat of steel. After the pins have been chilled we frequently find them sprung and the surface fractured from the effects of being chilled in cold water. We have had good results from pins that after being removed from the box were cooled off in cold blast; the surface in this case will not be hard, but will have a fine coat of soft steel. By this treatment you will not lose any pins, which is frequently the case when they are chilled in cold water Thos. Sheehan, of Erie, Pa., patented a process for case hardening in 1870. We used it for many years and found it a good process when properly prepared. The ingredients are: Salt, sal. soda, charcoal, black oxide of manganese, black rosin and limestone. We have also used Houghton's hydrocarbonated bone black, and found it a first-class article.

The meeting passed a resolution of thanks to the officers, superintendents, superintendents of motive power, master mechanics and master car builders of the various railroads for their assistance in bringing the master blacksmiths together; to the Master Car Builder and Master Mechanics' Associations for their complimentary action with reference to the Association, and to all others who had assisted in making the meeting a success.

The following officers were elected for the ensuing year: President, R. A. Mould, of the Erie R. R.; Secretary and Treasurer, Geo. F. Hinkens, of the St. Paul & Duluth R.R. Chicago was selected for the next place of meeting, and the meeting then adjourned until the first Tuesday in September, 1897.

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COMPRESSED AIR FOR POWER is being employed by E. D. Smith & Co., who are driving a two-mile tunnel for the Metropolitan Water-Works, of Boston, Mass. The tunnel is 11½ × 13½ ft., with four shafts and a portal. No. 1 shaft is 40 ft. deep; No. 2 shaft, 118 ft.; No. 3 shaft, 111 ft.; No. 4 shaft, 58 ft. deep. The entire work (including drilling, pumping and hoisting,) is being done by compressed air. The air is furnished from a plant placed betwen the portal and shaft No. 4. Air is carried about half the distance through an 8-in. pipe, then reduced to 6 ins., and afterwards to 4 ins. The air is furnished by two duplex Corliss engine air compressors, with steam and air cylinders 20 × 36 ins., built by the Rand Drill Co., which also furnished 24 slugger drills for the work. The plant has been fitted with a view to doing rapid and economical work on the tunnel. E. D. Smith & Co. have also made good progress on the work at Niagara Falls, where they are sinking a wheel pit 280 ft. long, 185 ft. deep, 20 ft. wide, for the Niagara Falls Power Co., the drilling, channelling and pumping for which are done with compressed air furnished by a Rand duplex Corliss engine air compressor, with cylinders 20 × 30 ins.

◆

ELECTRIC TRACTION is to supersede cable traction on the Wylie Ave. line of the Consolidated Traction Co. at Pittsburg, Pa. The cable was stopped at midnight on Aug. 26, and then withdrawn from the conduit. The engines and driving plant will be taken out. The conduit and track construction will be torn up, new tracks laid and the street repaved. All this work will be done by Booth & Flynn, the contractors.

◆

THE AMMONIA MOTOR CAR of the Standard Fireless Engine Co. was given a trial recently on the tracks of the East Louisiana Ry. Co., at New Orleans, La. The company desires to have its motor put in service on one of the street railways of the city.

◆

THE STREET RAILWAYS OF THE UNITED STATES, says the last edition of Poor's "Manuel," aggregate 15,956 miles in length, as compared with 13,176 miles last year; in five years the gain in mileage has been 6,294 miles. These lines possess an equipment, so far as the unsatisfactory statistical returns will show, of 28,154 passenger cars, 20,777 motor cars, 206 dummies and 28,621 horses. Since 1891 the number of horses in street railway service has declined 162,000, or about 80%. Out of the above mileage lines aggregating 531 miles failed to make complete returns of capitalization, etc. The 15,425.42 miles reporting show a capitalization of $828,547,285 in stock, and $525,949,928 in bonds; an average of $87,809 per mile in stock and bonds as compared with an average of $60,188 per mile for steam railways.

◆

A GASOLINE STREET CAR has been built at the shops of the Anacostia Ry. Co., Anacostia, D. C., being fitted with a motor invented by Mr. T. C. Pole, of Washington, D. C. The car has two sets of gearing, one for a speed of six miles and the other for twelve miles per hour. The gas engine is of 25 HP. and drives two heavy flywheels, the engine and flywheels running constantly at a uniform speed independent of the speed of the car. The car weighs about six tons and seats 25 persons.

THE CHIGNECTO SHIP RAILWAY ENTERPRISE is being revived in an attempt to have the Dominion subsidy renewed as a preliminary to raising more funds. This subsidy amounts to $170,602 annually for 20 years; but as the terms imposed upon the company were not complied with, it has been withdrawn by the Dominion Parliament. About $3,000,000 has already been expended upon the ship railway.

◆

THE FIRST RAILWAY IN COREA to connect the port of Chemulpo with the capital town of Seoul, 25 miles distant, is to be built by an American, Mr. James R. Morse. Mr. Morse was one of the first foreigners to enter Corea when it was opened to foreign trade in 1882 and holds other concessions, for mining, electric lighting, etc. The route of the railway has been surveyed by Mr. J. H. Dye, also an American, and the estimated cost of the road is $1,500,000 in gold. Seoul is only 100 ft. above sea level and the chief engineering work upon the line is a bridge, 1,600 ft. long, across the Han River. Under the terms of the concession the work must be commenced before March 29, 1897, and it must be finished within two years thereafter. The concession is for 15 years after opening, and it can then be purchased by the Corean government, or the concession extended for further periods of ten years. A French company has obtained a similar concession for a railway from Seoul north to Wi Ju, on the Chinese frentier.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was caused by the collapse of a wooden bridge span in a trestle carrying the Arcata & Mad River R. R., over Mad River, near Eureka, Cal., Sept. 13. The train was running at very slow speed, as was the custom in crossing the trestle. It was an accommodation train, consisting of an engine, box car and two day cars, all of which went down. Of 20 persons on the train, 4 were killed and 12 injured, some being fatally injured. It is said that the bridge had one pier in the river.

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AN OIL TANK CAR exploded at Wellington, Ill., Sept. 10, setting fire to adjacent cars; 25 cars and a grain elevator were burned.

◆

A POWDER EXPLOSION occurred Sept. 11 at the mills of the Ohio Powder Co., near Youngstown, O., causing the death of two men.

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THE SHAFT OF THE STEAMER "City of Worcester" broke Sept. 10 while the vessel was on its way down Long Island Sound. from New London to New York, and the steamer had to be towed into port.

◆

A SMALL WATER TANK BURST at Washington Heights, one of the sections annexed to Chicago a few years ago. The tank formed a part of the water system owned by the former town of Washington Heights. It had a capacity of 60,000 gallons, was elevated, and apparently was of wood, as press reports state that "several iron bands burst."

◆

A SURVEY OF TWO RESERVOIR SITES, one in Wyoming and the other in Colorado, was provided for by the last Congress. The examination of these sites has been placed in charge of Capt. Hiram Chittenden, U. S. Engineer, St. Louis, Mo. Capt. Chittenden was to confer on this subject, on Sept. 10, with Mr. Elwood Mead, M. Am. Soc. C. E., State Engineer of Wyoming. The purpose of the proposed reservoirs would be to store flood waters and thus relieve the lower Mississippi from the danger of floods in times of high water and improve its navigation at low water.

◆

A SUIT TO RECOVER DAMAGES for death alleged to have been caused by decomposing garbage has been instituted against the city of New Albany, Ind., by the widow of the deceased. Damages to the amount of $20,000 are claimed for the death of the man and the subsequent illness of the plaintiff and her three children. A few days before the filing of this suit another one was filed by a different person to recover $5,000 damages for depreciation of property. The garbage in question is reported to have been dumped on a vacant lot.

◆

THE BARKER DRIVE-WELL SYSTEM, recently patented by Delbert L. Barker, says the Providence "Journal," is intended to develop water from pipe-wells driven into fine sand. The plan includes the sinking of an open pipe, larger at the bottom and armed with teeth, by using a jet of water under pressure. When a water-bearing sand-stratum is reached, the sinking is stopped, but the hydraulic washing goes on until a cavity is formed at the foot of the pipe. Into this cavity gravel or other coarse filtering material is introduced; and as the jet action can be continued to enlarge the opening by washing the fine sand up the pipe, an artificial filter-bed of considerable size can gradually be formed. It is claimed that more water can thus be obtained than by the ordinary driven well.

A BASCULE BRIDGE has been decided upon by the Board of Aldermen of Brooklyn and the Queens County Board of Supervisors as the type of structure to span Newtown Creek, at Vernon Ave., Brooklyn, N. Y. Various plans for bascule, lift and swing bridges had been submitted in answer to the advertisements in the columns of Engineering News, but no particular plan was adopted.

◆

THE EXTENSIVE FREIGHT TERMINALS of the Illinois Central R. R. at New Orleans, La., are nearly completed. The terminals occupy a space of 14 blocks at the head of Louisiana Ave., and are built largely on ground made by filling in. The plant includes a wharf 1,600 ft. long and 100 ft. wide, six miles of tracks, cotton storage sheds of 100,000 bales capacity, freight sheds, and a grain elevator of 1,000,000 bushels capacity. The elevator is 83½ × 300 ft., and 165 ft. high, supported on 3,000 piles 45 ft. long, carrying brick piers on which rests the main framing of the building. It has two parallel tracks with steam unloaders, handling 250 to 300 cars per day, one track having seven and the other four unloading legs, from which the grain is delivered to the 180 bins. Mr. L. L. Dagron is the Resident Engineer for the railway company, and James Stewart & Co. are the contractors for the elevator.

◆

A RUSSIAN-AMERICAN MINING AND METALLURGICAL Company, says the Philadelphia "Record," has been organized in Russia by Mr. Edmund D. Smith, vice-president of the Russian-American Manufacturing Company. This new company is to be conducted largely with American capital and entirely under American management. It is called the Nicopal-Mariopal Mining and Metallurgical Company, with a paid-up capital of $2,275,000, gold, and proposes to secure control of valuable manganese mines at Nicopal, in South Russia. These mines are now under American management, and the ore is to be taken to Mariopal, on the Sea of Azov, where a large steel plant will be erected under the charge of H. S. Loud, formerly of the Illinois Steel Company. The company has already secured the contract for supplying 144 miles of oil-pipe, amounting to about 10,000 tons, in the Caucasus; and to make the delivery in time the company has purchased the entire pipe-plant of Morris, Tasker & Co., with the exception of engines and boilers. This plant is now being shipped to Russia and the pipe is all to be delivered next year. The Russian-American locomotive works, at Nijni Novgorod, is to be opened as a department of the Sormovo Iron & Steel Works, at that place. The plant to be used has been designed by Walter F. Dixon, of Paterson, N. J., and Julian Kennedy, of Pittsburgh, Pa.

◆

TRADE WITH COSTA RICA is to be fostered by the establishment of a consulate in Philadelphia, and Mr. Gustavo Niederlein, Consul for Costa Rica, 233 South Fourth St., Philadelphia, Pa., notifies us that he will be glad to receive two sets of catalogues from manufacturers, together with particulars of terms of credit and discount, freight, etc. He will also be pleased to answer inquiries as to the character of goods desired, etc. Some notes on the Costa Rica Ry. will be found in our issue of July 9.

◆

A TWIN-SCREW ELECTRIC LAUNCH has been built at Nyack for John Jacob Astor. The boat is built of mahogany, and is 70 ft. long by 8½ ft. beam, and is 4 ft. draft. Two electric motors of 25 HP. each are fed by a battery of 480 cells. She was designed by Mr. Mosher.

◆

THE PIG-IRON INDUSTRY, says the "Iron Age," is adjusting itself to the late change in conditions, and since May 1 there has been a decline in production from 189,400 tons per week to 130,500 tons on Sept. 1. On Jan. 1, 1896, 241 furnaces were making 207,481 gross tons per week; and on Nov. 1, 1895, the maximum was reached with 217,306 tons per week. On Sept. 1, 1896, only 145 furnaces were in blast.

◆

THE TRANSMUTATION OF SILVER INTO GOLD by a chemical or metallurgical process is claimed to have been accomplished by Dr. Stephen H. Emmens, the inventor of the explosive, "Emmensite." The "Engineering and Mining Journal" of Sept. 5 contains a letter from Dr. Emmens, in which he reiterates his claim, but gives no details as to his methods. The "Journal" thereupon says, editorially: "So far as our knowledge goes there is nothing yet known that gives any firm ground for a belief in the transmutation of the elements; in fact, the tendency of scientific investigation seems to lead to the opposite conclusion. Neither is there anything in Dr. Emmens's statements that would convince any careful investigator that he has succeeded in converting silver into gold."

◆

THE NATIONAL ASSOCIATION OF STATIONARY Engineers is meeting in Cleveland, O., this week, with over 400 members in attendance. The association has over 10,000 members. Its objects are the scientific education of engineers and promoting the enactment of engineers' license laws in order to prevent destruction of life and property in the generation and transmission of steam. It has nothing to do with the subjects of wages, strikes, etc.

HINGED CONCRETE BRIDGE ACROSS THE DANUBE.*

(With inset.)

This bridge, which was designed and built under the supervision of Mr. Max Leibbrand, engineer, connects the village of Inzigkofen with its railway station on the opposite side of the Danube River. The traffic being very small, the appropriation had been put at the lowest possible limit, and it was necessary to observe the greatest economy in deciding upon the kind of structure and the materials to be used and in designing the structure. The condition of the river and river bed was not suitable for the use of intermediate piers, but the presence of solid rock on the right bank of the river and a hard gravel on the left favored the adoption of an arch.

As there were no stone quarries in the vicinity, while a factory producing most excellent cement was located within a short distance, it was decided to build the arch of concrete. Comparative estimates showed this to be a cheaper construction than either a Monier arch, or one of iron alone, or of cement blocks. An important feature of the design is the placing of open cast-iron links or joints at the crown and at the abutments. The arch hinged in this manner is statically determinate, and may be rationally and economically computed; moreover, any danger through settlement, after the falsework has been removed, is eliminated, as are also any secondary strains due to changes in temperature or to variations in the vertical loading, to which the arch can freely accommodate itself.

VIEW OF HINGED CONCRETE ARCH OVER THE DANUBE RIVER NEAR INZIGKOFEN, GERMANY.

The following dimensions were adopted: Span, 43 meters (about 141 ft.) and a rise of 4.38 meters (about 14 ft. 4 ins.). There is one roadway, 2.5 meters (8 ft. 3 ins.) wide, and two sidewalks, each 0.65 meters (2 ft. 1½ ins.), aggregating 3.8 meters (12 ft. 6 ins.) as the width between railings. The width of the arch proper is 3.6 meters (11 ft. 9½ ins.) at the crown and increases to 4.6 meters (15 ft. 1 in.) at the abutments, thus affording an increased resistance to all lateral pressures, such as wind, high water and ice. The arch ring is 0.7 m. at the crown, 1.1 m. at the joint of rupture, and 0.78 m. at the abutments. The roadway is carried on 36 small posts standing upon the extrados of the arch, except in the middle portion where it is carried directly on the arch. As shown in the section each three of these pillars forms a bent, the two outer ones being curved at the bottom on account of the greater width of the arch ring; longitudinally the pillars are joined by arches. On top of the abutment are rollers to provide for expansion and contraction of the roadway structure. At the crown joint the wrought-iron handrail is connected to a cast-iron post in which it is free to move, and at this point the roadway is supported on trough plates.

Without entering into the details of calculation, it is of interest to note that the usual method of establishing the line of pressure by loading one-half of the arch ring was not followed in this case, but the arch was divided into sections, and the effect of concentrated loads at these sections was determined. Indeed, the hinged construction demands this method of calculation, as the problem is a determinate one, and the arch cannot be regarded as one elastic mass.

Construction was started in July, 1895, with blasting and excavation for the abutments, and the bridge was opened to traffic in November of the same year. All concrete used was mixed by hand, and the various proportions adopted for different parts of the bridge are indicated in the illustrations on our inset sheet. The bents of the lightly constructed falsework were carried on four piles each; resting on the cap-pieces of these piles were sand boxes and wedges, as shown. The planking under the arch projected sufficiently beyond the face to allow the sideboarding to be braced against it. The abutment links were supported on saddles bolted to the arch ring of the falsework. These saddles served the purpose of resisting the thrust of the arch before it had been closed and filled in at the abutments. The abutment plates were each provided with four lugs and bolts in order to hold them in position during the concreting. Before the falsework was removed the lugs were knocked off and the bolts drawn out, leaving the hinge free to turn on its axis. The crown hinge was supported on timbers directly over the arch planking.

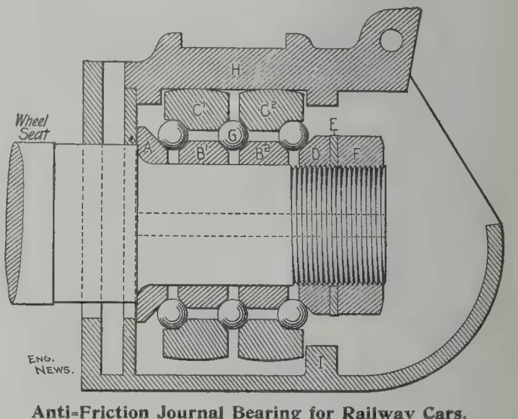
It is of the greatest importance that the axis of each set of links should be in true alinement, and perpendicular to the arch, as otherwise it would not be possible for the links to turn simultaneously, and secondary strains would arise, rendering the hinge construction useless. Behind the abutment links a space of 25 cm. (about 10 ins.) was left open to admit of the hinge following the settlement of the falsework; this space was not filled in until the arch was closed. The joints in the planking on the face of the arch were caulked with gypsum, and the interior surface covered with brown paper. The model of the arch ring, formed in gypsum, was then screwed on, and the whole coated with shellac. The planking below the arching was left rough, except for a space of 20 cm. next to the face, this strip being treated similarly to the front. Before concreting was commenced the falsework was loaded at the crown with the links and a number of sandbags, aggregating 40,000 kg. (about 88,200 lbs.). On Aug. 29 the concreting of the arch was started at the abutment links. The material was placed in sections boarded off perpendicular to the line of pressure, and from 1 to 1.3 m. long, and tamped in horizontal layers. The arch thus consists in reality of a number of concrete blocks of that length which, however, through the speedy progress of the work were most completely united. The concreting was advanced from both sides towards the joint of rupture; here a space of 1.2 m. was left open and work continued beyond this space towards the crown, the loading placed on the falsework being gradually removed. The open spaces at the abutments, and at the crown, were then closed, and finally those at the joints of rupture while concreting the spaces at the abutments. The end plates were supported on set screws, the strength of which was sufficient to withstand the slight thrust of the uncompleted arch, but not that of the arch when unsupported by the falsework. In this manner it was insured that the joints distributed the pressure over the whole surface, and not merely at the points of support.

The abutment piers were built next, and finally the pillars and arches supporting the roadway. On all visible parts of the bridge a layer of colored cement and sand from 10 to 15 cm. thick was put in simultaneously with the concrete and closely united to it.

Immediately after the roadway was completed and five weeks after closing the arch the falsework was removed. The settlements at the crown and at the abutments were closely observed from time to time by means of the apparatus shown in the illustration. The total settlement at the crown amounted to 32 mm., about 1¼ in., estimated at a temperature of 20°C. This was up to Feb. 10, 1896, the bridge in the meantime having been subjected to a test load. The roadway plates were covered with asphalted felt, ¼-in. thick, upon which was a layer of sand 4 ins. thick, then gravel, 3 ins. thick, which was finally covered with a thin layer of sand. The roadway is drained in the center and the water carried down the first row of pillars from the abutment. The total amount of concrete in the bridge is 634 cu. m., or about 830 cu. yds. The amount of cast iron in the hinges is about 33,000 lbs., and the whole work was executed at the estimated amount of 22,310 M., about $5,310.

ANTI-FRICTION JOURNAL BEARING FOR RAILWAY CARS.

Among the various mechanical improvements in the design of railway rolling stock which the ever present inventor is suggesting for use, "improved" journal bearings are perhaps as seldom seen as any. Nevertheless, such devices are occasionally brought to our notice, and in the accompanying cut one of the latest ideas in this direction is illustrated. This bearing, according to the inventor's statement, is to be given a trial by a prominent western railway, and is also of interest as exemplifying the persistent attempt to extend the ball bearing to new uses, with which engineers have become familiar during the past two years. It may be noted that the trail of the bicycle can be seen in the design, the inventor having been engaged in the manufacture of wheels and having developed his journal from suggestions obtained in that work.



Anti-Friction Journal Bearing for Railway Cars.

The device illustrated consists of a hardened steel collar A keyed securely to axle; collars B¹ and B² movable longitudinally on axle, but made to rotate with axle by means of a feather or key, and collars C¹ and C², which are confined loosely within the oil box and separated from B¹ and B² by a series of rows of balls. The collar D is screwed on to the axle, and forms one of the bearing surfaces, and is the adjusting nut by which all looseness or play may be taken up. This collar is locked in position by means of a washer E, containing a feather, which prevents it from turning on the axle, and F a lock nut. A cotter will be

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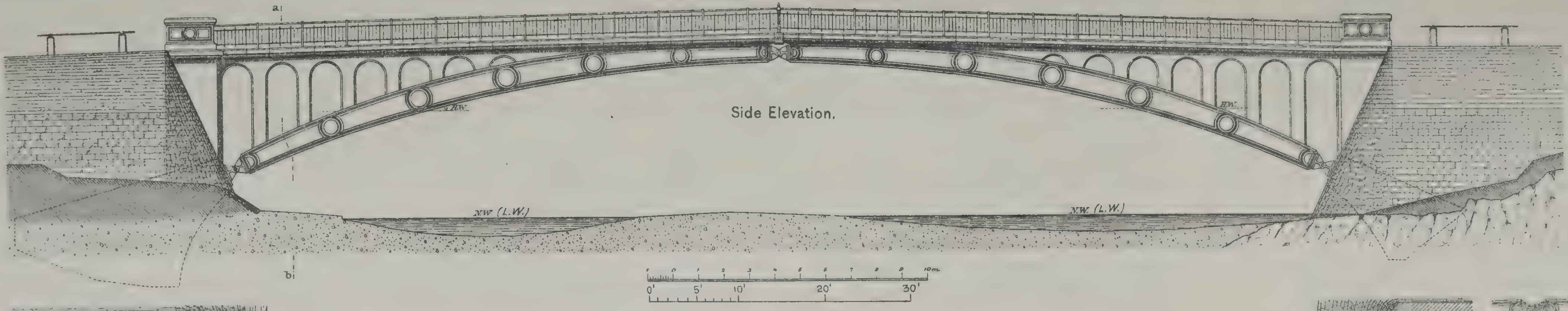
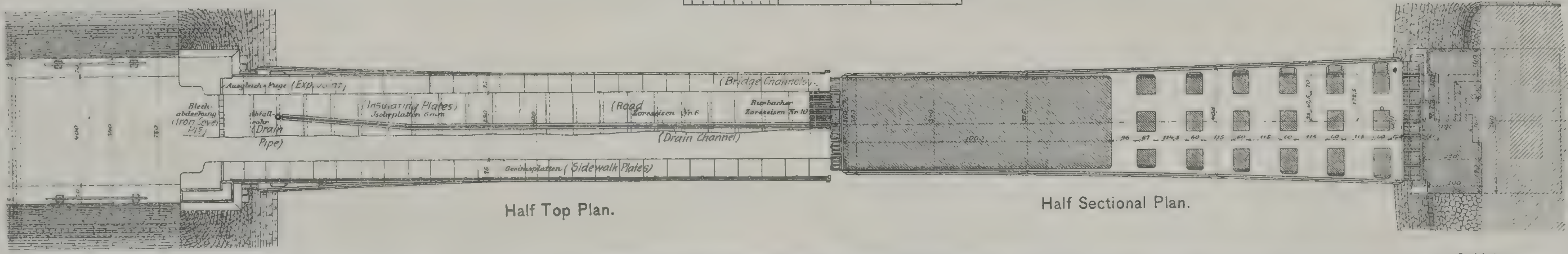
*Abstracted from "Zeitschrift fuer Bauwesen," by O. J. Marstrand.

Supplement to Engineering News, September 17, 1896.

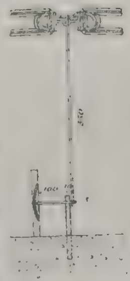


Side Elevation.

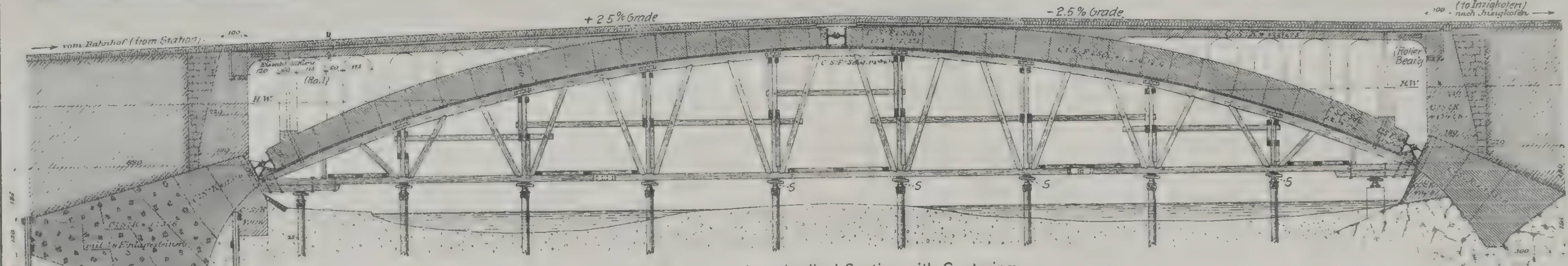

Ausgleich-Fuge (Exp. Joint)
(Bridge Channels)
Blech-abdeckung (Iron Cover Pl's)
Abfall-rohr (Drain Pipe)
(Insulating Plates) Isolirplatten 6mm
(Road
Zoreseisen Nr. 6
Burbacher Zoreseisen Nr. 10
(Drain Channel)
Gesimsplatten (Sidewalk Plates)

Half Top Plan.

Half Sectional Plan.

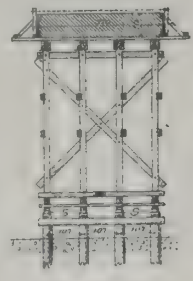


Settlement Indicator.

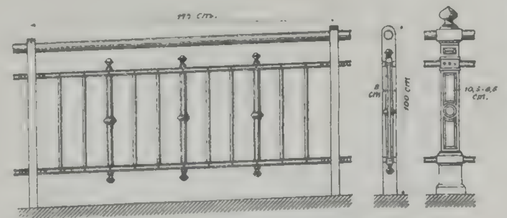


Longitudinal Section with Centering.

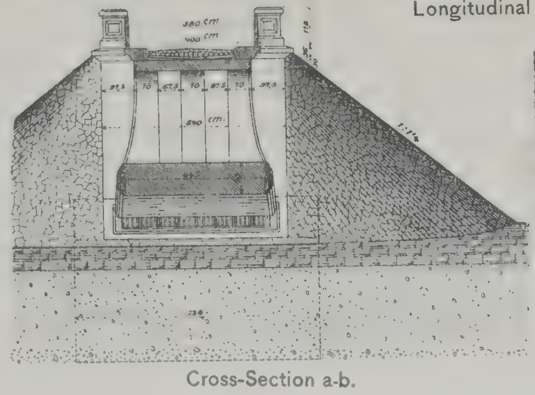
C Cement. S Sand.
F Feinkies bis 2,5cm ⌀ (Fine Gravel less than 2.5cm. Diam.
(Gravel) K: Kies. Sch: Schlegelschotter. (Broken Stone).



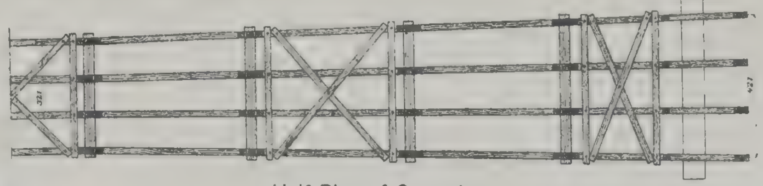
Cross-Section of Centering.



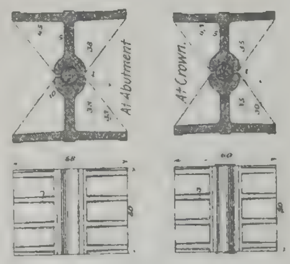
Details of Wrought Iron Railing.



Cross-Section a-b.



Half Plan of Centering.



Details of Hinges.

HINGED CONCRETE BRIDGE OVER THE DANUBE RIVER, GERMANY.

Max Leibbrand, Engineer.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

used to prevent this nut from coming clear off the axle in case it should accidentally work loose. The oil box is made in two pieces, which are held in position by the jaws of the pedestal. and may be readily removed by jacking up the car body ½-in. The box is tight, and, it is stated, wastes no oil, as there is barely enough used to allow the balls to pass through it at the lowest point in their revolution around the axle. Hardened steel balls of 1 in. diameter are used. The collars are also made of a high carbon steel, carefully tempered, and their bearing surfaces are turned at an angle of 45 to the axis of the axle. This is done to eliminate all sliding friction between balls and collars, as it brings the axis of the balls parallel to that of the axle around which they rotate. The inventor, Mr. W. M. Shumway, of Chicago, Ill., states that the cost of this bearing is but little more than that of the ordinary journal bearing.

NOTES OF A TRANSCONTINENTAL TRIP.

(Editorial Correspondence.)

II.

Union Pacific Ry.

This line deserves celebrity for its position as one of the two great railways chartered by Congress to extend the railway system of the country to the Pacific coast, the other line being the Central Pacific Ry. In 1862 the U. S. government passed an act granting to these railways subsidies of bonds and lands to aid in the construction of a railway and telegraph line from the Missouri River to the Pacific Ocean, and it is much to be regretted that in both cases the debt thus incurred has resulted in clouding the history of the railways by financial embarrassments and by continual contests between the companies and the government. The Union Pacific Ry. was given 12,800 acres of public land per mile of road, and a subsidy in government bonds at the rate of $16,000, $32,000 and $48,000 per mile, the total amount being $27,226, 512 for 1,033 miles. The time fixed for the completion of the road was July 1, 1876, but as a result of the vigorous prosecution of the work the line was opened on May 10, 1869, simultaneously with the completion of the Central Pacific Ry. The original main line extends from Omaha, Neb., through Cheyenne, Wyo., to Ogden, Utah, 1,034 miles, but numerous branches, feeders and additional lines were built until the entire system aggregated a very considerable mileage. Of late years, however, owing to the financial troubles, many of these lines have been turned over to other companies, the latest line thus lost being that of the Oregon Railway & Navigation Co., the main line of which forms a northwest connection from the Union Pacific Ry. to Portland, Ore. This has lately been put under the control of a reorganized company. In 1893 the system operated had an aggregate length of 8,564 miles (including 982 miles of water lines), while the present operated mileage is4,442 miles. Westof Ogden may be seen the partly completed grade of the line built by the Union Pacific Ry. before Ogden had been decided upon as the junction point with the Central Pacific Ry., and when each company was straining every nerve to build as much mileage as possible in order to increase its subsidy.

The line has a good track, its standard rail being a 70-lb. rail which closely resembles the Am. Soc. C. E. section of that weight, but having top corners of ⅜-in. instead of 5-16-in. radius. The rails are laid with square, suspended joints, spliced with 40-in. bars and six bolts, but Mr. Geo. H. Pegram, M. Am. Soc. C. E., the Chief Engineer, is not in favor of such long bars. Burnetised ties of mountain pine and hemlock were at one time extensively used, the company having a plant of its own at Laramie, Wyo. The treated ties, however, lasted only about two or three years longer than untreated ties (8 years for the former as against 6 years for the latter), while they cost 14 cts. more, in addition to which there was the cost of transporting the ties to the treating plant and then back to the distributing point. It has, therefore, been concluded that it is cheaper and more economical to use untreated ties, but protected by metal tie-plates, and these plates (of the Servis and Goldie type) are now very extensively used.

A new spring rail frog has been designed by Mr. Pegram for use on this road, the special object in view in the design being to provide ample strength and security without unduly increasing the weight, as an increase in weight not only increases the cost but is also very likely to interfere with the easy working of the movable parts. The frog possesses many good features and costs from $3 to $12 less than those submitted by manufacturers. This frog will be illustrated in a later issue. Rigid frogs have but a short life on this road, averaging only one year, while in some cases they are cut out in two months by the pounding of heavy freight trains,and the pounding of the wheels of heavy cars in express trains of 12 to 16 cars, running at 60 miles an hour. These trains are hauled by powerful engines of the eight-wheel and ten-wheel types, and a notable feature of the locomotive equipment on this road is the use of the diamond stack and short smokebox instead of the cylindrical stack and extension smokebox which have been almost universally adopted within the past few years. This is referred to more fully below, and further detailed particulars will be published separately in a later issue. A number of bridges have been recently renewed with heavier structures, and in many cases the work of erection has been carried out with exceptional rapidity. The company is now rebuilding the bridges across the Weiser River, 400 ft. long, and across the Payette River, 270 ft. long, and a bridge of 172 ft. span across the Bear River on the Oregon Short Line. These are new steel bridges on stone piers taking the place of old wooden bridges on pile piers.

In regard to the express trains on this railway, above mentioned, it may be noted that our foreign friends, while admitting that good track and high speeds do exist on some of our main eastern lines, are very apt to assume that our western railways have tracks largely composed of mere streaks of rust and that the speeds are about equal to those of a wagon train or a prairie schooner. It would probably surprise them very considerably to find trains on the UnionPacific Ry. (as on many other main western roads) with 12 to 16 cars, many of these being heavy sleeping cars, running easily and steadily hour after hour over an excellent track at a speed of 50 to 60 miles per hour. Yet this is a daily regular experience.

Locomotive Smokestacks and Smokeboxes.

On the railways of the eastern states the straight smokestack and extension smokebox are now almost universally adopted, and the diamond smokestack and short smokebox are practically obsolete and looked upon as representative of an antiquated practice, while the old balloon stack for wood-burning engines is almost forgotten,although both these latter forms of stack are in use to some extent on old engines and branch lines. It is therefore somewhat surprising to find on reaching the Union Pacific Ry. that the diamond stack and the short smokebox are the standard types and are found preferable to the straight stack and extension smokebox. The reason for this is partly in the character of the coal used and partly in the arrangement of the exhaust nozzles. The fuel is a light friable lignite, very apt to throw sparks, to check which a deflector and netting in the enlarged top of the stack is found much more effective than a netting in the smokebox, while the low nozzle used with the former gives better results than the high nozzle used with the latter. The form of smokestack has a wide and somewhat shallow top very different from the ordinary deep, enlarged top of the old diamond stacks. Lest it may be supposed that the Union Pacific Ry. uses old and antiquated engines with the old style of front end construction, it may be said here, that the road has a very fine equipment of modern engines, which have a fine appearance and do splendid work, as will appear from some further details which will be published separately from these notes. It might, perhaps, be thought that this particular detail of practice is due to local ideas and prejudices, rather than to actual conditions, but both forms of stacks and smokeboxes have been tried, with results as above noted. A few weeks later I found exactly the same conditions existing on the Western Division of the Canadian Pacific Ry., and sought an explanation from Mr. Cross, the Master Mechanic of this division, who is located at the Winnipeg shops. It seems that this road obtains lignite from Lethbridge, a semi-anthracite (really a bituminous) coal from Canmore, and anthracite from Anthracite, all these places being in the province of Alberta, on the eastern slope of the Rocky Mountains. The bituminous coal is used west of Canmore, and on the Western and Pacific divisions, and there the engines have straight stacks and extension smokeboxes.

The lignite is used east of Canmore, from Gleichen to Winnipeg. Most of the engines burning the Lethbridge coal, or lignite, have diamond stacks, though it is also burned on some engines having straight stacks. The engines with diamond stacks have stacks of the old style, with a deep enlarged top. These engines with diamond stacks have a low exhaust nozzle, set below the tubes, and any sparks are driven against the deflector cone in the stack (not against the netting) again and again and are churned up with the steam, until dead, while any live sparks which may finally escape through the netting are nearly dead and are not blown far away, so that even in dry weather there is little danger of their setting fire to grass, etc., beyond the plowed fireguard along the right of way. With a straight stack and netting in the smokebox extension a high nozzle is required, and being above the tubes and netting it creates a suction tending to draw the sparks through the netting, and any sparks which do get through are then blown high out of the stack like rockets. Reference has been made above to the balloon stacks of wood-burning engines, and the sight of a heavy express train on the Southern Pacific Ry. drawn by two powerful ten-wheel engines having huge balloon stacks and tenders piled high with wood, is particularly striking to eyes accustomed mainly to the engines of eastern railways. In another issue I expect to give further particulars, with illustrations, of western practice in regard to smokestacks and smokeboxes.

Omaha to Denver.

After a few hours spent in and around Omaha, I continued my journey westward, leaving at 3.30 p. m. (July 3), on the Pacific Express, which leaves Chicago (Chicago & Northwestern Ry.) at 10:30 p. m., for San Francisco, by way of Omaha, Neb.; Denver, Colo., and Ogden, Utah. This was a very heavy train, but hauled by one eight-wheel engine. In crossing Nebraska one notices the rich-looking country and the great number of trees planted in groups and rows on the roads and farms, these trees (mainly poplars) being evidently intended as wind breaks and snow protections. At Julesburg the train leaves the main line of the Union Pacific Ry. and turns south over the Union Pacific, Denver & Gulf Ry. to Denver, which city was reached at 8:10 a. m., July 4.

On this latter line, in the vicinity of La Salle, are shifting sands, extending for great distances, the sand gradually covering and killing all vegetation and trees. It also encroaches on the railway, and portable fences, like snow fences, are used to protect the line, especially in cuts, but these seem to be of only very temporary use, being soon surrounded and buried. The sand must be worse than snow, for it is continually giving trouble, while snow only occurs during a few months of the year. A mixture of snowdrift and sand-drift in a railway cut would be a very awkward thing to handle.

Mr. T. F. Dunaway, General Superintendent of the Union Pacific, Denver & Gulf Ry., states that they are troubled with sand drifting for a distance of about eleven miles, between mile posts 119 and 130, on the Julesburg line. This sand comes from a formation lying to the north of the line. High north winds blow the grass from exposed parts and drift the sand towards the track. It being a cattle range, the tramping of cattle to and from the river, for water, prevents vegetation from growing and keeps the sand stirred up so as to be easily moved by the wind. To prevent its covering the track, it is treated much in the same way as snow, by building snow fences to catch the sand. It is necessary to change the fences (which are 6 ft. high) once a year.

All along this part of the route, and from here on at intervals all the way to San Francisco and up to Portland, one sees the jack rabbits and the prairie dogs or gophers in abundance, and they furnish endless amusement, besides recalling to mind the pictures in the old railway guides. The gophers are pretty little furry animals, not unlike yellow squirrels, and in some places the entire landscape is dotted with the mounds of sand which mark the mouths of their burrows. They usually scurry away when the train approaches.but occasionally one will sit up on the far edge of the ditch or on one of the mounds,and watch the train attentively or chatter excitedly at it. These little fellows are amusing enough, but the jack rabbits are still more so, and it must be a particularly sour or grim passenger who is not moved to exhausting laughter by their performances. The rabbits are not unlike large hares, sandy-brown and white in color, but with abnormally large and sensitive ears (hence the name jackass or "jack" rabbit). One of these fellows will sit immovable near the fence while the train approaches, and just as it is opposite him he will throw up his ears in alarm, and go off through the sage brush like the wind, with a nervous hopping and leaping action that will send a car load of sedate passengers into hysterical and breathless laughter. One begins almost to believe in Mark Twain's statement about a jack rabbit he saw from a train and which ran so fast that "long after he was out of sight we could hear him whiz."

Denver, Colo.

The general appearance of this city is very attractive, as it has fine buildings, wide streets which are well paved and well cleaned, and an abundance of parks and trees, all of which show to advantage in the bright clear atmosphere. It is situated at an elevation of 5,195 ft. above the sea level and has a population of about 150,000. The city has a remarkably clean and neat appearance, and there is a general air of substantialness and prosperity, although at the present time business is universally said to be dull. The best stores certainly excel those of New York in their general appearance and style, and in the artistic display of goods. The residence district has numerous large and handsome houses, and a specially noticeable feature is the beautiful condition of the lawns, due to an almost continual use of lawn sprinklers and a frequent use of lawn mowers. Among the handsome public buildings are the city hall, the Arapahoe County court house and the new capitol. The latter stands on the summit of a hill and is a very fine structure, built entirely of Colorado products and manufactures. It is not yet quite completed. Some of the public school buildings are quite imposing structures, and in one of them is the city free library. The union station is a handsome stone building, at the side of the tracks, but has no train shed and no covered platforms between the tracks. In fact, this condition is found so frequently at new station buildings (as at Denver, Pueblo and Ogden) that one is led to wonder whether the architects purposely omit these shelters for fear of spoiling the view of the buildings. This station was completed in 1894.

There is a very complete system of street railways, extending far out into the suburban districts, and most of the lines are operated by electricity, some of which have replaced cable lines, the conduit system remaining undisturbed. Combination cars, partly open and partly closed, are extensively used on the cable lines, and the grip cars of these lines have track brakes.

In walking through the residence streets one wonders at the beehive-shaped structure of brick plastered with cement which stands near the front fence of every front yard or garden. Ideas of a new system of individual garbage cremation begin to occur, until on inquiry it is learned that these are the receptacles for ashes, the ashes being thrown in at the open top and periodically shoveled out by an ash collector through what looks like a furnace door at the bottom. The position of Garbage Commissioner is held by a woman, Mrs. Mary Pickerell, who is said to be a very smart woman and a very alert garbage commissioner. Denver has other public offices held by women, including that of City Treasurer, and, as far as could be learned, the results of this have been highly satisfactory, the women being good managers, well informed as to their duties and are not apt to dabble in municipal "rings" or to go into politics to the neglect of their municipal duties. Women and bicycles go together a good deal in these days, and so it may be appropriate to note here the very extended use of the bicycle by women and men in this city. They ride to and from business; they go shopping and calling, and they go from place to place about the city in ordinary daily pursuits, where in New York they would either walk or take a car. This very general use of the bicycle is due largely to the finely paved streets, many of which have asphalt paving.

The organization of the municipal engineering department is somewhat peculiar. There is a city engineer, but he is in charge only of grades and street line surveys. There is, however, more work in this than might be supposed, as the city covers a considerable area, only a part of which has as yet had the street lines and grades officially laid out. Nevertheless the office may be abolished in two or three years, as by that time all work will have been done and all information recorded, unless the city again extends its limits by taking in more of the suburban districts. At present there are two field parties at work, each consisting of four men, with a light wagon to carry tools, monuments, stakes, etc. The sewer and paving work are under the supervision of the Board of Public Works, which has its own engineer.

Among business firms there was a general complaint of hard times and lack of orders. This was partly due, no doubt, to the present general and widespread depression of trade, accentuated by the period of depression to which this country is subjected every four years in consequence of the uncertainty arising from the presidential campaign. These adverse conditions are made even worse, by the mistaken (though sincere) advocacy of the free silver policy which is now causing so much trouble. Of course, people living in a silver state, where a boom in silver would mean a certain activity in mining, may be expected to be prejudiced in favor of this particular metal, but this is a very narrow way of looking at the financial question, and it must be said that the arguments heard for "free silver" were neither convincing nor based on good or broad grounds. Considering that the silver production amounts to only about 4% of the total mineral products of the country (ranking with lime and building stone) it is not easy to see why this mineral should be given more attention and assistance than the other 96% in value of mineral products.

Colorado Fuel & Iron Co.—This company has its general offices at Denver, and its steel works, rail mills, etc., at Pueblo, 120 miles south, while it also operates extensive mines of anthracite and bituminous coal. The pipe mill makes cast-iron pipe of 4 and 6 ins. diameter, but in view of the growth of water-works, increasing demand for water-works supplies, and the high cost of freight, it would seem to be a good time to put in a plant for the manufacture of larger sizes of mains. The rail mill has turned out large quantities of rails for western railways, the present average demand being for rails of 70 and 75 lbs. per yd. They are said to be higher in phosphorus than is usually allowed, but to have proved to be good wearing rails, which is owing partly to the comparatively slow methods of manufacture. Some of the older rails for the Denver & Rio Grande R. R. had 0.13% phosphorus, although not more than 0.09% is now allowed. The company's Bessemer steel works were closed down about the middle of August, throwing some 400 men out of employment, and the following statement was issued by the president, Mr. J. D. Osgood, in regard to this action:

> All rail orders are filled, and the present unsettled business and financial condition of the country prevents the railways from buying rails for renewals, and all new enterprises are held in abeyance. All the other departments of the company's works at Bessemer are in operation, and will be continued so long as we can find a market for the products. Whenever new rail orders can be secured work will be renewed at the iron mines and blast furnaces. This action was taken without consultation with or suggestion from the directors or stockholders.

The American Water-Works Association is to hold its next convention at Denver, in 1897, and will certainly have very much of interest to examine in the extensive water supply system of that city, as will be seen by some notes made during a partial inspection of the works in company with Mr. Charles A. Allen, Chief Engineer of the Denver Union Water Co. These notes are too lengthy to be inserted here, but will be given separately in a later issue. In about two years the city will be supplied entirely by a gravity system, except for two high-service pumping systems on high summits. The system includes many miles of wooden stave pipe (with cement lined tunnels at summits), a large storage reservoir or lake, a sand filtration plant, etc., while the company also owns and operates ranches purchased with their water rights. There is a Venturi meter on the pipe line, with automatic recording apparatus, and among the proposed works is a large masonry dam in a mountain canyon to form an extensive reservoir.

Colorado Springs and Manitou.

At 7 p. m. on July 7, I left Denver by the Denver & Rio Grande R. R. for Colorado Springs, taking the New Mexico express (narrow gage), which runs through to Santa Fe, N. M. About ten miles from Denver is Fort Logan, a large U. S. military post which is just now a special center of attraction from the fact that Custer's cavalry is now stationed there. For some 30 miles the line runs along the plain, close to the slopes of the mountains, and then begins to ascend the Divide, reaching a summit at Palmer Lake, 7,237 ft. above the sea, and then descending to Colorado Springs, 75 miles from Denver, which was reached at 9.51 p. m.

This city is a most delightful place for rest and recreation, being 5,995 ft. above sea level, and having a wonderfully clear, invigorating and bracing atmosphere. The population is about 17,000. The streets are 100 ft. wide, and the avenues 160 ft. wide, and, with the exception of the few main business blocks, are almost all lined with good-sized trees, while Nevada Ave., the main street, has two rows on each side and two in the middle. Rushing and splashing streams of cold mountain water run through the irrigation ditches on each side of the street, there being usually a turfed strip between the sidewalk and the ditch. These ditches are mainly lined with plank, and have laterals extending to the gardens of the houses, plank gates being provided so that the water may be shut out of the laterals except for the length of time during which the owner is authorized to take water. Where new lawns have been made, the water is sometimes allowed to flood the entire lawn, to a depth of 1 or 2 ins., in order to thoroughly soak the underlying earth. Besides this system of garden irrigation, however, there is an almost universal and continuous use of lawn sprinklers, with the result that the houses stand amid beautiful velvety lawns and have their grounds rich with flowers and plants. In marked contrast to this richness are the occasional unoccupied and unimproved lots, on which the grass is a pale yellow and grey, burnt and scorched from the heat of the sun and the lack of water. This, on a small scale, is illustrative of the great changes which have been gradually wrought by irrigation, transforming what was practically a desert into a fertile and productive land. The great heat of a summer day is not oppressive, owing to the dryness of the atmosphere, but nevertheless on such a day the sight of the profusion of green and foliage and the sound of the rushing irrigation streams are most refreshing. The roads are well macadamized and kept in good condition for driving. The business blocks are substantial and of good appearance, and here, as at Denver, one is struck by the handsome appearance of the stores and the artistic way in which the goods are displayed. The water supply is obtained from mountain lakes on the slopes of Pike's Peak, and extensive works (including a long pipe line and a tunnel 6,000 ft. long, driven by electric drills) are now in progress for supplying water for domestic and power purposes, but as the present system and the new works were described and illustrated fully in Engineering News of Aug. 27, no further mention thereof need be made here. The work is under the supervision of Mr. H. I. Reid, City Engineer. The city is close under the mountains, the most conspicuous peak, from certain points of view, being the celebrated Pike's Peak.

The city is rather inaptly named, since it has no springs, the springs being at Manitou, five miles distant. This is on a branch line of the Denver & Rio Grande R. R., but there is also an electric line, which, with its frequent service of cars takes the bulk of the traffic. The Colorado Midland Ry. has both Colorado Springs and Manitou on its main line. The early train on the Manitou branch is an accommodation train, and has the engine placed between the passenger cars and the freight cars. At the intermediate stations it pushes the freight cars onto a sidetrack, leaves those for the station, and then after backing out goes on up the main track to couple up to the other cars which are to be taken on, these cars having been switched onto the main track in front of the train. From the cars may be seen a portion of the "Garden of the Gods," with the curious isolated blocks, columns and masses of bright red rock, which are styled statues, pillars, cathedrals, etc.

Manitou, with a population of 1,800, is a pleasure and health resort situated on the slope of the mountains, 6,324 ft. above sea level, and is a very pretty place, populated mainly by tourists and invalids. Numerous springs of mineral water (soda and iron of various compositions) occur here, and at the largest there are pavilions where persons can sit and listen to the bands or stroll around and purchase photographs and various mementos of their visit. The most attractive spring to persons in good health (who taste nauseous waters merely in order to say they have tasted them) is the great Manitou soda spring, where soda water far superior to any of the manufactured varieties, bubbles up in a large basin or shallow well, and is distributed in glasses by the genius of the spring, in the form of a small boy clothed in everyday costume with the addition of a pair of high rubber boots. On the street may be seen men, women and children carrying bottles to be filled at the overflows from the springs. A large proportion of these bottles were made to contain various alcoholic liquids, and are not elsewhere carried openly in the streets. At Manitou, however, these suspicious-looking bottles are carried about in broad daylight with no attempt at concealment, the owners being conscious of the innocence of the contents, and therefore heedless of appearances. It was cynically suggested, however, that possibly the whiskey had been emptied into a jug and that the appropriate soda water was being carried home to impart medicinal properties to the mixture.

Pike's Peak Rack Railway.

At the upper end of the main street of Manitou and at the terminus of the electric railway, is the station of the Manitou & Pike's Peak Ry., the celebrated rack-rail line, which has been fully described and illustrated in Engineering News. It was built in 1889-1890. This line attains an elevation of 7,518 ft. in a length of about nine miles (47,992 ft.), having an average grade of 16% and maximum grades of 25%, and the summit being 14,147 ft. above sea level. The sharpest curves are of 16° (or 359 ft. radius). The scenery is most grand and picturesque, especially as seen from some of the long grades benched out of the side of the mountain, while the views from the summit are beyond descripton. It is, however, not such a thrilling ride in some respects as that up the old Mount Washington Ry., for the latter, though by far the shorter and reaching only to 6,293 ft. above sea level, has heavier grades and a number of long high trestles, while it is built among grim-looking grey and black rocks. The Pike's Peak line has no trestles and only four short plate girder bridges, and the rocks and scenery are of a more cheerful color and character than those of the White Mountains. As is well known, the Pike's Peak Ry. has the Abt rack-rail system, with double rack bars (the teeth of which are lapped or staggered lengthwise of the track), while the Mount Washington Ry. has the old ladder rack of the Marsh system, which is erroneously known in Europe as the Riggenbach system. The teeth of the rack-bars show very little wear beyond a slight burr on the top of the up-grade face, indicating the flow of metal under pressure.

The running track is laid with 40-lb. rails, having square three-tie joints spliced with 38-in. angle bars and six bolts, but owing to the creeping of the rails some of the joints are now suspended. There are 18 pine ties to a rail length, and a row of planks is laid on the ties on each side of the rack-rail, the planks being double spiked to each tie. The ballast is of disintegrated rock, shouldered out beyond the ends of the ties. The track requires constant attention, and there are two section gangs, one of eight men and one of five men. The track gages are marked for the position of the rack-rail. There is not now much trouble from the creeping of the track, the banks having become consolidated and the anchorages having come to a heading. Near the Halfway House were seen the works for the Colorado Springs water supply plant, above referred to, and a view taken at this point was shown in Engineering News of Aug. 27. At the summit is a stone building containing a refreshment room and a room full of souvenirs, but there is no hotel accommodation. A few small patches of snow were seen in crevices of the rocks at the summit. An example of great carelessness was noted near one of the water tanks, where ashes had been dumped and shoveled outside the rail in a pile so high and so near the track that the big end of the main connecting rod on that side struck full into the heap of ashes. None of the men seemed to take any notice of this, however. Each train consists of one long four-wheel car, seating 50 passengers, and a Baldwin four-cylinder compound locomotive, having cylinders 9×22 and 15×22 ins., four main carrying wheels 25¾ ins. diameter and two double pinions, 22½ ins. diameter, for the rack. The engine has a two-wheel truck under the cab. Its weight is 45,850 lbs., with 33,200 lbs. on the driving wheels. The cars have rack pinions for braking purposes. The engine pushes the car up the mountain, and is not coupled to it, the contact between the engine and car consisting of a vertical roller on the front of the engine bumper beam bearing against a horizontal roller on the rear of the car platform. The speed is low, the up trip occupying 1 hour 50 minutes and the down trip 1 hour 30 minutes, with five intermediate stops on each trip. An interesting device seen at the Halfway House was the "toboggan" or "go-devil" on which a man occasionally descends the line, sliding on the rail and having a wedge brake gripping the rack-rail. I have seen such a device used on the Mount Washington Ry., the descent being made at terrific speed.

(To be continued.)

THE PECOS VALLEY IRRIGATION SYSTEM.

By L. B. Howell, M. E.

The valley of the Pecos River in southeastern New Mexico is the site of an irrigation system having at present under its operated canals some 200,000 acres of land. The source of water supply is the Pecos River, across whose bed two dams have been thrown, as shown by Fig. 1, designed for an aggregate storage capacity of 3,900,000,000 cu. ft. The smaller dam, situated six miles above the city of Eddy, was built in 1889-90. A brief description of this dam was given in Engineering News of May 17, 1890. The principal dimensions of the structure were as follows: Length, 1,040 ft.; greatest height above bed-rock, 40 ft.; top of dam, 30 ft. above floor of headgate channel. The dam was rock-filled, having on its up-stream side a rough wall of rock laid with the slope of ½ to 1. Outside of this wall earth was placed to a slope of 2 to 1. This surface was protected by rip-rapping. The slope was afterwards changed to 3 to 1, the original earth facing being washed out. On the down-stream side the limestone filling was allowed to take its natural slope, 1 to 1. Fig. 2 is a general view of the dam and Fig. 3 is a cross-section of it, as rebuilt.

At the eastern end of the dam, at right angles to it, was cut a rock channel, containing, respectively, at its end and side the headgates of the canal and the spillway gates for discharge into the river below the dam. Fig. 4 is a view taken from the dam at a point near its east end, showing secondary headgates, and two spillways. The main headgates are 4 ft. wide by 8 ft. high, sliding in vertical guides and operated by screws from a platform above. The upper spillway, Fig. 5, contains 31 gates, 5 ft. ½ in. in width by 7 ft. 2 ins. in height. These gates, when open, discharged at 13 ft. above floor of headgate channel, and when closed, discharged at 10 ft. below top of original dam. Fig. 6 shows the details of a spillway gate, with its releasing apparatus. Each gate is hinged to swing horizontally and is unlatched by a blow on the vertical releasing rod. When the gates are to be closed, the water is diverted by flash-boards, dropped above the gates. Below the main headgates is a set of secondary gates for diverting the water through the lower spillway, which is 61 ft. wide. At the west end of the dam, a spillway, 200 ft. in width and having no gates, was cut in the rock. It discharged water at 7 ft. below top of dam.

A feature of the construction was the tunnel or scour channel piercing the dam at a point near its eastern end, and at a depth of 9 ft. below the headgate channel floor. A gate was placed at the upper end of this scourway and was operated by a vertical screw 36 ft. in length.

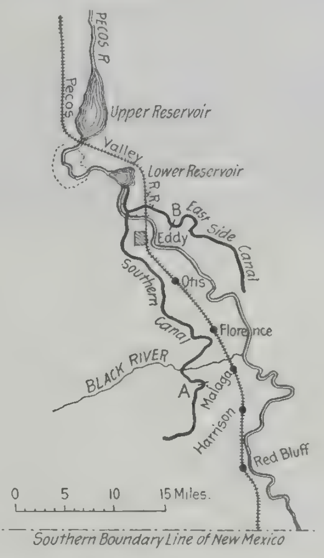


Fig. 1.—Map of Pecos Valley Irrigation System, Eddy, N. M.

It will be seen from the above description of the dam, that its safety depended entirely upon the ability of the spillways to keep the water below its crest. No attempt was made to build a structure able to withstand an overflow. In August, 1893, a heavy flood caused the destruction of the dam, because of the insufficiency of spillway capacity. The water rose steadily, despite the heavy flow through the spillways, and finally poured over the dam, quickly carrying it away. In rebuilding, the height of the dam was increased 5 ft. and its length to 1,135 ft. Its cross-section is shown in Fig. 3. The capacity of the west spillway was increased by cutting it down 3 ft., and widening it to 240 ft. A second rock spillway on the west was added, having a width of 300 ft. Both now discharge at 15 ft. below top of dam, at the same level as the upper spillway at the eastern end of the dam (gates closed). The scourway was found to be of no value and was removed in the rebuilding. The present dam forms a reservoir of 300,000,000 cu. ft. capacity, at the level of the top of the upper spillway gates.

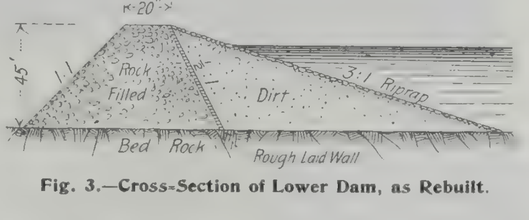


Fig. 3.—Cross-Section of Lower Dam, as Rebuilt.

In 1893 was commenced the second and larger dam. Following the windings of the Pecos, it is situated eleven miles above the lower dam. It is similar in construction to the latter, but of greater length and height, the dimensions being, respectively, 1,835 and 56 ft. As in the present lower dam, the top is 35 ft. above the floor of the headgate channel. Water is diverted into a rock-cut 1,100 ft. long, through headgates, and back into the river bed, which serves as a channel leading to the lower reservoir. The upper end of the rock-cut channel and the headgates are shown by the view, Fig. 7. The headgates are six in number, 4 ft. wide by 8 ft. high. At present water is stored to a depth of only 18 ft. above floor of headgate channel. This level will, however, eventually be raised to 25 ft., or 10 ft. below top of dam. A long earth embankment in continuation of the dam on the west, was built along the shore of the reservoir. At present it contains a spillway 400 ft. wide, which discharges at the 18-ft. storage level, or 17 ft. below top of dam. The capacity at the 25-ft. level will be 3,600,000,000 cu. ft., 8,100 acres to be submerged.

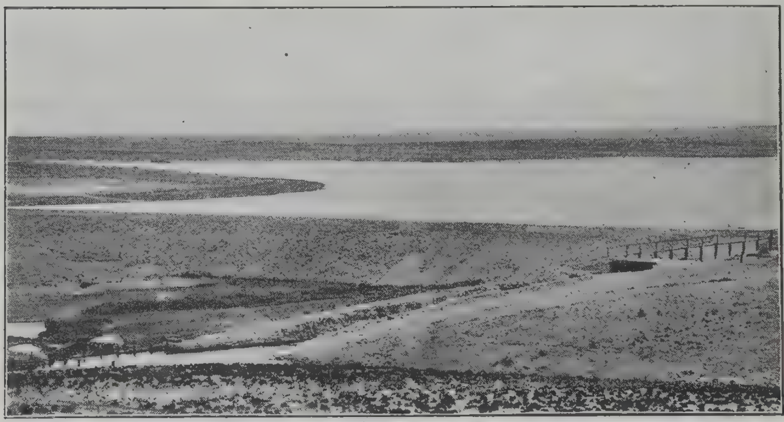


FIG. 2.—VIEW OF LOWER DAM FROM THE SOUTHWEST.

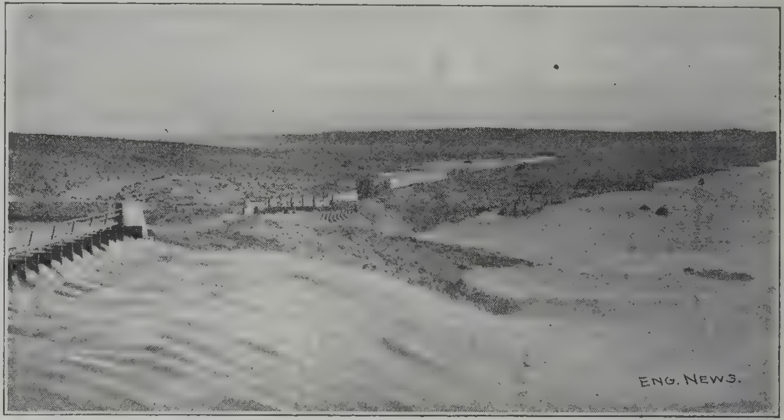


FIG. 4.—VIEW OF SPILLWAYS AND SECONDARY HEADGATES, LOWER DAM.

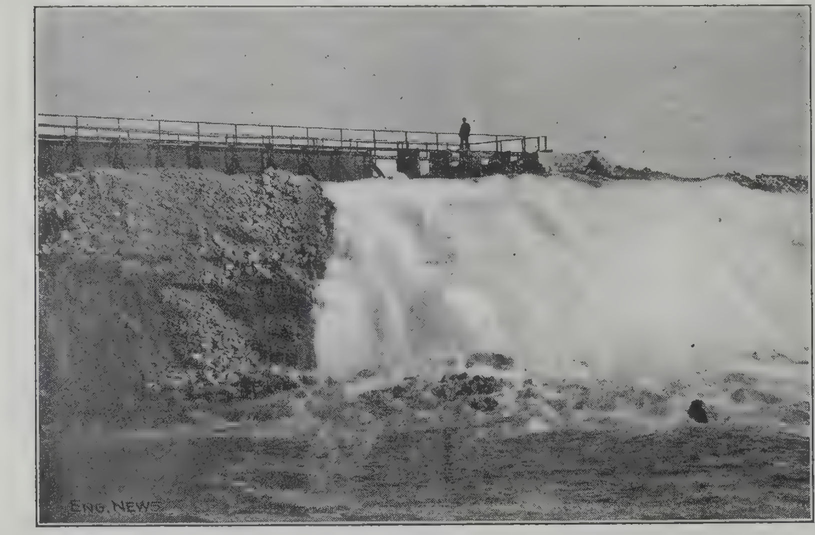


FIG. 5.—VIEW OF UPPER SPILLWAY AT LOWER RESERVOIR.

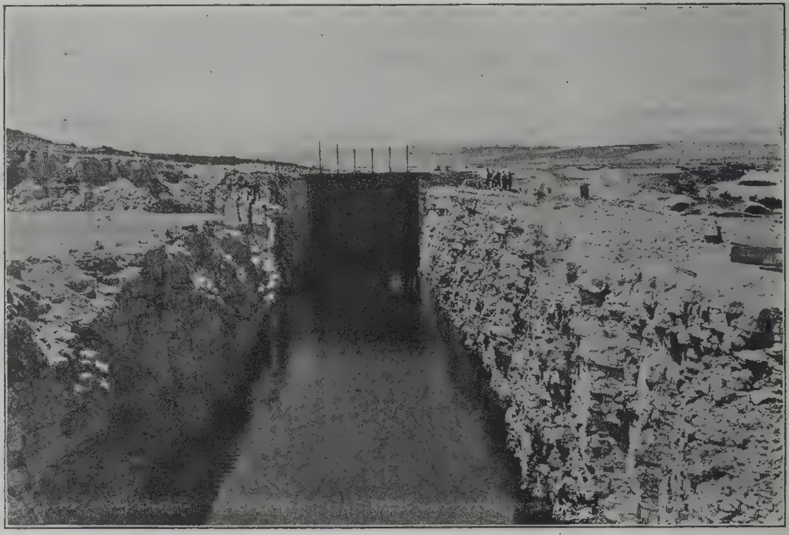


FIG. 7.—ROCK CUT CHANNEL BELOW HEADGATES AT UPPER RESERVOIR.

The lower reservoir has its outlet in a single canal, the first section of which, following the east bank of the Pecos, 3.2 miles, has the following dimensions: Forty-five ft. wide on the bottom, with 7 ft. banks, having a slope of 1½ to 1; capacity, 400 cu. ft. per sec. At the end of the first section, the canal branches, the main portion continuing southward, and a smaller ditch leading in a wide bend to the east of Eddy, as shown on the map accompanying, Fig. 1. The latter is operated at present for a distance of four miles and is completed for 16 miles. Its capacity is 150 cu. ft. per sec. The main branch is in operation as far as the point marked (A) on the map, 31 miles below the lower reservoir, its width on bottom varying section by section from 30 ft. at the point of junction with the "East Side" canal, to 15 ft. at its terminus. The grade of the canal is 1½ ft. to the mile throughout. The Pecos River is crossed on a wooden flume, 468 ft. long by 25 ft. wide. The Black River, 28 miles below the reservoir, is crossed on a similar structure, 1,028 ft. long by 16 ft. wide. Laterals are cut in at frequent intervals and cover the whole area eastward from the canal to the river, a distance which reaches a maximum of about five miles.

Distinct from the system of reservoirs and canals described above, but under the same management, is the "Northern" canal, carrying water to the town of Hagerman and the vicinity. This canal derives its supply from a group of springs situated near Roswell, 90 miles north of Eddy, and forming the source of the Hondo River, a tributary of the Pecos; no storage is attempted. The flow is diverted into the canal by a small dam and continues southward a distance of 38 miles, varying from 120 to 300 cu. ft. per sec. during the rainy season. The grade of the canal is 1 ft. per mile. Nine-Mile Creek is crossed on a wooden flume 330 ft. long by 25 ft. wide. Felix Creek is a dry, rocky bed, except in periods of heavy rainfall, when it becomes a stream of considerable width. An earth embankment 1,000 ft. long and 23 ft. high is thrown up across the river bed. It acts as a dam and as the lower bank of the canal. In each end of the embankment is cut a weir 10 ft. deep through which flood waters escape. The waters of the canal spread out into a small lake at this point, there being no upper bank. The same plan is followed in crossing a dry stream at a point on the southern canal, except that a single weir is cut in the center of the embankment.

When subjected to irrigation, the soil of the Pecos Valley is found to be exceptionally fertile. Fruits, grains, vegetables, all thrive. The land under the canals is controlled by the Pecos Irrigation & Improvement Co., whose headquarters are at Eddy. Water is brought to the boundaries of the farm by the company, all ditches outside being maintained by it. Each section of the canal is in charge of a "ditch-rider," whose duties consist in the maintenance of canal and laterals, the supervision of the supply to the farmers, and, in general, the rendering of assistance and advice to the latter in methods of irrigating. Telephonic connection is maintained between the offices of the company and all parts of the system, including the two reservoirs.

The storage capacity of the two reservoirs is sufficient to supply all the land under the present length of southern canal, as it is gradually placed under cultivation. In all but four months of the year, March, April, May and June, the storage is not now drawn upon, the natural flow of the river being sufficient for the demand during the remainder of the year. An extension of the system will involve the construction of other reservoirs at several points in the Pecos. The first one to be undertaken would probably be situated between the two present reservoirs, as shown on the map by dotted lines. Two other sites have been located, one near Red Bluff, and the second above Riverton, Tex., a canal to be taken out at the latter point.

For the information contained in the above descriptions, the writer is indebted to L. H. Bartlett, Superintendent of Water Service of Pecos Co., Eddy, N. M.

TESTS OF FIREPROOF MATERIAL.

A test of the Roebling fireproof construction system for floors and partitions of buildings was made in New York on Sept. 3, under the supervision of the Department of Buildings. This system has wire netting embedded in cement or concrete, the floors having the netting in the form of an arch between the lower flanges of the floor beams, and sometimes having a flat ceiling composed of a layer of netting attached to the flanges of the beams and covered with cement and plaster. The system was described and illustrated in our issue of July 18, 1895, and May 14, 1896, and is being introduced by the John A. Roebling's Sons Co., 117 Liberty St., New York city, this firm having already applied it in several large buildings.

A small steel skeleton building was erected on a vacant lot at 82d St. and Western Boulevard, having grates for the floor, and having the roof formed of the Roebling arched and flat-ceiling construction, besides which there were two partitions extending from the walls. The fires were lighted at 11:10 a. m., the temperatures inside the structures being recorded by a Uehling & Steinbart pyrometer (Eng. News, Nov. 14, 1895), and ranged as follows:

	Degrees.		Degrees.
11:26 a. m.	1,150	Noon	1,990
11:30 "	1,300	12:01 p. m.	2,000
11:37 "	1,600	12:02 "	2,025
11:42 "	1,800	12:03 "	2,050
11:53 "	1,800	12:04 "	2,100
11:55 "	1,900	12:05½ "	2,125
11:59 "	1,950	12:07 "	2,150

About 12:45 a detachment from the fire department extinguished the fire, using a single hose, the principal damage done being the falling of plaster from the wire, leaving the netting exposed, though the concrete above it still carried the load of bricks piled upon it before the commencement of the tests. One partition, with a single sheet of netting, had collapsed and was nearly stripped of its plaster covering; while the other, with two sheets of netting, though distorted and cracked was still practically a partition. Some of the ceiling plaster fell from the wire during the fire, and some was knocked off by the stream of water from the fire hose.

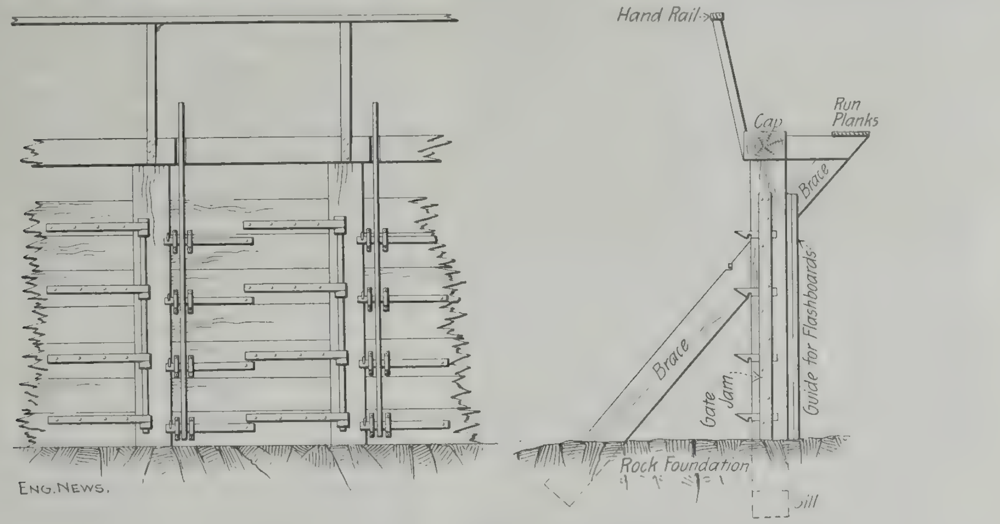


FIG. 6.—DETAILS OF SPILLWAY GATES.

In another brick building, 10 × 11 ft., with half the roof formed on the Roebling system and the other half being 10-in. hollow tiles, all set between 10-in. I-beams, a fire was lighted in the same way, and maintained from about 11:07 a. m. to 12.30 p. m., when it was extinguished by the firemen. On each of these floor arches was a load of bricks of about 9,000 lbs. on a space 4×4 ft., but neither arch showed signs of collapse, though some of the netting of the Roebling arch was exposed by the falling off of the plaster.

After the structure had cooled down the Building Department examined the structure to note deflection of iron work and any other interesting facts connected with the test. It was then ascertained that the iron beams supporting the floors over which was placed the safe load of 150 lbs. per sq. ft., had not deflected, or at least the deflection was so small that it was imperceptible on the readings of the level rod. It was also found that the partitions had buckled through having been placed directly under the iron beams of the floor above and fastened to the brick wall below. There was no chance for expansion and the buckling was a necessary consequence when the heat caused the iron in the partition to expand. Some of the intermediate studs in the partitions were buckled in the form of an S. In one case, where no flat ceiling and air space were used, the wire netting of the arch was practically destroyed, but the iron and concrete of the floor are considered amply strong to carry any safe load, so that in a building there would be no need to rebuild the floors because of the destruction of the netting. In the other building the Roebling floor is said to have shown no deflection, while the flat floor showed a deflection of about ⅝-in. The floors will shortly be tested to destruction by loading.

A similar test was made on Sept. 10 of the system of floor construction manufactured by the Fawcett Ventilated Fireproof Building Co., Ltd., whose main offices are at 448 to 450 Bourse, Philadelphia. This system was illustrated in Engineering News of April 9, 1896 (page 235, Fig. 8). Steel beams are used a uniform distance of 2 ft. apart. Terra cotta lintels of a hollow cross-section are supported on the lower flanges of the beams in such manner that the under side of the lintel is about 2 ins. below the beam. An air space is thereby formed between the lower flange of the beam and the base of the lintel. Above the lintel the space is filled in with concrete.

The test was made in a brick building erected for the purpose, on a lot at the corner of 68th St. and Ave. A. The building was 14 ft. × 11 ft. inside, by 10 ft. high. The roof was formed of the Fawcett floor, 6-in. beams being used, running lengthwise of the building, and the floor being designed to carry safely 150 lbs. per sq. ft. A small chimney was placed at each of the four corners of the roof and a grating was fixed near the bottom, covering the whole inner area. The ceiling was made of common plaster laid directly on the bottom of the lintels, which were grooved with dovetails so as to retain it. Several cords of wood were placed on the grates, some kerosene was sprinkled on it, and the fire was lighted at 9.33 a. m. By 10.30 the pyrometer had reached 1,850° F., and the maximum temperature of 2,200° was recorded at 10.50 a. m. At 11.10 a. m., the wood having partly burned out, the temperature had gone down to 2,000°. The walls of the building had by this time cracked badly from expansion of the brick on the inside. More wood was put in between 11.20 and noon, but the temperature could not be brought higher than 1,850°. When the maximum temperature of 2,200° was reached, the roof, which had been loaded with brick on the two central panels to 150 lbs. per sq. ft. had sagged down about 4 ins., due apparently to expansion of the lower flange of the beams by the great heat. At 12.20 p. m. water was thrown into the building by the Fire Department, the stream of 60 lbs. pressure being directed against the ceiling. When the building had been cooled sufficiently to allow persons to enter it was found that the only damage done was the sagging of the beams, the removal of most of the plaster, and the breakage of the base of several of the lintels. The concrete above the lintels remained in place. On Sept. 11 the test was continued without fire, by adding to the load on the two central panels of the roof up to 600 lbs. per sq. ft. without any further damage being visible. During the fire test the fire did not break through the roof at any point, and the upper surface remained so cool that the hand might be placed upon it.

TELEPHONE WIRES IN WATER-WORKS TUNNELS AND SUBMERGED PIPES.

The importance of prompt means of communication between points on water-works systems separated by water, like intake cribs and pumping stations is obvious. Telephonic communication is maintained at two places of which we know, Chicago and Vancouver, B. C., and doubtless at some others,

The extent of this sort of telephonic communication in Chicago is stated in the following letter from Mr. John Ericson, Assistant City Engineer, written on Sept. 4, 1896:

> The old Chicago Ave. crib, the Four-Mile crib and the 68th St. crib are the only ones so far connected with telephones. The wire to the Chicago Ave. crib is laid in the tunnel and the one to the Four-Mile is also laid in the tunnel. The latter cable was laid part of the way by means of hoisting engines and wire rope, but this being found to be a slow and expensive way, the balance of it was laid by men carrying the cable through the tunnel. This cable has been in good condition since laid in 1892.
>
> The one to the 68th St. crib was laid by means of hoisting engines and wire ropes placed on both the intermediate and the outer cribs. This cable worked satisfactorily for a few months, when it gave out entirely. As it was impracticable to make any repairs to the cable, a new cable was laid on the lake bottom to the crib; this cable is now being used. At Lake View there is no telephone connection as yet, but a cable similar to the one at 68th St. will probably be laid from the pumping station on the bottom of the lake to the crib in the very near future.

The telephone cables at Chicago consist of three wires insulated and wound with hemp, apparently tarred hemp, and then wound with a cover of metal wire of about the size of a telegraph wire.

At Vancouver a telephone was laid in a submerged pipe in a manner which cannot be set forth to better advantage than by the description of the work, kindly sent at our request by Mr. Thos. Tracy, M. Can. Soc. C. E., City Engineer of Vancouver, as follows:

> The pipe through which our telephone cable was laid was of cast iron, 12 ins. in diameter, with flexible joints, and was put together on ways on the north side of Burrard Inlet and pulled over by means of steel cables from capstans on the south shore. In order to lessen the strain on the joints a steel cable, 1¼ ins. in diameter, was placed in the pipe and cinched up tight at each end. When the pipe was in place on removing this cable a No. 16 wire was attached to the end and drawn into the pipe.
>
> When ready to put the telephone cable in, the No. 16 wire was replaced by a No. 6 galvanized wire and by this the cable was drawn into the pipe.
>
> The cable used was a No. 12 copper, insulated, covered with lead and braided on the outside. The strength of it was barely sufficient to stand the strain of pulling in 1,600 ft. in length. For a greater length a stronger cable or a steel armor on it sufficient to stand the pulling strain would be necessary.
>
> If the distance be not too great a line with a number of floats, decreasing in size from the front, attached throughout the length would probably answer. The line could be changed until one was in sufficiently strong to haul the cable.
>
> I would suggest that an additional smaller (loose) wire be drawn in so that in case of a breakage in the hauling wire or cable the whole of the work would not have to be gone over.

At Toronto, Ont., the laying of telephone cables in the submerged pipes across the bay has never been attempted, but telephone service to the island is maintained. Mr. E. H. Keating, M. Am. Soc. C. E., City Engineer of Toronto, describes this service as follows:

> Our telephone service to the caretaker's residence on Toronto Island and the island pumping station is maintained by means of a submerged cable across Toronto harbor. We also have an electric alarm bell at the main pumping station in the city which indicates the limit to which the water is allowed to be drawn down at one of the connecting cribs across the harbor. This service is also operated by means of a submerged cable.

It was once proposed to place a telephone cable in the water intake tunnel at Cleveland, while the intake was in use, but Mr. M. E. Rawson, Chief Assistant Engineer of the Department of Public Works, informed us that the project had not been carried out, but he considered it feasible to do so.

We have been unable to find any other instances of laying telephone wires in submerged pipes or in water-works intake tunnels. Telephone service along pipe lines is maintained in several instances, notably in connection with the water supply of Covington, Ky., and Newark, N. J.

A PHOTOGRAPHIC SURVEYING CAMERA is said to be used with advantage in India, which photographs on the same plate with the picture the magnetic bearing of its central vertical plane. This camera is mounted on a tripod, with leveling screws, and turns on its axis on a horizontal plate with a graduated rim, permitting horizontal angles to be read when desired. On the top of the camera-box is a level and a telescope, with an arm for taking vertical angles. The vertical cross-wire of the telescope bisects the ground-glass screen of the camera. A second vertical wire inside the camera is on the same vertical plane; and the shadow of this second wire is shown upon the plate when developed, making the center-line of the picture. Behind this second wire is a compass, mounted on a rack inside the camera, by which it can be made to just clear the plate when a picture is taken. The graduation of the compass card is carried out on a vertical strip of translucent material through which the light passes to the plate, thus photographing the compass bearing on the plate. A horizontal wire is also photographed on the plate, showing on the picture the true horizon, when the instrument is properly levelled.

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The classic definition of civil engineering in the article on "The Artistic Element in Engineering," in our issue of Sept. 10, was ascribed by the author to Telford, as is usually done, but Prof. Marvin writes us that he has learned that Tredgold was really the author of that definition.

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The tests of fireproof floors which are now being made by the Department of Buildings of New York city, will, it is expected, lead to an important increase of knowledge respecting the safety of the so-called fireproof high buildings. The credit for the inauguration of this series of tests is due to Mr. Howard Constable, M. Am. Soc. C. E. He has for the past year or more been studying the subject of fireproof flooring and the methods of testing, and has induced a number of manufacturers to construct samples of their flooring and turn them over to the Department of Buildings for test, according to methods which he has prescribed. The present building law of New York city prescribes that the spaces between all iron or steel floor beams in fireproof buildings shall be filled with common brick or stone arches, or with "sectional hollow brick or hard burned clay, porous terra cotta, or some equally good and fireproof material." Mr. Constable's object is to construct a terra cotta floor which when loaded with its full allowed or safe load shall withstand an intense fire for several hours, and then a stream from an ordinary fire engine without being destroyed or letting its load fall through. When it has been found that a floor of the ordinary terra cotta construction, of sufficient lightness, reasonable cost and good appearance, can be made to stand such a test, then a standard of endurance under test will have been reached to which all the newly proposed styles of flooring will have to conform before they can be allowed by the Building Department.

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Our present knowledge concerning the strength and fire-resistance qualities of different floor constructions is exceedingly imperfect. Probably less is known by architects and structural engineers regarding the safety of floors than of any other portion of a building. In Mr. Constable's earlier tests of strength of floors he found factors of safety ranging all the way from 1⅝ to 20. The relative cost of the steel beams in a floor, as compared with the terra cotta or other filling has caused some builders to go to an extreme in increasing the spans between beams, thus greatly increasing the risk of destruction by fire, even though there may be ample strength in the absence of fire. It is to be hoped that the tests now in progress will, among other things, lead to the establishment of rules which will fix the maximum spans for floor sections, and of standards of workmanship for the terra cotta or other filling material.

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The tearing up of asphalt pavements for the laying of subway, water and gas pipes, and for sewer connections, is one of the knottiest problems with which the public works departments have to deal. Builders have a right to these connections which cannot be abridged, and corporations obtain rights for street disturbance which the city authorities find it difficult to combat. While it is usually made compulsory to obtain a permit for such work and the parties are compelled to restore the pavement in kind after the break is made, the filling put in almost invariably settles in time and the street surface sinks with it, leaving a long hollow in the pavement. The attempt is now being made in several large cities to appeal to the pockets of the offending parties by making the cost of repairs as excessive as is reasonably possible, in the hope that this cost will discourage any but the most necessary openings. Brooklyn has just framed a regulation requiring not only a proper refilling and ramming of the trench, but also the laying of 8 ins. of Portland cement concrete under the paving surface. It is expected that this concrete will bridge the opening and prevent surface settlement even when the filling beneath does sink. But the new regulation also adds most materially to the cost and nature of the repairs and tends to place this work in the hands of experienced and responsible men, rather than to divide it, as now, among many contractors. Incidentally it may be mentioned that New York city charges $4 per square yard for opening an asphalt pavement, with a minimum charge of $16; and $8 for the first yard of granite pavement—and $4 for each additional yard. The city of Philadelphia charges $13 for a permit to open an asphalt pavement, and increases this amount to $18 between Dec. 1 and March 1 in any year.

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In commenting upon horseless carriages, the "Horseless Age," of London, states that it does not believe that any fairly satisfactory vehicle of this type has yet been produced, and gives its reasons as follows: The experiments in France and elsewhere prove that light-oil engines can be used for purposes of locomotion, in this connection. But no vehicle has yet been designed to burn heavy oils without producing a disagreeable smell. The carriages which have made successful runs burn petroleum spirit, benzine or naphtha; materials which necessitate the storage and carriage of a highly inflammable liquid; which does not comply with the laws usually in force, and would make trouble with the insurance companies. The man who is called upon to invest about $1,500 in one of these carriages will properly demand that it be safe, odorless and free from vibration, or comfortable. And the trials of horseless carriages so far made prove that these conditions cannot be secured; in other words, the horseless carriage is not yet a commercial success. Those interested in the design and operation of these carriages, from an engineering point of view, are well aware of these defects, and are striving to remedy them; but others who believe that a finality has been reached and that investment in every horseless carriage scheme that presents itself is a short and sure road to profit, would do well to await further developments.

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For some time past engineers in this country have been receiving circulars, inviting them to invest in the shares of the "Civil Engineers Exploration Syndicate, Limited," of London, and these papers eloquently set forth the advantages of this connection. Engineers are told that members introducing business to the syndicate, in the form of patent processes, concessions, contracts or other enterprises relating to the business of an engineer, will be entitled to a bonus of ten per cent. from any net profit derived by the syndicate. Throughout the documents the name of the Institution of Civil Engineers figures prominently, and the Council of that body now issues a circular letter to its members stating that this use is unwarranted by any official action of that body, and it disapproves of the formation of any such syndicate or company because it believes that such a combination among its members, for the purposes set forth, would be undesirable in the true interests of the profession. The chief objections we see to any such organization are that any one can join its ranks, without reference to previous experience or character, and the temptation is held out to weak engineers to indulge in what is properly termed unprofessional conduct. On the one hand, subscription to the shares constitutes membership and enables any designing or unprincipled party to participate in its operations, or, perhaps, to direct them in time. On the other hand, the interest of the syndicate in a patent process, for example, is made the interest of every member of the syndicate, and the temptation is at least strong to recommend the adoption of this process regardless of the true demands of engineering conditions and unbiased professional opinion. An engineer is also often necessarily intrusted with the preliminaries of very important business enterprises, the divulgence of which, in advance of the interests of its promoters, may be made a subject of barter under the terms of the syndicate's prospectus. Happily, the trust thus reposed in the engineer is very seldom betrayed; but the self-respecting engineer will carefully avoid placing himself in a position where he could possibly be suspected of so doing. Channels are already open for doing legitimately all that the syndicate proposes to do, and with the Council of the Institution of Civil Engineers we believe that such an organization as is proposed is opposed to the true principles and best interests of the profession of engineering.

THE RELATIVE SIZE OF THE TRADING WORLD IN 1860 AND IN 1896.

Reduction in time and cost in the transport of goods are the two important factors in promoting international trade, or even an exchange of commodities between different parts of the same country. Both of these items have been enormously reduced within the last thirty years; and the relative distances between trading centers have decreased to such an extent, as compared with the available means of a generation ago, that the world may be said to be much smaller now than then. For all trade purposes San Francisco, at the present time, is about as near to New York as St. Louis was in 1860, and the events and issues of all nations, political, commercial and financial, are known to us almost as soon as they happen. The forces at work within this period have tended to unite the various divisions of the earth to such an extent that anything seriously affecting one part must be felt throughout the whole; and this unity of interests should be taken into consideration in any attempt to deal with problems brought about by a universal and radical change in conditions.

The law of trade is a natural law of supply and demand that expands with the facilities for manufacturing and exchanging goods; and the causes that operate and produce effects in a limited field will extend over a wider territory just as the means for so doing are developed. Within the period in question our scientific, engineering and general material advance has been phenomenal in the history of the world; and it is with this advance that we now have to deal as typified in the effect upon commerce of the extension of railways, the growth in sea tonnage and the shortening of routes of trade.

If we take any date anterior to the introduction of railways, or previous to 1825, we may safely consider each nation separately, from a manufacturing and trading point of view. Each supplied its own wants, mainly from material and labor within its own borders, and was little affected by what its neighbor was doing in a similar line. Foreign trade was practically confined to the import of the luxuries of life and commercial rivalry could hardly be said to exist; at least, from the present point of view. Without railways at all and with highways in a generally very bad condition intercourse was limited within the boundaries of anyone state; and the centralization of population, so characteristic of the present age, was impracticable, owing to the lack of means for supplying such centers with food and other necessaries of life. Up to 1825 the processes of manufacture were still generally crude and closely followed the practice and traditions of a more remote period. The volume of foreign trade was then relatively large; but this trade was conducted in comparatively small and slow ships and over seas imperfectly known. The advent of railways and the gradual development of the steam engine and of processes of manufacture brought about a decided change; but even up to 1860 the broad effects of this change were only beginning to be felt, as compared with present events. Clipper-built sailing ships 34 years ago outstripped the paddle-wheel steamers on the ocean in the race for foreign markets; and on land railways were, to a large extent, being pushed forward into undeveloped regions, with the resultant growth yet to be realized.

It is not necessary to review in detail the several stages by which the conditions controlling trade and manufactures throughout the world have been so radically changed within little more than three decades; but some comparative statistics will enable us to more fully realize the effect of these changes. The year 1860 is selected as a somewhat arbitrary but convenient point of departure; though it should be said that the forces that have since yielded such brilliant results were quietly at work before that date and the ground was being prepared. In any comparison of relative progress in the world the increase of population comes first; because in these more peaceful days this increase compels as well as encourages development in all directions by the necessity for finding food and work for the new millions. Scientific and engineering progress, within the dates mentioned, has had its origin in Europe and North America, and for this reason the population of these countries is alone considered in the summary to be here presented. This aggregate population was 322,600,000 in 1860, and was about 446,000,000 in 1890, a gain of 123,400,000 people in 30 years. The population of Asia and Africa, now estimated at nearly 1,000,000,000, had little or nothing to do with bringing about present progress; but it enters into commerce as an important factor in inducing western nations to manufacture for these teeming millions and to utilize the cheap labor found there in supplying raw materials for general consumption. Were this Eastern population ever to advance to a competitive point in intelligent productive capacity, the effect upon the rest of the world can only be guessed at by political and social economists; and that there are possibilities in this direction the sudden rise of Japan to the position of a power among nations is a sufficient indication.

This gain of 123,400,000 in the civilized population means a vastly increased productive capacity; but, for reasons already stated, without a corresponding increase in the means of manufacturing and handling goods this growth in numbers would have little or no effect upon commerce, national or international. In considering the means actually provided in this interval, railways may be safely classed as one most potent factor in the new growth. In 1860 the aggregate length of all the railways in the world was about 66,290 miles, and these lines were almost wholly confined to the older and more settled parts of the world's surface. In 1893 this mileage had increased to about 390,000 miles, a practically sixfold gain in 33 years. The immediate local effect of this railway construction, coupled with the general development of manufacturing processes, was gradually to decrease the cost of producing and handling goods and vastly to increase the comforts of travel and of living. But aside from this and almost more important in its bearing upon the world at large, was the gradual opening up to civilization and to cultivation of vast areas of what was previously waste and inaccessible lands. To the railways built west of the Mississippi River since 1865 we owe the mineral and agricultural development, which has already added so enormously to our national wealth. And to the extension of railways into the heart of the Argentine Republic, into India and Russia and now across Siberia, we are indebted for a rivalry in the markets of the world that has materially reduced the profits upon our own grain and cotton. In several of these sections development upon modern lines has only commenced, with railways as a basis of operation, and what the ultimate productive capacity of these regions may be we have no means of even estimating. Our only consolation is that the consumers are also rapidly increasing throughout the globe, and it is a fairly well established law that the volume of the product consumed increases with the advance in civilization and even faster than the means for supplying the demand.

When the direct local effect of railway extension upon trade is to be considered, we can best study this in our own country where fuller statistics are available for this purpose. And as the railway mileage of the United States is nearly equal to half of the total world's mileage, it is natural to assume that conclusions based upon our own experience would indicate general results and tendencies elsewhere. In 1860 the railways of the United States aggregated 30,630 miles in length, as compared with an aggregate of 179,280 miles on Jan. 1, 1895. This is an increase of 148,650 miles in 34 years, or more than twice the total world's mileage in 1860. In the fifteen years between 1880 and 1894, inclusive, the mileage of railways in the United States increased 93,726 miles, an average of 6,248 miles per annum; and in the first five years of this period the net increase was 40,759 miles, or an average of 8,152 miles per year. The effect of this rapid extension of carrying capacity can best be indicated by comparing rates and tonnage for certain intervals, and for this purpose the following figures for 1882 and 1894 are taken from the last issue of Poor's "Manual:" In 1882, the 114,461 miles of railways then in operation moved 360,490,375 tons of freight, with a tonnage mileage of 39,302,209,249 miles, and earned $485,778,341 for this service; equivalent to an average of 1.236 cts. per ton-mile. In 1894, 179,280 miles of railway moved 675,129,747 tons, with a tonnage mileage of 82,289,400,498 miles, and received for this work $700,477,409, or an average of 0.851 cts. per ton-mile. In the thirteen years, 1882-94, the total freight movement of all the railways of the country reached the enormous aggregate of 843,365,482,911 tons, and for this service the railway companies received $7,856,765,284. But had the average rate of 1882 prevailed throughout this whole period the public of the United States would have paid, in excess of the above amount actually charged by the transportation companies, a further sum of $2,567,232,085, averaging nearly $200,000,000 per annum. Whether this material reduction in rates in thirteen years be ascribed to more economical administration, to the increase in the volume of freight, to the attempt to secure traffic by cutting rates, or to any other cause, the gain to the public is evident enough. But it may be broadly stated that the growth of facilities for handling and transporting goods, joined to an intelligent economy in operation, tends to increase the volume of freight moved and to decrease the average charges upon this traffic. As an apt illustration of what modern appliances and conveniences for handling certain classes of goods will do in this direction, we have the cost of mining and shipping iron ore from some of the Lake Superior mines. Ore from the Mesaba mine is placed upon the cars at the mine at a cost of 20 cts. per ton, not including a royalty of 25 cts. per ton; but with this initial cost of 45 cts. at the mine it is transported over nearly 100 miles of railway, transferred to a steamer and taken over 780 miles of lake route to Cleveland, O., and there landed upon a dock for $2.25 per ton, every charge included. The average ton-mile rate on the railway was about 0.95 cts. in 1894; but the lake-rate, at 85 cts. for nearly 800 miles of transportation is but little more than one-ninth of the railway rate per ton.

Alongside the railways and under the seas is the electric telegraph, another strong factor in extending trade throughout the world by providing a means of quick communication. Of its social and political importance in furnishing us with the world's news of the day, mention has already been made, but who can measure its value from a commercial standpoint? In the slow-going days of sailing ships and stage-wagons all communication was by letter, subject to the accidents and delays that these means of conveyance imply. Business was conducted in a more leisurely way a generation ago, and months might elapse between the sending of an order and its execution in some distant part of the globe. With the telegraph and the telephone in every counting-house, the whole method of transacting business has altered. Space is no longer a bar and the element of time has almost disappeared in the transmission of advice or orders.

Statistics of the extension of the telegraph throughout the world, between 1860 and the present time, are not available; but they are not needed to impress upon the reader the wonderful importance of this agent in the sending of news. But for the telephone, much more recently introduced, it may be said that there are now over 200,000 miles of wire in operation in the United States alone, and in 1893 175,000 subscribers had over 500,000,000 "talks" with each other. Ten submarine cables connect Europe with North America, under the Atlantic Ocean, and another cable ties Brazil to Spain and the rest of the Old World. Other cables traverse the North Sea and bounding the western coast of Europe, pass through the Mediterranean on to India and the Far East.

Up to this point all that has been said refers mainly to the increased facilities for transport and communication on land; but the change in conditions for moving freight over the seas has been equally great and has had an even more important bearing upon the trade between nations. In the last 30 years the total carrying power of the shipping of the world, steam and sails, has increased from 13,770,000 tons to about 49,000,000 tons; and while the sail tonnage has gained over 1,000,000 tons in this period the chief growth has been in the steam tonnage, which was 764,000 tons in 1860, 7,400,000 tons in 1886, and is doubtless considerably over 8,000,000 tons at the present date. Between 1885 and 1895, 1,500,000 tons have been added to the displacement tonnage of the merchant marine of the leading commercial nations; a gain of over 9 per cent. in ten years. This rapid increase in steam tonnage has been the direct result of the cheapening of production by new processes in metallurgy and of the wonderful late development in the design and power of marine engines, with a corresponding economy in fuel consumption and general operation. The nominal horse-power of the engines of the "Great Eastern," launched in 1859, was 2,600, and this engine-power must now be contrasted with the 31,000 I. HP. of the "Campania." Ships of 8,000 tons and more are built to carry freight alone; and these vessels now swarm in every sea, with the natural result that the struggle for cargo and the general cheapening of the cost of transport has reduced freight rates to an unprecedentedly low figure.

With these improved facilities for the interchange of goods it is not remarkable that international trade has more than doubled within about 30 years. Mulhall, in his "Statistical Dictionary," places the approximate value of the combined imports and exports of the world at $7,445,000,000 in 1860, and at $16,885,000,000 in 1889. This growth in the volume of foreign trade created a demand for shorter trade routes and has been productive of some of the world's most remarkable engineering feats. The building of the Suez Canal, opened in 1869, shortened the length of the sailing route between Europe and the East by double the length of a continent; and the construction of a similar cut-off through Central America has only been delayed. The Corinth, Baltic and other shorter ship canals have all been built within the three last decades and at some time or another within this time projects have been advanced for cutting through about every narrow strip of land that anywhere separates two navigable and important seas.

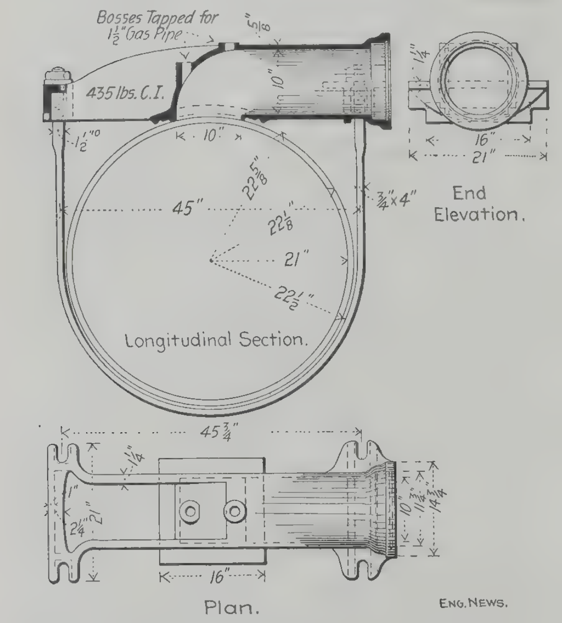
But enough has been said to plainly indicate that while the world's productive capacity, as measured by its gain in population, has normally increased in the last 30 years, the facilities for utilizing this capacity in manufactures and in supplying the world with the product of this labor have grown at an abnormal rate. As before remarked, this world of ours, measured by time and the cost of transport of men and goods from one part to another, is very much smaller than it appeared to be to our fathers. And the immediate effect of this shrinkage is a certain unity of interests throughout the globe and a sensitiveness to events commercial and financial outside of our own country, that never before existed, nor could exist under previous conditions. The wars of conquest and of personal ambition that so long occupied the time and expended the resources of nations, are giving way to industrial wars, within nations and between nations. And in the adjustment which is now going on everywhere the present scientific and engineering advance, which has alone made our material and commercial growth possible, must be well and duly considered.

LETTERS TO THE EDITOR.

Comments on Four Articles Published in Engineering News for Aug. 27.

Sir: There probably has never been an issue of Engineering News that had so many items in it upon which I felt that I could throw additional light as the one for Aug. 27. The first item that attracted my attention was a "Peculiar Break in a Water Main." In "The Technic," published by the Engineering Society of the University of Michigan, 1890, I described a similar occurrence at Greenville, Mich., the article being copied by your issue of Aug. 23, 1890.

The split sleeve described by Mr. Hill has been used in the Detroit Water-Works for nearly 20 years, it having been introduced here by Mr. Henry Bridge, Superintendent of Extension, about 1876. The Smith tapping machine has also been used by us for a number of years, and very satisfactorily, except in the matter of expense. On this account we are now experimenting with a machine of local invention, known as the Howe tapping machine. One of the advantages of the latter is that it is arranged for using any standard gate instead of a special form. It also takes up less room in operation, which is a considerable advantage in streets which are paved and must be resurfaced at a contractor's price per square yard.



Saddle for Tapping Water Mains Under Pressure Used at Detroit.

We have also used here another device, known as a saddle, for tapping mains under pressure, of which I send you a print. The scheme of operation was to fit the saddle to the pipe and mark out the size of the opening, usually 10 ins. square. This was then cut out by drilling small holes, about 7-16-in., around the edge, being careful to drill them tangent to each other or with intersecting circumferences. As soon as the drill, which was wrapped with a cloth, was withdrawn a pine plug was driven into the hole. The swelling of these plugs was found amply sufficient to hold the piece in place after all the iron had been cut away, when working against 40 lbs. pressure. After the piece to be removed was entirely severed from the body of the pipe the saddle was put on and fastened in place by wrought-iron bands coated with graphite paint. The joint between the saddle and pipe was calked with lead and the connection made to the side line from which the pressure was let on and the apparatus tested. When all joints were found tight a steel bar was inserted through a short gas pipe nipple in one of the holes in the saddle directly over the opening. Two or three blows were given the bar with a light sledge and the piece cut out was knocked loose from the wedges and dropped into the pipe while the bar itself was driven out by the pressure of water. A wooden plug was immediately inserted in the nipple, driven tight and cut off flush with the top, after which the cap was screwed on and the connection was complete. As the saddle was already full of water from the side line when the piece was driven in there was no danger of rupture from shock. There were about 25 10 and 6-in. connections made in this way during 1893 and 1894, on 42 and 30-in. pipe lines, all of which have been entirely successful, excepting one in which a heavy sledge was used which broke out a corner of the piece without loosening the whole. After that experience we put in two holes for driving and used a light sledge and were thus able to make a clean opening in every case. The cost of these connections was only about one-tenth that of the Smith sleeve and valve for material and the labor was so nearly the same that there appeared no advantage in either from that point. As a rough-and-ready device for those who cannot afford the more expensive machines it will be found quite satisfactory for connections on large mains. It will be at once seen that the saving in cost over the Smith connection will decrease with the size of main and below 20 ins. there would be little if any economy in it.

Commenting further on the items in your issue of Aug. 27 it occurs to me that the table showing metered and unmetered water consumption at Lexington may be misleading in that the metered consumers do not seem to be charged with their share of the leakage of mains and slip of pumps, if any. You readily see that before meters were introduced this was divided among all taps, but as each tap was metered it ceased to be charged with the source of loss, so that in 1895, 223 taps appear to be bearing the leakage that should be charged to the whole 1,323. As I have thus far failed to obtain any very reliable statistics on the loss in street mains and fixtures from leakage, I doubt if the amount can be satisfactorily determined by guess. While I am heartily in favor of meters I think that over ardent advocates sometimes claim too much for them.

The American patent held by the Joly Iron Works on their stair construction strikes me as being of rather doubtful value, as the U. S. Lighthouse Department has been using practically the same device in combination of wrought and cast iron for the past ten years at least.

Very truly yours, G. S. Williams,
Civil Engineer to the Board of Water Commissioners.
883 East Congress St., Detroit, Mich., Aug. 29, 1896.

The San Juan Route for the Nicaragua Ship Canal.

Sir: I notice in a recent number of your valuable paper an article with map by Mr. J. T. Ford advocating a new route for the Nicaragua Canal. He proposes to dam the San Juan River just below the mouth of the Serapiqui, and thus flood the valley of the San Juan and use it for the canal.

Mr. Ford has evidently not read my article in the "Railway Gazette," published several months ago, in reply to a somewhat similar suggestion from him. In that article I stated that while in charge of the canal work in Nicaragua I caused careful and exhaustive examinations to be made at this locality with this very object in view, and I found to my regret that it was utterly impracticable, as nothing but swamps existed in that vicinity, and no flanking hills or high land for a dam could be found, although the country was examined for three miles in every direction.

There is a high spur of the Cordilleras which comes to the river's edge on the north side at this point, but unfortunately there is nothing but swamp on the south side of the river. Yours truly,

J. Francis Le Baron, C. E.
(Late Engineer in charge Nicaragua Ship Canal.)
Jacksonville, Fla., Sept. 11, 1896.

Timber for Harbor Work.

Sir: I have recently been consulted by a Danish importer of American lumber as to the adaptability and superiority, if any, of red cypress to southern yellow pine, for a bathing establishment to be located in salt water, and which is proposed to be built by the city of Copenhagen in the near future. Not being posted on harbor work in this country, I beg to ask for your opinion in this matter, in order to direct the proper authorities in their selection of American lumber to this or other harbor work in Denmark. At present a North German pine is extensively used, and is protected against the attack of the teredo navalis by thin sheets of iron. Yours truly, O. E. M.
Elmira, N. Y., Sept. 5, 1896.

TIE-PLATES.*

In our issue of Sept. 3, we had occasion to call attention to the important place which the tie-plate is taking in railway track, as an aid to greater efficiency and economy, and it is a significant fact that reports on this appliance were read and discussed at the annual conventions of the American Society of Railroad Superintendents and the Roadmasters' Association of America last week, as noted in another column. We give below an abstract of each of these reports. It will be seen that there is a very strong and general opinion in favor of plates having ribs which embed themselves in the tie, and also a somewhat strong opinion in favor of a rib on the upper side of the plate, to take the thrust of the rail flange in order to reduce the wear or necking of the spike. It is only fair to say, however, that the flat-top plate, without a rib, is far more extensively used than the shoulder plate, and that many persons who have used the former find them quite satisfactory and question the advisability of paying the higher price for the shoulder plate. The two reports are substantially as follows, and some notes of the discussion thereon will be found in another column.

Report of the Committee on Roadway; American Society of Railroad Superintendents.

The committee, recognizing the vast number of subjects connected with the roadway department of a railway that are of interest to you all, has considered it best to select some one of them as the principal subject of its report, the small number of members composing the committee and their inabilty to confer with each other frequently, making it almost impossible for them to cope with more than one of these subjects at a time. The subject of tie-plates is of particular importance to all who are concerned in maintenance of way, and we have made an effort to obtain such information as we can as to what the experience with them has been up to this time, in order to form an idea of what may be expected of them in the future.

You are all, doubtless, so familiar with the various designs of tie-plates that have been and are now on the market, that a detailed description of each can hardly be necessary. The conflicting claims of the manufacturers of each kind of plate, based on arguments that are at first glance so apparently sound, as well as the remarkable difference in the action of the same kind of plates under different circumstances, make it extremely difficult for any of us at this time to determine which form of plate is best for our particular use; and as it takes from five to ten years' experience to determine what good they will do our ties in the way of preserving them, or preventing their wear, a positive conclusion as to what form of tie-plate is the best can only be arrived at some years hence by the lesson of "the survival of the fittest."

One gentleman has stated, in his reply to the inquiries of the committee, that "the relation of the elements composing substructure, superstructure, motive power and character of traffic is so complex that any one kind of plate can not possibly prove satisfactory under all conditions"—and this is possibly true.

The requirements of a tie-plate are, primarily, the preservation of the cross tie, a point on which any argument is superfluous; and the importance of tie-plates as a factor in their preservation and the formation of good track by restricting rail movements is well established. The growing tendency to higher speed of trains and heavier rolling stock is rapidly making the task of maintaining a proper kind of track more difficult and more expensive; and the rapid depletion of our forests by the unceasing and increasing demand for railway ties, more especially hardwoods, and particularly oak, the high price of which in many sections of the country makes it no longer an economical tie to use, makes it necessary that this wood shall sooner or later be replaced by ties made of softer woods, either treated by chemical process to prevent decay, or by mechanical means to protect them from destruction by the mechanical action of the rail; and the tie-plate is, so far, the best means that has been devised toward the accomplishment of the latter result.

The several different designs of tie-plates that have been used in this country are more or less familiar to you all, such as the "Servis," the "Goldie," the "C. A. C.," the "Wolhaupter," etc. These have also been used to some considerable extent in Canada and Mexico, but information is lacking as to the forms of plates used in other foreign countries. An effort has been made to ascertain as far as possible what form of plate is best adapted to American railways, regardless of any particular form now in use, whether or not all of the elements necessary to the desired results are embodied in one plate, or form a part of the composition of many. The qualities necessary in a tie-plate to fulfil the service it is called on to perform may be generally stated as follows:

1. Adhesion to the tie, so that it can be considered as practically a part of it, preventing damage to the wood fiber and rattling by passing trains.

2. Adhesion to the tie to prevent its lateral movement, even on curves of high degree, so that the track can not spread.
3. The above vertical and horizontal adhesion to be obtained by such a mode that it will not assist decay of the tie.
4. It should be so constructed that its application be simple and economical.
5. Its cost should be sufficiently low, so that, when added to the total cost of the tie in place, it will by sufficiently prolonging the life of the tie, pay for itself, due allowance being made for a saving in labor on track repairs, and a better condition of track.

The fulfillment of these requirements should have the following results:

1. Prevent damage to the tie by the rail cutting into it;
2. Make the use of rail braces unnecessary;
3. Make possible the use of soft wood and longer lived ties on curves as well as on tangents, and on all conditions of track;
4. Make possible the use of a tie in the track during its natural life under the most trying conditions of alinement, grade and traffic;
5. Greatly reduce the expense of maintenance of track to proper line and surface;
6. Make possible the maintenance of track in a safer condition, and afford relief to our forests of tie producing timber.

As to how these results may finally be obtained, investigation shows that enough experience has not been accumulated on which to form a decided opinion. A circular was sent to each member of the society, and also to a number of officials of roadway and engineering departments of large systems, who are not members of the society, to all of whom we are indebted for the careful manner in which they have answered our questions. The replies are in such varied form that it is not possible within the limits of this report to give them in detail, but we have selected from them such information, and have quoted the accounts of such experiences as we believe will be of most interest.

The total number of replies received was 73, in which 24 stated that they had not used tie-plates, and were therefore unable to express any opinion at all, and 49 had used them to a greater or less extent.

The number of tie-plates of each kind in use was not in all cases given, and we have no accurate figures as to how many there are. Several large systems of this country and some foreign roads using tie-plates have not been heard from. Ouly four systems that we have learned of have adopted tie-plates for use on their entire lines, one western road having nearly 3,000,000 Servis plates in use, principally on California redwood ties, also on cedar and some burnettized pine and fir. Another has 250,000 Servis plates on cedar ties, and another 293,000 Servis plates on California redwood, each of these systems having had them in use extensively from two to six years, while the total experience extends over various periods of from seven to ten years. A system in Massachusetts has had 300 miles of road equipped with plates for six years. the number in use being divided between the Servis, C. A. C., and Goldie, about equally. Valuable information was received from one southern line that has had 40,000 plates in use for four years, consisting principally of Servis and Goldie, with a few Wolhaupter, the kind of ties used not being stated, but presumably oak.

Accounts were given of the use of 300,000 Servis plates during the past eighteen months on another prominent southern road, and of some extensive experiments with Goldie and Servis plates on one of the northwestern trunk lines, but the majority of those replying to the circular report experiments with all of the different makes, more or less, without showing how many of each kind are in use. As a matter of information, it may be well to state that, where the number of plates in use was specifically stated, the aggregate number of each kind was as follows: Servis 4,565,000, Goldie 1,000,000, C. A. C. 600,000; however, these figures are of uncertain value, for the reason that they do not represent all of the tie-plates in use; yet they indicate a more general use of the form having longitudinal ribs entering the tie parallel with the grain.

So many different dimensions of plates of each kind are in use that it is well that attention should be called to them:

Servis.	Ins.	Servis.	Ins.
2 ribs	3¾ × 8 × ¼	2 ribs	4 × 8 × ¼
2 ribs	5 × 8 × ¼	3 ribs	5 × 7¾ × ¼
3 ribs	5 × 8 × 3-16	3 ribs	5 × 8 × ¼
3 ribs	5 × 8 × ⅜	3 ribs	5 × 8½ × ¼
3 ribs	5 × 8¾ × ⅜	3 ribs	5 × 9 × ¼
3 ribs	6 × 8 × ¼	4 ribs	5 × 8 × 3-16
4 ribs	5 × 8 × ¼	4 ribs	5 × 8¾ × ¼
4 ribs	6 × 8 × 3-16	4 ribs	6 × 8 × ¼
4 ribs	6 × 9 × ¼		
Goldie.		Goldie.	
4 ribs	5 × 6 × ¼	4 ribs	5 × 6 × ⅜
4 ribs	5 × 8 × 5-16	4 ribs	6 × 8 × 5-16
Goldie.		C.A.C.	
4 ribs	8 × 8½ × ⅜	4 ribs	6½ × 9 × ¼

The plates used at joints are generally punched, where necessary, to use spike slotting in splices, and the length of plate is frequently changed to conform to the additional width of the angle bar, although in a number of cases the same plate is used at joints as on intermediate ties. The kind of wood from which the cross-ties are made, the dimension of same, the weight of rail and width of its base, the volume of traffic and character of roadbed all enter into the question of determining what the dimensions of the tie-plate should be. As to the proper thickness of the plate, this question is one that must be determined by experience, although some very decided opinions have already been formed by officials that deserve the highest consideration; for instance, the chief engineer of one line declares that, "only a re-enforced thin plate will perfect a union with a tie, which union is essential to the usefulness of a plate. The vibrations of a heavy plate are sufficient in themselves to loosen them from the tie," while there comes from the manufacturers of a heavy plate (having lugs underneath cutting the grain of wood at right angles) the following argument against such a plate.

"There is not enough stock in this style of plate to stand corrosion and wear, and oppose the crowding of rail with the necessary resistance, for at least 25 years," the inference being that the heavier plate is expected to last that long in service. The latter statement is re-enforced by that of a prominent chief engineer of a system that has been experimenting for the past eight years with a number of different kinds of plates, that, "when made of heavy enough material (⅜-in. thick), the results were good. Where less than ⅜-in. thick, the tie-plates buckled. * * * All these forms of plates were used on steep grades and sharp curves, on heavy drill tracks in yards, and on bridges with sharp curves."

The same gentleman also advanced the following opinion:

> "A tie-plate, to give good results, should have a thickness of at least ⅜-in., should have a shoulder on outside of rail, and should have sharp flanges or lugs to cut into the tie at right angle to the grain without tearing the fiber of the wood. Thin Servis plates have been worn entirely through from rust and friction within three years, and have been buckled in yards under heavy traffic in three months. Plates with no outside shoulder, made of thin metal, also have the objection of cutting into the back of spike heads on sharp curves."

And yet there are quoted below accounts of experiences from which opinions are given in direct opposition to those expressed above:

> "The Servis 3-ribbed plates were placed on ties in M——— tunnel and were in service 3½ years and were completely worn out, in many cases only the ribs remaining, and these so firmly imbedded in the ties that it was almost impossible to remove them. The test of these plates was severe, as in addition to the wear from traffic, they were subject to corrosion due to gas and water. If used outside of the tunnel they would probably have lasted five or six years."
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> "We have an example of the use of Servis plates at G——— three years. They were put down on the inside of a 10° curve to prevent the rail from rolling over. These ties are now in condition to give three years more service, while the adjoining ties, which were new when the plates were put down, are in such a condition that they will have to be removed this season. * * * We have used Servis tie-plates as above mentioned, and have now adopted Goldie plates as our standard, size 7 × 6 × ⅜ ins. These are known as shoulder plates."
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> "A section of track 2,500 ft. long, which is a combination of sharp curves and tangents (a loop track whose alinements were confined by existing improvements, mansions, etc.) where we had from four to five men constantly employed gaging and surfacing without any satisfactory results, but since the tie-plates are in use, the track does not require any more attention than other sections. We have also reduced our track force at the rate of about one-half man per mile, but attribute this as much to the more settled condition of the roadbed after five years' running than to the use of tie-plates exclusively. We are saving in the cost of ties by making worn ties do their work by the aid of tie-plates. We save in the retamping of ties, otherwise consequent to changing of ties, which naturally always destroys the tamping. * * * It was the unsatisfactory work of rail braces on sharp loop track curves which prompted us to use the combination tie-plate." In this case, the Servis plate is referred to.)
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> "Plates were put on bridge ties. * * * Ties that were put in lasted for two years. New ties put in (where ties before lasted two years) were protected with tie-plates and have been in five years, and are in good condition. Ties (that previously lasted four years) when renewed were protected with plates, and now show no perceptible signs of wear after three years' service. * * * Servis plates on oak ties maintain a perfect union with the tie; on cedar ties, they do not under a light rail with heavy traffic, but do so under a heavy rail. The Fox plates break between the slots, and the parallel flanges under the rail shear off. The C. A. C. plates rattle. The Wolhaupter, I can not say anything in regard to, as we have just placed them in the track."
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> "200,990 were placed on California redwood in 1889, and ties of same wood and in similar soil have had to be removed on account of rail cutting into tie to such an extent as to cause breakage. The life of a redwood tie, without plate, is about six years; tie plates will more than double the life of such ties.
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> "90,020 have been placed on pine ties, and we figure that it increases the life of such ties 30%, saving in regaging curves in track work, which heretofore has been necessary once a year, thus spike-killing the tie."
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> "We have found that on curves, our chestnut ties lasted from two to five years longer where we have used plates, but we note the greatest saving where we have used them in the leads of our busy yards. In one yard in particular where we were obliged on account of the heavy traffic to renew the switch timbers every two or three years, when rebuilding this yard four years ago, we used tie-plates, and as yet the timbers do not show any perceptible wear. * * * We first used the Servis tie-plate, but are now using the Goldie principally, size 5 × 8¾ × ⅜ ins., and 5 × 7¾ × ¼ ins. We have favorable results from both longitudinal ribs and with lugs cutting the grain at right angles, having adopted the Goldie in preference to the Servis on account of the shoulder and thicker plate that we are able to secure."

The engineer of maintenance of way of a line having used both forms of plates extensively, writes as follows:

> We have never found either the Goldie claw plate or Servis rib plate loosening from the tie; that is, the union has always seemed to be perfect. While I think the bottom of the longitudinal ribbed plate is better than the Goldie, the shoulder is of greater value, and for this reason prefer the Goldie plate. We find that the lighter the rail the greater the proportional value of the plate. I think that some time there will be a plate made that will combine the longitudinal rib and the shoulder on full width of the plate. This, I think, will be accepted as the standard plate when made.

(The above is from an official of a road that uses cedar ties exclusively.)

The following is from a letter from the engineer of maintenance of way on a different portion of the same system, on which cedar and burnettized hemlock ties are used:

> "Our objection to the Servis plate was that we found that they did not adhere to the tie under all conditions. This was demonstrated by some of the plates on a few curves put in during the previous four years. We found that the plates had moved in the grain of the wood as much as half an inch, spikes and all moving with them. Thus far, we have found the plate with lugs or claws all right, but as our experience with the latter has not been for more than a year, we are not satisfied as to what the result may be after several years' service."

It is possible that in the last case referred to, the ties were of such soft wood, and the other conditions were such, that they would not act well under any circumstances; however, this is merely a surmise.

It is observed that where a very positive preference is expressed for a particular kind of plate, it is often the case that no experience has been had with any other form, which is a good argument for tie-plates in general, but not a strong one for the superiority of one form of plate over the other. There are some notable exceptions, however, where, after having made extensive experiments with several kinds of plates, one particular form has been finally adopted. These cases are deserving of the most serious consideration.

By far the most important feature of a tie-plate is the means by which its contact with the cross-tie is maintained, and, naturally, on account of the different means employed in the various makes of plates, there is more diversity of opinion as to this feature than any other.

The question is mainly, whether the union of the plate with the tie shall be secured by ribs entering the tie parallel with the grain, or by lugs or claws entering the tie at right angles to the grain. Of the 44 opinions received on this point, 28 declare their unqualified preference for the plate with longitudinal ribs, 8 are equally as positive in their preference for the other form, 3 appear to be as well satisfied with one as the other, and 5 have not yet formed a positive opinion either way.

Some of the principal arguments advanced in favor of a plate with longitudinal ribs are as follows: It adds materially to the stiffness of the plate; it excludes water, etc., from between the tie and the plate because of a closer adhesion; it does not weaken the tie by cutting the fiber; it is more easily adjusted. Some of these opinions are quoted in full as follows:

> The track can be re-arranged better and at less cost with plates with longitudinal ribs than with plates which cut the fiber at right angles.
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> Where the ribs enter the wood parallel with the grain, they simply push the fiber to one side in entering. The fibers immediately begin to close up around the ribs, and in a short time, the iron ribs and the fibers of the wood adhere so closely that the plate can not be pulled out of the tie without bringing some of the wood fibers with it. On the other hand, any projection entering the wood across the grain cuts the fibers, leaving a gaping hole which never closes up, and the plate can always be easily removed from the tie, and in fact, is apt to be loose and to rattle at any time. This can be very simply and clearly shown by an axe. If a sharp axe is driven into the tie across the grain to the depth of one inch and left there, it will be very apt to fall out of itself in a short time, but if it is driven to the same depth parallel with the grain and left there for a day or two, it will be hard to pull out.
>
> 1. The ribs entering the tie do not cut the fibers, but simply compress them, and these compressed fibers are continually re-acting on the ribs, thus holding the plate firm.
> 2. The weight of trains on these does not tend to elongate the fibers, but to spread them laterally. This increases the pressure of the wood against the longitudinal ribs, and keeps the plate and tie permanently bound together.
> 3. When the tie begins to decay (when a plate is of most service), the longitudinal flanges hold the soft fibers of the wood together, thus prolonging the usefulness of the tie.
> 4. The longitudinal flanges give a better distribution of a given amount of metal for strength, and allow plates to be made thin enough for elasticity.

On the other hand, one superintendent expressed the belief that the tendency of the longitudinal ribs is to split the tie, but this theory is not supported by any argument that we have seen. It is claimed by those who prefer the tie-plate with lugs or claws cutting the fiber at right angles that they are more easily applied than the other kind; and it may be noted that this same claim has been made for both forms. One writes in regard to the Goldie plate as follows: "This form is best for the reason that lugs across the grain hold the plate tight to the tie, and offer more resistance to the movement of the plate, and do not tend to split the tie as does the ribbed plate parallel with the grain," while the following arguments have been received against any form of plate having lugs that cut the fiber at right angles:

> Every pressure of the plate would have a tendency to compress the fiber of the tie, and thus cause a larger

> space in which the lug could work, resulting in a loose plate.
>
> They are decidedly not suited to the softer woods.
>
> The object of a tie-plate is to prevent the rail cutting across the fiber, or in reality to prevent what a plate with lugs actually does.
>
> It is not desirable, such plates without stiffening ribs have to be much thicker and therefore heavier and more expensive in order to give satisfactory results. We do not think a plate with lugs cutting the grain at right angles will adhere as well as the other.
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> I have noticed that where lugs are used, the plate is apt to bend so that the lugs at one end of it only enter the tie, and the result, of course, is unsatisfactory.

A claim of the makers of the C. A. C. plate is that "the re-enforced lugs directly under the center of rail-seat insure quick penetration into the wood, and as they do not come to the edge of the plate, but are covered on all sides by a good margin of metal, no water can get in to soften the fibers of ties, loosening the hold of the lugs. Lugs thus interiorly placed are not only more effective, but lessen the tendency of the plate to sag in the middle, as in the case of that form of plate with lugs bent down at edge of plate, or at corners."

As to whether or not a tie-plate should have a shoulder on the outside of rail to relieve the spiking, and assist in maintaining the gage, it seems to be the general opinion that such a shoulder is desirable, although a large number of engineers and other officials who have used plates with no shoulders are of the opinion that it is unnecessary. It does seem, other things being equal, that a plate with a shoulder on the outside of rail, and especially one with a shoulder extending entirely across the plate, would do more toward keeping the track in gage and lessening the wear on spikes than one without such a shoulder, and that a plate so constructed would be of particular benefit on curves. The statement is made by some that a plate without a shoulder at all is not a complete rail brace, "as the fibers of the tie are too soft to offer sufficient resistance to the spreading of gage;" however, this opinion may have been expressed with only a view of using ties made of soft wood. Only a few superintendents claim that rail braces cannot be entirely dispensed with on sharp curves, while it is the most general opinion, so far as we are able to learn, that tie-plates fully perform the functions of a rail brace, and are in fact an improvement on them. For instance, one states that "they are very effective in preserving gage and saving spiking on account of ribs (uses the Servis combination plate) entering the tie and furnishing sufficient resistance so that the track in which we have laid four consecutive ties with plates without spiking on a 9° curve with a 5-in. elevation, the gage was perfectly preserved."

Another states that he "considers them better than braces, as the plate holds the rail perpendicular, and makes a more uniform surface wear, and so prevents scaling, prevents the rail spreading, which, with 60-ton engines on curves at fast speed, is not overcome by braces on every second tie on curves of 8° and over, and every third tie on curves of less than 8°." A very clear explanation of the action of a rail brace, as well as a good argument in favor of tie-plates was given us by Mr. J. A. Dodson, of the Southern Ry., as follows:

> The centrifugal force exerts a strong pressure on the head of the rail, tending to revolve it about the outer edge of its base. This unequal bearing of the rail on the tie, combined with the sawing or abrasion of the tie from the rail flexure as each wheel passes over, soon depresses the outer edge of the rail into the tie, thus destroying its vertical position. This is a tendency which may be retarded, but cannot be counteracted by a rail brace; a rail cannot turn over until the outside of base is lower than the inside. When the tie becomes cut at the outer edge of rail base, the brace is forced into the tie at its edge nearest the rail and slightly draws the spike at the side remote from the rail. When such a condition is reached, which does not require any considerable length of time, the flange of each wheel begins to shave the head of the rail on the gage side, which is destructive to both rail and rolling stock. The only remedy is to draw all the spikes, adze the tie and prepare for a repetition of the same trouble. By using tie-plates, the cutting of the tie is stopped, the rail is maintained in an upright position to gage, and all trouble from this source vanishes. The saving in ties, rail, wheels, spikes and labor is considerable, sufficient to pay for the tie-plate several times.

As to the effect on spiking, there appears to us to be reasons why a plate with a shoulder should be more beneficial than one without it, provided the plate is so constructed that the only function of the spikes that is left is that of holding the rail down to the ties. There can be no doubt, however, that any of the plates in question, either with or without a shoulder, will have a beneficial effect on the spiking, as the punched holes of the tie-plate insure the spikes being driven vertically, for men will naturally exercise more care in starting and driving them; first, because the plates require it, and second, because improper spiking is more easily detected if the spikes are not driven vertically, and any attempt to straighten the spikes by hitting them with a maul will only make matters worse. The spike holes, however, should be of such a size and position that the spikes shall fit the rail flange snugly in order that the spike heads shall have the proper hold on the rail. On some roads where plates having no shoulders are used, three spike-holes are punched so that two spikes can be used on the outside of rail, with very satisfactory results as to keeping the track to gage. No considerable use seems to have been made of plates of a bevel or wedge-shaped form, but some manufacturers have recommended them "to give the rail an inward inclination and at the same time increase the thickness of the plate at the shoulder, thereby increasing its stability, and reduce the flange-wear of the rail heads."

One official reports having used such plates, but says that they are at present using the Servis plate both on curves and tangents. considering it for all purposes as good as the wedge-shaped plate. One or two members have recommended a plate with a bevel of from 1-16 to ⅛-in.

A very few objections have been received against the use of tie-plates on heavy grades, the possibility of bad results being suggested from the "reducing of friction contributing to the rail running down hill." One suggests that "if spikes are allowed to raise up, the rail would creep more readily on a steel plate than on wood, and where the force is small, spikes will work up," but it is not probable that there is much foundation for such an objection.

As before stated, it may properly be said that all of the different forms of plates mentioned above have their good points, but it would not be safe at this time, considering the comparatively short experience that has been had with them, to condemn or to approve of either kind. It is possible, as was before suggested, that no one form of plate yet devised will give perfect results under all conditions, yet it appears that a plate combining longitudinal flanges entering the tie parallel with the grain and a shoulder on the outside of the rail, would be most desirable. That tie-plates, as one of the most important features of track equipment, have come to stay, there is no doubt; and that they are of special value on sharp curves and heavy grades; in tunnels, particularly where wet and where the difficulty of securing good track is great because of the softening of the ties by the action of water, gases, etc.; in yards where there is constant switching and heavy traffic; at platforms in front of stations; and in street crossings where the ties are kept soft by moisture, and where it is both difficult and expensive to get at the track for renewal of ties, re-surfacing or re-gaging; on bridges and trestles, particularly those on curves, and on grades where a great deal of sand is used and where traffic is very heavy. It is possible that in the southern states where oak ties are plentiful and cheap, their use on tangents might not be justifiable, but in the north and west where only soft ties are to be had, or where the price of ties is high, their general use on all kinds of track seems desirable.

The following extract from a very interesting communication from the chief engineer of one of our most important railways is worthy of consideration: "There are, I believe, very few roadmasters who, if they were asked to choose, for general use, between 60-lb. rail with tie-plates and 75-lb. rail without tie-plates, would not select the latter. The cost is about equal."

We have not attempted to go very deeply into the question of the cost of tie-plates, being more particular to consider their mechanical features. Their cost, of course, largely depends on their weight and dimensions and the number used, ranging from 5 to 15 cts. each; but we think it would be more proper for those desiring information of that kind, to obtain it from the manufacturers themselves.

Report of the Committee on Tie-Plates; Roadmasters' Association of America.

The committee communicated with the various manufacturers requesting they be furnished with a sample of their appliance. The Q. & C. Co., of New York and Chicago, furnished the Servis plate; the Railroad Supply Co., of Chicago, the Wolhaupter plate; the Avery Stamping Co., of Cleveland, O., the Fox plate, and Dilworth, Porter & Co., of Pittsburg, the Goldie plate. These plates were taken and imbedded by a hydraulic machine in a new yellow pine tie.

1. Tie-plates certainly hold rail to gage.
2. They prolong the life of soft wood ties from mechanical decay or wear five or six years, and hard wood ties two to four years.
3. They are invaluable on curves.
4. A spike has a better support when used with the tie-plate than without, as the tie-plate gives the spike a required backing.

Practical experience has shown that any form of tie-plate to be successful must unite itself to and become part of the tie. Designs of tie-plates which fail in this particular feature have invariably proved unsuccessful. Most of the tie-plates offered cover this feature, but some of those on the market fail entirely in this regard, and your committee is unable to see where they are of any practical service.

There are three factors working in conjunction with the tie-plate: the tie, the rail and the spike.

In the rail, the wave action causes an alternate rise and drop to a bearing on the tie-plates and thence to the ties; this results in a jumping movement of loose tie-plates if the imbedment is not firm and thorough. This loosening indents the ties, breaking or bending the tie-plates and causing a lamination of the rails. Where the tie-plate fails in the imbedment and causes the above results the remedy adopted by the manufacturers seems to have been to increase the thickness of the plate, which does not prevent the undulation of the rails but adds a heavier plate, and while the tie-plates are saved, the rail receives increased wear, spotting and spoiling the rails. In an experimental test made by the Pennsylvania R. R. in 1870 of a flat plate 6 ins. square and ⅜-in. thick, they acted as an anvil and caused the rail head to show a spot where the wheel struck it immediately over the tie-plate. These plates were not imbedded in the tie and possessed none of the mechanical qualities for imbedment of any of the tie-plates now on the market.* About 1880 the Manhattan Ry. had a similar experience with a flat plate and was obliged to take them out of the track. In fact it had decided to use no tie-plates until those allowing the flange for imbedment came upon the market. It is obvious that any tie-plate that has not a good, firm and secure imbedment in timber, is useless.

Any and every tie-plate should be heavy enough to act as a perfect bearing plate under the rail, but where increased thickness is used either the tie or the rail has to suffer. When tie-plates unite themselves to the ties a much thinner plate can be and is used; for such plates partake of the stiffness and strength of the wood which supports them, that is providing the plate has a full and good imbedment. Your committee finds in reports received that the wave motion of light section rail is much more severe than of the heavier rails, now being generally used, so that any tie-plate found resisting the action of the former has a reserve of strength and can be safely used with the latter. In connection with the matter of heavier rails, it is an error to suppose that the stiffer the rails the more severe the wear is on the tie-plate, or tie supporting them, as on some lines the number of ties used per rail length is reduced when the heavier rails are laid.

In looking over many cut ties it became evident that most of the wear is due to the moving rail and even in the softest woods where indentation was to be expected, there was but little appearance of it. It is here that the tie-plate proves of the greatest service. It prevents the tie from being cut into by lessening the up and down motion and decreases the lengthwise movement with the result that there is less creeping of rail and little or no wear into the tie, if the tie-plate is properly imbedded.

The duty of the spike is to prevent lateral motion of the rail. If imperfect spiking is done this is not accomplished, and to accomplish perfect spiking the tie-plate should have its holes so punched as to allow a close fit of the spike to the rail flange. Where this is not done trouble is experienced in the wear of the parts due to the working in and out of the rail against the spikes. This in connection with the up and down movement causes a wear in the neck of the spike. It is therefore most essential that tie-plates should be properly punched, and no tie-plate should be placed in position unless the tie has been adzed to a true bearing, as the principal cause of tie-plates buckling has arisen from this neglect, for no tie-plate can be a bridge. In connection with this last finding the committee has been struck with the fact that many of the tie-plate manufacturers are placing a shoulder on the plate, and that said shoulder as now used is of little or no value, for when the spike wears the rail gets loose motion and the shoulder and spike both cut. To the mind of your committee it appears if this shoulder were placed the full width of the tie-plate it would offer a support for and reduce the strain on the spike with consequent and better results in the line and gage of the rail.

While considering the three important essential parts which enter into the relation of the tie-plate, your committee fully understand that the tie itself is the principal factor, and have tried to secure information as to results obtained with different woods used with and without the tie-plate. The consensus of opinion seems to be that the life of the cedar tie averages 12 or 14 years, hemlock ties 5 years, tamarack ties 6 years, and oak ties 9 years. The price of ties is so variable in different sections of the country your committee find it hard to strike the average cost, yet in all the reports we have received the invariable answer has been that where the tie-plate has been used, no matter the quality of the tie, it has prolonged the life of the timber from mechanical wear. Furthermore, the committee finds that better results have been obtained from a narrow than a wide tie-plate, and feel that a plate 5 ins. wide is ample for all purposes.

On the second division of the subject matter: "Will the Use of Tie-Plates Dispense with the Use of Rail Braces?" your committee, after a most thorough and searching experiment and investigation, unhesitatingly state they will do so. We have received reports showing where they have proved successful on curves of 3° 30′, 4° 25′, 15°, and even on 60°, where they have held the rail in place without any rail braces being used. Moreover, no lateral movement or cutting of ties has occurred on these curves, and the track is in perfect and true gage.

Your committee has had reports from chief engineers and roadmasters in all sections of this country where ties have been used under almost all possible conditions with and without tie-plates, and the reports received show that the use of the tie-plate is a very necessary appliance on all track work.

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*It should be stated, however, that the Pennsylvania R. R. still favors flat plates.—Ed.

Its use is economic, as it reduces the repairs on the road bed and makes a more perfect track with consequent reduction on repairs of rolling stock. Further, its use as a measure of safety is beyond question, for it means truer gage to the track. Your committee unite in recommending the general use on all repair and construction work of the tie-plate, and feel that its added cost to the track maintenance will be more than compensated by the cost of labor saved in tie renewals alone.

R. Black, Chairman; J. B. Moll, Geo. W. Light.

A TABLE GIVING THE PERIMETER, AREA AND HYDRAULIC MEAN RADIUS OF EGG-SHAPED SEWERS.

A handy table for use in designing egg-shaped sewers has been handed us by an engineer and is published herewith. The table is based on a sewer having a horizontal diameter of 1 ft. and a vertical diameter of 1½ ft., and gives the wetted perimeters, areas and hydraulic mean radii for such a sewer, with varying depths of flow up to two-thirds of the full depth of the sewer. To apply the table to other sizes follow the directions beneath the title to the table.

Table for Finding the Wetted Perimeter, Area and Hydraulic Mean Radius of Egg-Shaped Sewers Where the Horizontal Diameter is Two-Thirds the Vertical, and the Sewer Flows Not Over Two-Thirds Full.

(For corresponding values of p, a and r for other sewers of like proportions, $A = a \times D^2$; $P = p \times D$; $R = r \times D$; D being the horizontal diameter of the other sewer.)

d.	p.	a.	r.	d.	p.	a.	r.
0.100	0.464	0.0280	0.0604	0.270	0.870	0.1163	0.134
0.110	0.488	0.0312	0.064	0.275	0.882	0.1192	0.136
0.120	0.512	0.0364	0.071	0.290	0.915	0.1285	0.140
0.125	0.524	0.0387	0.074	0.300	0.938	0.1357	0.144
0.130	0.536	0.0404	0.075	0.325	0.992	0.1512	0.153
0.140	0.560	0.0449	0.080	0.350	1.048	0.1690	0.161
0.150	0.585	0.0495	0.085	0.395	1.101	0.1867	0.169
0.160	0.610	0.0548	0.090	0.400	1.159	0.2050	0.177
0.170	0.634	0.0597	0.094	0.425	1.215	0.2238	0.184
0.175	0.646	0.0625	0.097	0.450	1.268	0.2435	0.192
0.180	0.658	0.0646	0.098	0.475	1.321	0,2637	0.199
0.190	0.681	0.0695	0.102	0.500	1.375	0.2840	0.207
0.200	0.706	0.0748	0.106	0.550	1.480	0.3267	0.221
0.210	0.730	0.0803	0.110	0.600	1.584	0.3702	0.234
0.220	0.753	0.0858	0.114	0.650	1.687	0.4159	0.247
0.225	0.765	0.0884	0.116	0.700	1.790	0.4618	0.259
0.230	0.777	0.0917	0.118	0.800	1.994	0.5580	0.280
0.240	0.799	0.0976	0.122	0.900	2.194	0.6563	0.299
0.250	0.823	0.1036	0.126	1.000	2.392	0.7560	0.316
0.260	0.846	0.1096	0.130				

CONVENTION OF THE AMERICAN SOCIETY OF RAILROAD SUPERINTENDENTS.

The twenty-sixth meeting of this association was held at the International Hotel, Niagara Falls, N. Y., on Sept. 9 and 10. At the opening session on Sept. 9, with the President, Mr. Charles B. Price (All. Vall. R. R.) in the chair, the first business was the reading of the report of the Executive Committee. This report called attention to the new arrangement of the meetings, and to the desirability of enlarging the sphere of usefulness of the society. It recommended a larger number of committees, or a larger number of members on the present committees.

A proper and convenient classification of the committee work would, of course, require considerable study, but the general idea is to let the society's organization for work follow naturally that of the railways themselves, so far as the department coming under the immediate jurisdiction of superintending officers is concerned. It is further recommended that a number of cash prizes (say of $50 each) be offered, either by the committees or by the society, for papers or special reports on a variety of live topics connected with the operating and maintenance departments. These papers should be received early enough to permit of their being printed and distributed in advance of the meeting. In this connection, the committee suggests the propriety of collecting all papers and reports of importance which have appeared in the printed proceedings of the past 25 meetings and publishing the same in permanent form, carefully edited and well indexed, and with such revision as may seem desirable. Such a volume would be of great interest and value to every railway man in the country, and would undoubtedly command a sale sufficient at least to pay the cost of publication.

It may also be worth your consideration to look into the plan, originally proposed by your Secretary, of forming a closer affiliation with representative bodies of railway officials, such as master mechanics, car builders, roadmasters, accountants, etc., who, under the organization of most railway companies, report directly to the superintendent. Such a movement, however, could best be initiated by a meeting of the executive committees of each organization, to look over the ground and report to their respective bodies such recommendations, if any, as may seem to the best interest of all.

The report of the Treasurer, Mr. R. M. Sully, showed the following summary: Balance in hand in 1895, $1,311; receipts, $1,467; expenses, $1,408; balance in hand in 1896, $1,369. The report of the Secretary, Mr. C. A. Hammond, showed that the membership consists of 214 active members, 18 associate and 5 honorary; 5 members have resigned since the last meeting, while 3 have died. The total present membership is 237, a gain of 12 over those reported at the last meeting. Since the last meeting the Society has lost the following members by death: John Adams, General Superintendent, Fitchburg R. R.; Wm. G. Wattson, Division Superintendent, West Shore R. R., and Waterman Stone, honorary member, and the first secretary of the society. Pecuniarily there has been a falling off from last year, more than offset, however, by decreased expenses. Besides the regular reports and proceedings and the papers by members, the Society has within the last few years reviewed, and published in its proceedings, special papers, including the following: "The Improvement of Railway Track," by E. E. Russell Tratman; "Rails and Rail Fastenings," by J. Churchward; and "Roadway Department Economics," by Andrew Morrison.

The next business was the reading of the report of the Committee on Roadway, an abstract of which is given in another column. This report dealt mainly with the now very important question of the value of tie-plates, but concluded with the suggestion that the question of the merits of different processes of tie preservation and the experience with ties so preserved should be taken up by the committee for the next year. In the discussion, Mr. Derr (Erie R. R.) said that he had in use some hundreds of thousands of the Servis plates, and he advocated their use on every tie on curves and on alternate ties on tangents; he did not favor thick plates. Mr. Hammond thought thick plates advisable for yard tracks.

The report of the Committee on Machinery was then presented by Mr. Potter (Flint & P. Mar. R. R.). He explained that the committee believed that the general subject was fully taken up by the mechanical societies, and had therefore prepared a short report on the motive power of the future, referring to electric traction. An abstract of this is given below:

Electric Locomotives on Railways.

We have arrived at a very interesting point in the evolution of railway motive power, a point of transition from old methods and theories to new ones, a point from which it seems possible to almost certainly predict the entire change from steam to a more economical motive agent. Already the electric motor appears as a formidable competitor of the steam locomotive in suburban and inter-urban traffic in many parts of the country, and he who brings himself to believe that the application of electric power for transportation purposes will never get beyond this class of traffic has a very narrow vision of the field of progress. Unless we make the assumption that we have reached the end of progressive development, we must admit the very great probability of the entire suppression of steam by electricity as a motive power on our railways, not only in suburban and inter-urban traffic, but in cross-country traffic also.

Primarily, such change will take place because the perfection of economy has probably already been reached with regard to the application of steam. We have every reason to believe that the steam locomotive of the present day represents the perfection of economy in its peculiar field, or very nearly so, as there are no valid grounds for believing that the application of the principle of compounding will work much of a revolution in economical locomotive practice, and there seems no other direction in which to look with any degree of confidence for a further economical application of steam power.

There is a wide chasm between the actual and the theoretical economy of the steam locomotive, and it is a chasm which the highest talent of the entire civilized world has for many years been trying to bridge. The effort has resulted in the production of a wonderfully perfect mechanism, the modern locomotive. But in spite of its perfection, the modern locomotive is far from being an economical machine when judged by the standard of the theoretical, and the very fact of its perfection is the sign of its doom. There still remains this chasm to bridge, and there still remains the inventive faculty of mankind which is striving to bridge it.

As long as there was any possibility of improvement in the steam locomotive, man's inventive faculty concentrated itself there, and by every possible means endeavored to attain the theoretical point of economy with the aid of the agent, steam. But now the time is at hand when the limitations of steam have been fully recognized for all practical purposes. The limit has been reached. But the perfect application of steam still falls far short of the goal strived for; that is to say, the perfect machine is actuated by a force which has properties that do not admit of the highest economy. Man's inventive faculty, therefore, must turn to this new force which has properties that promise a greater economy in its application to motive power and strive to invent and perfect the machine which shall control and apply it. It seems just as certain that the perfect electric motor will be evolved from the present conditions as it is certain that the perfect steam motor has been evolved from the conditions which were present 50 years ago.

The first efforts to apply electricity are crude, just as the first efforts to apply steam were crude; the first electric motors are very imperfect, just as the first steam motors were very imperfect; but constant work on the problem will gradually evolve improvement after improvement, just as the steam motor was improved, until at last it has produced the mechanism which controls and applies the electric force to the full extent of its natural limitations. What those limitations are, we can only conjecture; they are no doubt much further in the future than the limitations of steam power were three-quarters of a century ago.

However, the almost certain knowledge that electricity will eventually supersede steam as a motive power on our railways need not disturb us in the least; it need cause not the slightest uneasiness to any existing interest, because it is absolutely certain that the supersession can only take place in conformity with well-defined laws of progress which must infallibly operate to adequate compensation for all apparent losses incurred during the period of transformation. It will merely represent a higher development of the means of transportation, and will have its analogy, so far as economic consequences to existing interests are concerned, in the change from the stage coach by the steam locomotive.

The 35,000 steam locomotives on our railways, representing a capital investment of at least $250,000,000, are not to be consigned to the scrap heap on an uncertainty, nor even in a hurry. Before the new power has the slightest chance to supersede the old, it must positively prove itself the economic superior of the old, and the demonstration of this economic superiority necessarily carries with it full compensation for all apparent losses that may be incurred.

We shall be compelled to meet these problems with our present resources as long as possible, and manipulate our present instruments for all they are worth, until their insufficiency has been absolutely demonstrated. When that time comes, there will be nothing left for us not to change to the new instruments and enter the field of competition on equal terms. It stands us in hand, then, to keep pace with the development in the science of electrical engineering, so as to be fully prepared to act intelligently on the changes that force themselves upon us, whenever it so happens that those changes are demonstrated to be unavoidable.

There was not much discussion on this, but what little was said appeared to indicate that a change from steam to electric traction was most probable but could not be a practical issue for very many years to come.

The report of the Committee on Transportation was read by Mr. Knibloe (Buff. Creek R. R.); it dealt mainly with the tonnage standard for loading freight trains, as a means of economy in freight service, and was substantially as follows:

Tonnage Rating of Freight Trains.

A circular was sent out containing interrogatories as to the methods of loading trains, whether by the tonnage system or by the car system. From over 200 members only 52 replies were received. Of the 52 roads represented, 22 were loading trains by the tonnage method, the balance were not. From the replies received from the members on whose road the tonnage system is in vogue, it is clearly shown that large savings can be made by use of the tonnage system. The percentage of increase shown in tons or cars per train by reason of the use of the tonnage system varies from 3% to 20%. The use of the tonnage system in five cases reported has served to increase the average speed of trains. In the other cases reported the speed has either decreased or no change has been noted. In a majority of answers it is shown that the tonnage system of loading trains gives greater uniformity of movement and avoidance of overloading of trains. Reports show that there is a large field for improvement in systematic effort tending to increase the number of tons of freight per car. One member reports that he has made an increase of from 12% to 15%, which is a remarkable showing. We therefore recommend that the tonnage system be used in loading trains in preference to the car system, and that the question of the loading of cars to full capacity is one that deserves close attention and will give very gratifying results.

In the discussion it was suggested that this was a case for the use of the dynamometer car to determine the actual efficiency. Mr. Brunn (Erie R. R.) said the tonnage system is giving excellent results on his road, one important result being that more empty cars are now available. Mr. Knibloe considered that additional track scales should be put in to facilitate the working of the tonnage system, while the length of trains should in any case be limited to that which the train crew can properly handle, regardless of loads.

In the afternoon there was an excursion to the power house of the Niagara Falls Power Co., after which another business meeting was held. At this meeting Mr. Derr (Erie R. R.) presented a very brief report from the Committee on Signaling, explaining that it had been thought preferable to invite some signal engineers to address the society. He therefore introduced Mr. Charles Hansel, Vice-President and General Manager of the National Switch & Signal Co., who delivered a most interesting address on the principles of signaling and interlocking, illustrated by an exhibt of the appliances used, and a complete set of instruments of the train-staff system of block working. In the explanation of the operation of these appliances he was assisted by Mr. Patenall, the inventor of the Patenall electro-mechanical slot. When Mr. Hansel had concluded his address, Mr. J. G. Schreuder, Chief Engineer of the Union Switch & Signal Co., exhibited a working model of an overlapping block signal system for single or double track lines, the signals being of the disk or "banjo" pattern. This system we shall describe and illustrate in another issue. The discussion was postponed until the following day, when Mr. Derr and Mr. Brunn explained the very complete system of absolute block working on the Erie R. R. Mr. Price (All. Vall. R. R.) has two yard sections fitted with the Union Switch & Signal Co.'s system above noted. Mr. Neville Priestly, of the Indian State Railways, said that on these railways there are signal and interlocking plants at the stations, but not to any extent on the open line, owing to the lightness of the traffic. We shall give a more complete report of this discussion in a later issue.

In the evening there was the annual banquet, which was a very enjoyable affair.

At the meeting on Sept. 10, the discussion on signaling was taken up, as already noted, after which there was a general discussion on the report of the special committee (presented at the meeting of 1895) on "The Relations Between Railways and Their Employees, Including Methods of Training and Discipline." In the afternoon there was an excursion down the Niagara Gorge Electric Ry. to Lewiston, on a special train, by invitation of Mr. J. M. Brinker, President of the railway. The party then crossed the river to Queenstown and returned on the Canadian side of the river by the Niagara Falls, River & Park Electric Ry.

CONVENTION OF THE ROADMASTERS' ASSOCIATION OF AMERICA.

The fourteenth annual convention was held at the Cataract House, Niagara Falls, N. Y., on Sept. 8, 9 and 10, with a fairly large number of members and guests in attendance, and an exceptionally large and comprehensive exhibit of track tools and appliances. The opening meeting was held Sept. 8, the President, Mr. C. E. Jones

(C., B & Q. R. R.) being in the chair, and the Vice-President, Mr. Kerwin (C. & N. W. Ry.), and the Secretary and Treasurer, Mr. J. B. Dickson (C. & N. W. Ry.) also present. The meeting was called to order at 11 a. m. Mr. Jones read a brief address, referring to the important work of the proper maintenance of the 180,000 miles of track in this country, and the proper handling of the army of men engaged in the work. The roadmaster should be able to instruct his subordinates in theory, and to lead and direct them in all practical work, especially in case of washouts, wrecks or other emergencies. He briefly referred to the aims of the association in bringing roadmasters in contact with each other, for the exchange of opinions and experiences, with the object of improving their efficiency and value to the railways. The association, he said, now has about 600 members.

Brief addresses were then made by some of the older members. Mr. Caffrey (L. V. R. R.) said that he never failed to get instruction at these meetings, and to go back with new interest and confidence in his work. He thought that the higher officers do not yet recognize the importance of the association and its work, and that it would be for the benefit of the railways if the officers insisted upon their men attending the conventions instead of merely giving them permission to attend when it is asked for. He also referred to the great increase in speed of trains which had been so noticeable within recent years, and which has in many cases been apparently made almost without consideration of the track conditions. Mr. Kerwin referred to the satisfactory condition of the finances of the association, and Mr. Collins made a few remarks as to the desirability of members present attending the meetings instead of sitting outside and discussing matters in a personal way. It may be noted here that there was very little interest shown in the discussions, though these are (or should be) the most important part of the proceedings. Perhaps if the reports were required to be sent in to the secretary in time to be distributed to the members a month or so before the meeting, the discussions might be more free, as the members would have had time to consider the reports.

The secretary, Mr. Dickson, then read his report for the year, showing the following results: Receipts for dues, fees and advertisements in the annual report, $1,941; expenses, $1,325; balance in bank, $615; amount still due to the association in payment for advertisements, $225. A vote of thanks was tendered to Mr. Dickson for the efficient manner in which he has transacted the business of the association. The list of applicants for membership was then read, and after their election the meeting adjourned.

The afternoon session commenced at 2.45 p. m., and the first business was the election of officers, which resulted as follows: President, R. Caffery, Lehigh Valley R. R.; First Vice-President, A. S. Weston, New York Central R. R.; Second Vice-President, T. Hickey, Michigan Central R. R.; Secretary and Treasurer, J. B. Dickson, Chicago & Northwestern Ry.; Member of Executive Committee (for a term of three years), Wm. Brandt, New York, New Haven & Hartford R. R.

The general business having been disposed of, the reports of committees were taken up, the first on the list being that on "Tie-Plates," an abstract of which is given in another column.

The discussion on this important subject was far from satisfactory, being mainly of a desultory and fragmentary character, in spite of the fact that nearly every man in the room had more or less experience with tie-plates, and in spite of the vigorous remarks of Mr. Jones and Mr. Kerwin, who rightly rebuked the members for this unreadiness. They meet mainly for the purpose of discussing practical questions, and if they do not discuss them a great proportion of the value of the convention is lost. As Mr. Jones said, if he were to talk to any one of these men when meeting him out on the track, they would give their own ideas and experience freely, and probably criticise the report in some way, while here they practically allowed it to pass by with only half-hearted consideration.

Mr. Collins said that in his experience tie-plates do hold the rails to gage, and he much preferred a plate with a shoulder the full width of the plate, as it puts a greater proportion of the resistance on the inner spike. He has had plates on 3° curves in main track, and 10° curves in branch track, laid five years ago, the rail braces being at the same time removed, and there has been no occasion to re-gage the track. It would be a wise economy to use tie-plates on all curves, and especially on switch leads, as ties and switch timbers wear by rail cutting and the adzing of the seat of the rail to set it back vertical. The use of a shoulder greatly reduces the wear or "necking" of the spike. A shoulder plate is preferable in any case, but he would insist upon it for use on curves. He was also strongly in favor of the use of tie-plates instead of rail braces. Mr. Hawkins (Nor. & So.) said his road uses cypress and white cedar ties, and next year it will complete the application of tie-plates to all ties. A great advantage in their use is the avoidance of continual re-gaging of the track. He was not inclined to believe in the necessity of using a shoulder on the plate, especially if the plate is properly punched to fit the spikes and rail. Mr. Dodson said that with oak ties it was not economy to use tie-plates on curves of less than 3°. He put plates on a 10° curve 18 months ago, and has had no trouble, while formerly using a brace on each tie, the track had to be re-gaged twice a month. Mr. Ross (Flint & P. M.) said that the use of the tie-plates increased the life of hemlock ties two years. He thought tie-plates better than rail braces, while the latter require three extra spikes to each brace, and the former requires no extra spikes.

Mr. Shanks (C. Vt.) said that in Massachusetts the life of a hemlock tie is about five years without plates and eight years with plates, but he would prefer a wider base to the rail instead of using tie-plates, since in his opinion this would give the same advantage at less cost.* He has used plates with and without a shoulder on top, and prefers the former. Mr. Greening (Lehigh Valley) said that in one case the rail necked the spikes so much as to widen the gage and nearly cut off the heads of the spikes. Mr. Dodson (So. Ry.) said that a shoulder added about 2 cts. to the cost of a plate, but he questioned the use of a shoulder, more particularly one 5 ins. long, or a shoulder on each side of the rail. With a rail brace, the cutting of the tie along the edge of the rail base throws the weight upon the head of the brace, tending to pull the spikes at the heel, while the tie-plate prevents this first cutting action. Other members spoke in favor of a shoulder tie-plate, with shoulder the full length of the plate, and Mr. Stickney (B. & Me.) said that he shimmed on top of such a plate. A vote was taken on the question of the advisability of using a shoulder or lip on the upper surface of the plate, and resulted as follows: 39 in favor of shoulder, 7 in favor of a flat plate. Several members, however, who use only the latter plates refrained from voting, and it should in fairness be pointed out that the flat-topped plate is the form used very much more extensively than the shoulder plates. On roads where track heaves, also, the shoulder might be somewhat of a trouble in shimming the track.

The meeting then adjourned. In the evening there was a very pleasant "parlor entertainment" at the hotel, consisting of songs, music and recitations, which was somewhat of a novelty and was very conducive to the more intimate acquaintanceship of the members and their friends.

At the morning session on Sept. 9, the first business was the election of Mr. J. A. Lahey (C. & N. P) as a member of the executive committee to fill the uncompleted term of Mr. G. W. Bishop, who has resigned on account of retiring from railway service. The report of the committee on "The Best Method of Protecting Facing Point Switches" was then read by the chairman, Mr. W. D. Otis (N. Y. Central):

Protecting Facing Point Switches.

The means of protection should be as follows: (1) A distant signal placed at least 2,000 ft. from the switch, depending upon the location; (2) A home signal located at the switch (with a positive indication in each direction to show whether the switch is set for the main or side track); (3) A facing lock which locks the switch. These should all be operated by a two-lever interlocking switchstand, so constructed that when the signals are put at danger it unlocks the switch so that it can be operated. The interlocking system should be so arranged that the danger signal cannot be put to indicate safety until the switch is again set for the main track.

The regular proceedings were then interrupted to hear brief addresses from Mr. John Doyle (Det., L. & N.), Past President, and Mr. I. Burnett, the founder of the association.

When the subject of the report was taken up for discussion, there was little desire to speak, and such discussion as there was had to be dragged out by the vigorous questioning of the chairman, who seemed unable, however, to arouse any particular interest in the matter. Mr. Weston said the plan recommended was that used on the New York Central R. R., for single track lines; 2,000 ft. is the least distance that it is safe to give an engineman to stop his train during foggy weather, and the signal cannot show "clear" unless the switch rail is fully home against the stock rail. The home signal at the switch is not a semaphore, but a double-lever switchstand with lamp and single target; it shows a red target and light when set for the siding, and no target and a white light when set for the main track. This is the practice on this road. Mr. Coates (N. Y., N. H. & H. R. R.) pointed out that this was in conflict with ordinary interlocking rules, by omitting the one signal, so that when set for main track there is a distant signal but no home signal. Mr. Doyle suggested putting on a white target or taking off the white light, so as to make the day and night signals the same. Mr. Shanks said that as a matter of fact different roads have distinct methods of practice, and it should be the duty of the association to endeavor to crystallize these into one uniform practice. There should be at every switch a red and a white signal. The absence of the latter tends to lead the engineman into carelessness in looking out for a red signal, while with a signal for either position his attention is attracted to the switch. As a result of the opinions expressed in this direction it was voted to amend the second recommendation in the report by the addition of the phrase given in parentheses. Mr. Coates said that there were other devices besides switch locks to effect the same purpose, including a yoke which must be thrown (first setting the distant signal) before the switch lever can be thrown. Mr. Reisler thought the report ought to be extended to include switches at block signals; on the Erie R. R. the switches and block signals are operated together without the use of an interlocking machine. Mr. Caffery, however, thought that the report was intended to refer only to switches operated directly by hand and not those at interlocking points. Mr. Reisler's motion was not carried.

Next in order came a paper on "Ditching," by Mr. J. M. Meade, Res. Engr., A. H. S. F. Ry. This was read by the secretary and received as information. The following is an abstract of this paper:

Ditching.

Whilst there is a general desire for action and information on this subject among all of us, it must be admitted that we have yet a great deal to learn, and this very ignorance is mainly due to a lack of teaching and training from those who know the real meaning or philosophy of the art.

As nearly every road has its own standards in regard to cross section and shape of road bed and ditching, it hardly seems necessary to attach to this paper plans showing how track should be ditched. It is an old subject. The main object is to remind the roadmasters of the great importance attached to this matter; economy in track maintenance begins right here, and one of the most important factors in prolonging the life of cross ties and saving the rails rests with good drainage. Good ditching shows for itself and tells its own story.

Our managers should never grumble or hesitate as to the security derived and money saved in allowing the roadmaster sufficient force to keep his track well drained. One or two days' rain will often spoil weeks and months of hard work by the section foreman by neglect of this kind.

In ballasting or other important track work, great attention should be given to the matter of drainage; every ditch should be amply large to carry off all the water that will ever come into it and sufficiently deep to keep the moisture away from the ties and ballast. Frequently on new roads, cuts will slide in and sometimes make the track impassable; this is often prevented by a good surface ditch on top, placed some distance back from the top edge of the cut, as circumstances will admit. In cases where this will not stop the sliding, the writer has known bad cases cured by cutting vertical trenches on the slope of the cuts from top to bottom, placed about 20 ft. apart, as the case demands, with the dirt mounded up in oval shape between the trenches. This is a good remedy where the earth seems to be alive and constantly on the move.

Many roadmasters seem to think that it is not necessary to spend any money draining banks. This is a mistake; banks should be properly drained as well as cuts. Rough track is often found on embankments caused by the ties being buried in mud. This is wrong; ties on embankments should have free drainage from their ends, on a slope of at least over 1 in. in 12 ins. We often meet with material in cuts of a spongy or boggy nature, where even rock ballast will not keep the track smooth. I have seen bad cases of this kind cured by putting porous tiling in the side ditches and cinder ballast at least 12 ins. deep under the ties. Where places of this kind are encountered in cuts there is no end to the trouble and if the grade of the railway can be changed to at least 0.5% it will often give permanent relief.

We often hear the question raised: "How much of the time of a section gang should be given to ditching?" This can best be answered by the circumstances governing the case. In the proper seasons for this kind of work, and where sufficient help is allowed, it is considered good practice to give at least one-fourth of the time to the matter of ditching.

The next report was that of the committee on superelevation on curves and the use of easement curves; this was amended somewhat during the discussion and the following is the report substantially as adopted:

Superelevation on Curves for Speeds of 10 to 70 Miles Per Hour, and the Advisability of Using Easement Curves.

We are of the opinion that curves should be elevated for the highest speed at which passenger trains usually run over them, limited, however, to an elevation of about 7 ins. if the track also carries freight traffic. If exclusively passenger traffic we would not be limited to 7 ins. if the circumstances seemed to require more.

We recognize the various conditions that may require a modification of this rule. In such cases each will be governed by the prevailing circumstances, bearing in mind that the passenger traffic deserves more consideration than freight.

At the proper speed for which the curve is elevated each rail carries equal weight; in other words, a weighted line through the center of gravity of the car will remain perpendicular to the plane of the rails while passing the curve.

When trains pass curves at greater speeds than the track is elevated for, the weight on the outer rail is increased, flange friction is increased and the tendency to turn the outer rail over is much greater, but we believe in full elevation because it is not only safer but a much better riding track and the advance in the condition of track and increased average speed require greater attention to this matter.

We are decidedly in favor of easements for all curves of 2° or over. They make the entrance to curves gradual, reduce the shock at high speed and keep the line much better. They should be put in with a transit and should be of sufficient length to carry all the elevation at the rate of about 50 ft. per in. That is, the elevation should begin with the easement and reach full elevation at beginning of regular curve. The spiral or cubic parabola is equally good.

Where no easement curves are used we recommend full elevation at ends of curves, running it out on tangents at the rate of 50 ft. per in., except for reverse curves. Uniform elevation, good line, gage and surface are as essential as the proper elevation for a perfect track.

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*It is hardly necessary to point out that this is an entirely erroneous idea. Such a distribution of metal in a rail would be very bad, and the added metal would add but little strength to the rail, while that part lying between the ties would be so much wasted metal. It is far better practice to slightly reduce the width of the rail base with a view to the use of tie-plates, as in the Dudley type of rail sections, where the width is slightly less than the height.

Where easement curves are not put in by the engineer, good results can be obtained by throwing in the whole curve a given distance and flattening the ends by extending the curve beyond the ends of the original curve equal to one-half the length of easement. To get easement of a certain length as the curvature increases, the amount the original curves move in will increase.

Your committee recommends the use of the formula in mechanic's text books, viz.:

$$\text{Elevation} = \frac{G \times V^2}{32.2 \times R} \text{ in which}$$

G = gage of track in feet,
V = velocity of train, in feet per second, and
R = radius of curve in feet.

The following table computed by this formula shows the elevation in inches for each curve, 1 to 10°, and for speeds of 10 to 70 miles per hour, inclusive:

Deg. of	Miles per hour							
curve.	10.	20.	30.	40.	50.	60.	70.	Remarks.
1	1-16	¼	⅝	1	1⅜	2⅛	3	Maximum elevation about 7 ins. by the formula given.
2	⅛	½	1¼	2	2¾	3¾	5	
3	3-16	¾	1⅞	3	4⅛	5½	7	
4	¼	1	2½	4	5½	7	..	
5	5-16	1¼	3⅛	5	6⅞	...	..	
6	⅜	1½	3¾	6	8⅛	...	..	
7	7-16	1¾	4⅜	7	...	...	..	
8	½	2	5	8	...	...	..	
9	9-16	2¼	5⅝	9	...	...	..	
10	⅝	2½	6¼	10	...	...	..	

Mr. Doyle explained that it was not thought necessary to work out the elevation for the high speeds on the sharp curves, since in operation the trains would be slowed down on such curves. Mr. Coates (N. Y., N. H. & H. R. R.) said he preferred a formula giving a higher rate of elevation on a high degree curve than on one of low degree. Thus for curves of 1°, 2°, 3° and 4°, he would give (for 40 miles per hour) an elevation of 1½, 2⅜, 3⅛ and 4 ins., instead of the 1, 2, 3, 4 ins. given by the committee. He would also limit the elevation to 6½ ins. The Pennsylvania R. R. uses a cord 75 ft. long, stretched on the gage side of the outer rail, the middle ordinate being equal to the elevation. Taking a case where passenger trains run down grade at 60 miles per hour, and freight trains go up the grade at 15 miles per hour, should the elevation be calculated for the fast or the slow train, as the high elevation necessary for the former will seriously affect the operation of the latter. Mr. Stimson (G. R. & I.) said that under such conditions on his road the curves are put up for the fast trains, though the freight trains wear the inside rails pretty badly, but the management requires this to be done for the safety of the fast trains. Most of those participating in the discussion approved of the use of easement curves, though some members did not appear to be clear as to the purpose or laying out of such curves. Mr. Emery thought there are places where such curves cannot be put in on existing roads, as, for instance, where the curve ends at a bridge or tunnel, or in a narrow cut with masonry retaining walls, or where curves come very close together, while the method of flattening the ends and sharpening the centers of curves would necessitate an entire realinement and the purchase of additional right of way in some cases.

In the afternoon there was an excursion on the Niagara Falls, River & Park Electric Ry. (on the Canadian side of the river). At the evening session the report of the committee on "The Latest Improvements in Frogs and Switches" was taken up, but it did not in any way follow the ground indicated by the title, since it was merely a general sort of report on frogs and switches, reiterating recommendations which are now pretty familiar. An abstract of this report is given below:

Frogs and Switches

It is very essential that all roads should adopt some form of frog and switch as a standard, for use at all places except where some special design of construction is necessary. Where railways do not manufacture their own frogs, switches and crossings, it is well to furnish frog makers with a complete set of their standard blue prints and specifications for same, but in the event of special frogs, etc., careful measurements should be taken and blue prints furnished accordingly.

For main line work, spring rail frogs not less than 15 ft. long; and in yard work, wherever practicable, spring rail frogs of not over 12 ft. in length. Variations from this, of course, depend greatly upon the circumstances under which the work is to be laid out. Where a rigid frog is adopted for such work with a heavy traffic, a bolted and filled frog with ¾-in. steel plates is certainly preferable and more economical. A great deal depends, however, as to the kind of frog to be used, which can only be determined upon under the existing circumstances.

The clamp frog may be utilized to advantage in main line service where traffic is light; the great objection, however, to this class of frog is its inability to support itself; the clamps naturally become loose, in consequence of which the wing rails receive the weight of passing traffic, the point dropping below the surface of the wing rails, causing them, sooner or later, to become battered and useless. The only advantage gained in the use of the clamp frog is that when one wing rail is worn it admits of the frog being transposed, or having a new wing rail substituted at a small cost, thus prolonging the life of the frog. In complicated yards where a large number of switches and frogs are necessary this style of frog cannot be used to good advantage on account of the long ties, as the clamps project below the base of the frog, requiring a greater spacing of the ties or shorter ones used; whereas a frog with a plate can be used under any conditions. In yard work where sharp curves are necessary, a frog 12 ft. long is recommended, owing to the fact that frogs placed in curves of low radius require a wider throat and flangeway, consequently the space from outside of guard rail to point is greater in order to allow the wheel flange to pass through without binding, overcoming the battering and pounding down of the entire frog. The clamp frog, for the time being, gives but little trouble, having no bolts and rivets to become loose, but is on the whole a very expensive frog as a result of its loose method of construction, there being no support whatever to the point. On the other hand, the bolted frog with ¾-in. steel plates, made in proportion to the size of the frog, has a tendency to support it equally through its entire area of bearing and is certainly the most economical.

While spring rail frogs in yard construction may or may not be as economical as the bolted and filled frog, it is not good policy to make a general use of them in freight yards where a great amount of switching is required, as switchmen are more or less liable to have their feet caught in the frog. The objection to the double rigid frog, as usually made, is that the wheels are furnished with no guard in passing from one point to the other. In order to overcome this difficulty it is well to have the guard rail of the frog so made that it will shade both points ⅛-in.; in this manner one frog will answer as a guard for the opposite frog while trains are passing through the combination. Rigid double frogs up to No. 7 can be used on combinations of 8° 10′. In combination switches above this the use of movable point frogs is recommended.

In a proposed guard rail two clamps are made use of on either end which hold the rail rigid and overcome the possibility of the rail turning over. The two bends in either end have a tendency to crowd the wheels gradually through the frog, preventing them from striking the point, reducing to a minimum that sudden shock which would otherwise be the result in the use of an ordinary guard rail. For main line passing tracks a No. 11 spring frog is recommended. For yards and miscellaneous sidings it is impracticable to adopt a standard frog as all depends upon the location and amount of room at disposal.

Since the adoption of the interlocking system at railway crossings, allowing trains to pass at full speed, the expense is consequently materially increased, as they require a greater amount of care and attention. Thorough inspection should be made each day of such high speed crossings, and any defects at once remedied. Roadmasters must endeavor to keep them in such shape as to avoid the complaints which might otherwise arise from other roads with which their line intersects, reducing the cost of maintenance to a minimum, and in order to do this they should receive constant care from the time they are placed in position. A crossing should be placed in such a manner as to be perfectly rigid, and the least expense will be incurred in the maintenance of such a crossing. In order to accomplish this it is advisable, if the circumstances will admit, to have at least 4 ft. of broken stone foundation, with framed timbers of suitable kind and size, and a properly-constructed drain from the bottom of the pit. The gage of crossings on tangent should be 4 ft. 8½ ins., with 1¾-in. flangeways, placed on ¾-in. steel plates, made in proportion to the angle and area of the crossing.

On one complicated crossing the flangeway on the inside of the curve is 2¼ ins., and on the outside 2⅜ ins. The flangeway is necessarily made narrow on the inside so as to answer for a guard rail and wider on the outside to allow the necessary space for curvature of the wheels.

Switches in main tracks should be put in with a theoretical lead corresponding with the theoretical switch point, in accordance with the angle of the frog, and where a 15-ft. switch point is used, as is very often the case, the length of the lead should be shortened the difference between the theoretical switch point and the 15-ft. point, which will make the lead practicable. Where a 15-ft. switch point is used as a standard for yard work the leads can be shortened; for instance, a No. 15 frog can be used on any lead from 115 to 132 ft. No. 10 frogs are often used as a standard in connection with a No. 9 lead. Then why not use a No. 9 frog with a lead to correspond, as it certainly would be practicable, furnishing as it does a perfect curve in making use of a frog one size less and would last longer than a No. 10 if a rigid frog?

All switches should have a 5-in. throw, as they are more economical to keep in repair and also do away with that element of danger caused by wheels catching the open point, which is often the experience with switches having less throw. It is very essential to have a suitable guard rail placed 4 ft. 6⅝ ins. from the point of the frog, regardless of the gage of the track, as oftentimes tracks leading to factories, etc., are gaged to 4 ft. 9½ ins. Two tie rods on all yard switches are also recommended, with a stop block on the stop rail; the stock rail should be bent 9 ins. ahead of the point and the switch point will set up snug and in perfect shape as far back as the point is planed. A kink in the stock rail ahead of the point all the way from 15 to 20 ins., is often made use of. The objection, however, to this method of construction is that it permits worn or double flanged wheels to run in the space between the point and the stock rail as the only part of the point that sets up against the stock rail is just near the point of the switch. All main track switches should be made with reinforcement bars connected to the points, in order to hold them securely in position should they become broken, and thereby prevent in many instances a serious derailment.

At the morning meeting on Sept. 10, the first subject taken up was Rail Joints. The committee had made no report, but the chairman thought the matter important enough to be discussed even though the committee had neglected its duty.

Rail Joints.

Mr. Brown approved a suspended joint with ties 12 to 15 ins. c. to c., but with the addition of a base support; he has tried the Long and Thompson joint. Mr. Stickney has been using the Weber and Continuous joints, and his foremen claim that the latter is the easier to maintain. Mr. Black (Manhattan Elevated) said that seven years ago his road adopted the Samson angle bar on a 70-lb. rail, but after about two years' service this would break in the web. They then tried a truss joint, and then the Weber joint, which is now the standard and is applied to 90-lb. rails. Some of the Weber joints were put on old rails which had been in use nine years and were ready to be taken out. The rails improved so much at the ends that they remained in four years more. Mr. Coates said that the Weber joint is used on the four-tracks of the New York, New Haven & Hartford R. R., leading out of New York; careful measurements of the four joints which had the Weber joint applied on April 25, 1893, showed the following deflections:

	April 24, 1893. in.	May 1, 1893. in.	May 9, 1893. in.	April 14, 1896. in.
Joint No. 1	5-64	2-64	1-64	0
" No. 2	5-64	2-64	2-64	0
" No. 3	6-64	3-64	2-64	0
" No. 4	4-64	2-64	1-64	1-64

Mr. Hickey (Mich. Cent.) said that many of the 44-in. iron splice bars were taken out, straightened and put back, but the 44-in. steel bars did not give any trouble by bending. Mr. Shanks has had good results with Weber joints on new 75-lb. rails, and by putting the Continuous joints on old 60-lb. rails which had had 16 years' service, he brought the rail ends back into tolerably good surface; he approved of a suspended joint with bridge or base support. Mr. Ware (B. R. & P.) had put Weber joints on rails that had got badly pounded by 13 years' service, and brought the rails back to better condition. Mr. Sullivan (Boston & Albany) applied 12 Continuous joints six years ago; two of these were recently taken off, but a straight edge placed on the rails and on the splice bars showed no deflection. Mr. Caffery (L. V.) evaded the usual inquiry about miter joints by saying that the discussion referred to joint devices, while the miter-cut rail ends could be spliced by any form of joint device.

The next and last report was that of the Committee on Ballast, which was substantially as follows:

Ballast.

1. What is the best kind of ballast?

Stone.—Ballast made from stone, crushed to the proper size for tamping, that will neither solidify in track, nor disintegrate while being worked, makes the best ballast.

Gravel.—The term gravel, as ordinarily used, applies to so many different kinds of material that, in alluding to it, an explanation should follow each statement describing the quality of the gravel in question. We have seen gravel in small quantities, generally in pockets, that was clean, hard stone; ranging in sizes from that of a pea to a hulled walnut. No material could be better for ballast than this, but, owing to the amount of soil and fine sand that is usually put in track with the gravel, we find it inferior to crushed stone.*

Burned Clay.—This has many qualities to recommend it for ballast, and those who have used it the longest are the most enthusiastic in its praise.

Furnace Slag.—This makes very good ballast, and the same may be said of locomotive cinders under certain conditions.

2. What are the best methods for handling different kinds of ballast?

The methods of handling ballast differ under different conditions and localities. What would be economical in one case, would be expensive in another.

Stone is generally moved from the quarry to the crusher by small dump cars on an inclined railway, attached to cables. Where it is convenient to locate the crusher about level with the quarry, parties who move the stone with dump carts claim that they can do it more economically than with cars. After the stone is crushed, it is elevated and put into storage bins, convenient to load into cars by gravity. The distribution of crushed stone on track can best be done with hopper bottom cars. The Rodger ballast car is, perhaps, the most complete car for this work that is in general use.

Gravel can generally be more economically loaded with steam shovel than in any other manner. It can best be handled in hopper bottom cars also, or may be distributed with good success on flat cars, when the haul is not too long, and unloaded with the rapid unloader. Furnace slag and locomotive cinders may be handled the same as gravel.

3. What is the best kind of cross-section for each kind of ballast, both as to roadbed and ballast?

The best cross-section is the one which will keep the destructive elements farthest from the track. Roadbeds should be wide enough to reduce the heaving of the track to a minimum.

They should be drained below the frost line in all clay cuts. Where it cannot be done by open ditches, it may be successfully done with tiling. Whether drainage is made in open ditches or under ground, it should be done with the view of getting the water away from the track as quickly as possible.

In the discussion on this report, Mr. Caffery said he thought ¾-in. stone too small, and would prefer it 1½ to 2 ins. in size, as with this limit there would be plenty of the smaller sizes to fill in. Mr. Coates had tried 2½-in. stone, but found it too large, the stones from the crusher coming out in long narrow pieces, so that a stone of 2½-in. section is entirely too large; he favored breaking to a 1½-in. ring, and thought ¾-in. so small that in tamping the stones would be crushed and broken. He has used trap, limestone and sandstone, the latter being very unsatisfactory, as might be expected, as it breaks in tamping and gradually crushes. Mr. Mott laid one mile of ¾-in. stone screened from dust and dirt, which made excellent ballast, but he would prefer 1½-in. stone similarly cleaned. Mr. Lahey considered it the best practice to use a bottom layer of coarse stone and a top layer of screenings. Mr. Brown thought there were as many varieties of stone as of gravel ballast. If stone is crushed fine it disintegrates so rapidly that it is expensive, and he therefore uses a 3-in. ring. With light rails on coarse stone ballast, however, it is difficult to keep the rail in good surface, as the stones cut into the tie and make an uneven bearing. Mr. C. E. Jones (C., B. & Q.) said that in 1880 his road accepted the proposition of Mr. Davey, of Chicago, to burn 10,000 cu. yds. of clay for ballast, and now the road has hundreds of miles so ballasted, 58 miles being on his own division. Gumbo (not clay) makes the best material for burning as it has more combustible matter than clay, and comes out in pieces about the size of a walnut, though some clay makes good ballast. Even good stone ballast will crush under bad rails, and burned clay has been criticised because it has failed under similar conditions, but if properly burned and properly laid under good rails it is an excellent material. On newly ballasted track, the burned clay is laid about 8 ins. deep under the ties. At first it cost about 90 cts. per cu. yd. at the pits, but now it costs only about 19½ cts., the company furnishing the ground, coal and tracks. One ton of coal will burn about 5 cu. yds. of ballast. Slack coal is used with a little hard coal to help the fires, but wood will not answer the purpose. There must be an experienced man in charge to attend to the burning. Contrary to the claims of contractors welds will grow in this ballast. As to the handling of ballast, several members spoke in favor of the Rodgers' ballast car.

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*Reference might have been made here to the practice of washing gravel for ballast.—Ed.

A motion to reopen the discussion on tie-plates was suggested by Mr. Emery, but it was eventually decided to take up the subject again at the next annual meeting. After the passing of various resolutions of thanks, etc., the meeting adjourned. In the afternoon there was an excursion to the power house of the Niagara Falls Power Co., and a dinner was given at the hotel in the evening. On Sept. 11 there was an excursion by rail to Lewiston, and thence by boat to Toronto, and a very large number of members participated in this trip. The next meeting will be held at Old Point Comfort, Va., on the second Tuesday of September, 1897.

There was a large and representative exhibit of track materials and appliances, arranged by the Road and Track Supply Association, of which Mr. H. W. Frost is Secretary, and a general statement of these exhibits will be found in our Supplement this week.

CONVENTION OF THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.

The fourteenth annual meeting of the Street Railway Association of the State of New York was held at the Bennett House, Binghamton, N. Y., on Sept. 8, with President G. Tracy Rogers in the chair, and 33 delegates of street railway companies and about 60 other attendants present. President Rogers delivered an interesting address.

The executive committee made its report, laying special stress upon the importance of carefully watching bills presented to the State Legislature affecting the physical and financial operation of street railways. In the last session 140 bills and amendments of this character were presented. In view of the increased attendance and volume of business to be transacted the committee recommends that hereafter two days shall be devoted to this annual convention. The report of the Treasurer showed, for the year, receipts of $6,997.86, and an expenditure of $6,700.88. The reading of reports was then taken up and Mr. G. H. Stedman, of Rochester, N. Y., presented the first, upon "The Matter of Transfers." He believed that a liberal transfer system, properly guarded to prevent fraud, pays; and, within certain limits, the more frequent the transfer points, the better. The weight of opinion now seems to favor the "ringing up" of transfers as well as cash or pass coupons. In the debate which followed Mr. Rossiter, of Brooklyn, said that in August his company transported 2,600,000 passengers on free transfers, and increased earnings $40,000. He ascribed the gain to a liberal system of transfers, as his company gives a transfer to a passenger riding on a transfer; though he doubts if 2% of the passengers demand the second one. Mr. Deming, of Buffalo, complained of the abuse of transfers in his city, stating that the system there was so laid out that it is possible to ride all day long on a transfer. Some more complicated system of tickets with the names of streets printed upon them may remedy the matter, but he was not sure. Mr. Robinson said that there were lines in New York city upon which five or six transfers could be secured; the passengers give these tickets to boys who sell them, and trouble results. The travel is too great to permit the use of punched tickets. Investigation, however, shows that the illegitimate use of tickets is not great. On lines in the retail dry-goods districts transfers cause a large increase in travel. To a question of the percentage of transfers as compared with cash fares, delegates answered as follows: In Syracuse, 25% of the passengers were carried on transfers; Buffalo, about 32%; Binghamton, a little less than 25%; Rochester, 27 to 30%; Brooklyn, 22 to 25% in summer, and 16 to 20% in winter; on the Atlantic Avenue Line in Brooklyn, 16% was the average for nine months in the year.

Mr. C. Loomis Allen, of Syracuse, read a paper on "General Track Construction, and the Most Approved Method," advocating especially the use of a harder quality of steel in the rails than was generally furnished. He said that none of the high-carbon rails on the New York Central Railway, near Spuyten Duyvil, have broken after six years of unusually heavy traffic, though the makers saw fit to warn the railway company that they would not be responsible for any damage resulting from the use of what they considered unfit material. Mr. Allen quoted "a firm of steel inspectors" to the effect that high-carbon rails would give from 40 to 60% longer life than rails of ordinary Bessemer steel. To-day, these rails cost no more than ordinary steel rails. In Syracuse rails are being now laid 60 ft. long, 9 ins. high and of the half-groove section. The joint is the ribbed or corrugated 12-bolt, 36-in. joint. Mr. Rossiter said that his company used practically the same rail, but in 30-ft. lengths, and few rails break in handling and the wearing results are more satisfactory than with the old rail. The President closed the discussion by saying that he did not know of many roads adopting the high-carbon standard.

Mr. W. W. Cole, of Elmira, presented the next paper entitled, "How Can We Prevent Accidents and Increase the General Efficiency of Employees." He regarded the proper selection of employees as the first and most important requisite, and he submitted a series of questions put to all new men, the most important of which were as follows: Relating to the ownership of real estate or personal property; to personal debt; the use of intoxicants; the highest wages previously received anywhere. Mr. Cole recommended that all employees should be placed under a bond of at least $200, as this had a restraining influence upon the men and also upon business men recommending men to the company. After a man has been turned in as competent by his instructor, he should pass an examination as to his duties and the regulations of the company. All motormen should be furnished with blank reports to be filled out each evening and giving the condition of his car, and file this report with the foreman of the shops. If trouble with any part is reported, an inspection should at once be made, the report signed by the inspector and sent to the superintendent. Such a system is more efficient than mere verbal reports. Thorough shop inspection is another important preventative of accidents; and this demands a system of reports in all departments that will form a connected chain and check the work of the individual, provided that the system is not complicated and is always attended to. Loss of power is a frequent cause of accident, and no road should try, from an economical point of view, to run too close to a theoretical consumption of power. There are too many contingencies which theory will not meet. Mr. Robinson described the system of instruction in use on the Metropolitan Street Railway. His company has organized a club in one of the depots where a series of lectures are given every two or three weeks, illustrating by stereopticon views the underground trolley, cable machinery and apparatus and the general operation of the road. He considered individual instruction preferable, but stated that the lectures were largely attended and were advantageous. Mr. Rossiter's company depended entirely upon instructors to teach the men the running of the motors, and the superintendent was supposed to instruct the men in the details of each division, grade crossings, stops, etc. Out of 1,600 men employed in August only 16 motormen left the service of the company in that month, showing that the men took an interest in their work. Mr. Fitch, of the Erie Railway, and Mr. C. D. Hammond, of the Delaware & Hudson Canal Company, both approved of the thorough examination of all employees, with schools of instruction.

Mr. H. S. Newton then read a paper upon "Power from the Trolley Circuit." He advocated the sale of surplus power to manufacturers as the only way of reducing loss from idle machinery. In New York State this method of disposal is attended with many difficulties owing to the restrictions put upon it by the insurance people. He illustrated the advantages possessed by the railway companies, as producers of power for private consumption, as follows:

> Take for example a station in one of our cities containing a 1,200-HP. direct-coupled Corliss engine held in reserve, and estimate what could be done with this engine and its attached generator were it thrown into active duty on a private consumer's power circuit. Figure on an investmentment of $75,000 in the engine, generator, and other apparatus relating to the two. Then assuming coal to be worth $3 a ton and the engine to have a fuel duty of 3 lbs. per HP. per hour, we have coal consumed for each day of ten hours:

18 tons, at $3	$54
Cost of labor, engineer, firemen and oiler, say	10
Oil and waste	2
Incidental repairs	10
	$76
Add to this 10% depreciation for one day	21
And interest on the investment at 5%	10
	$107

> Then figuring on an ability to sell the output for ten hours in the day at 2¾ cts. per 1,000 Watt-hours, we have 1,200 HP. for ten hours equals 8,952,000 Watt-hours, at 2¾ cts., equals $246. With cost of production as above stated, the net profit amounts to $139.36, a fair sum to go towards reducing operating expenses.

Mr. Newton believed the purchase of this power would not only be profitable to the users of the smallest unit, but also to those using 50 to 100 HP. steam plants and employing their own engineers. At 2¾ cts. per 1,000 Watt-hours, the charge would be but little over $10 per day for the equivalent of 50 HP. used uninterruptedly. The presumption is that the small engine and boiler employed to move line-shafting, with the increased power necessitated by loss in friction would more than overbalance the bill sent in for electric power. The objections of the insurance companies or Board of Fire Underwriters, seem to be embraced in the one feature of ground return. They suggest that you build a fireproof house, outside the shop, for holding the motor and run the machinery inside by a belt and line-shafting. If this is not done the insurance rate is increased 2%, because the Underwriters claim that no reliable method of insulation has yet been discovered that will make the installation a good risk. Mr. Newton said that in Syracuse there were 400 or 500 iron poles, each pair of which was a dead ground to the trolley wire suspended between them. Yet in three years there has been no ground on these poles. He admits that many disastrous fires have been started by defective installation; but he contended that a large percentage of these resulted from the contact of a current-carrying wire with water or gas-pipes; and that 90% of the arc-light circuits, if subjected to the gas-pipe test, would show as great a capacity for kindling fires as the trolley circuit. Yet these arc circuits, with 3,000 to 5,000 volts difference of potential and their invariably grounded circuits come into any building. He believed that with protected wiring and reliable insulators, both systems could be made absolutely safe.

Mr. James B. Cahoon next read a paper on the "Daily Inspection and Care of Car Equipment." He advocated a rigid daily inspection of motors, trucks and car-bodies by competent inspectors, and enters into the detailed processes of this inspection. Mr. H. S. Cooper, of Schenectady, presented a paper on "The Desirability of Forming a Board of Claim Agents," the subject matter of which was referred to the executive committee.

In the afternoon session Mr. F. O. Rusling, of Rochester, introduced "The Use of Old Rails as Underground Conductors." Mr. Rusling, while Superintendent of the Buffalo Railway Company, called in expert advice to remedy serious indications of electrolysis of pipes within a half-mile of the power house. The pipe system affected and surveyed included three systems of natural gas pipes two of illuminating gas, one of water pipe and two conduits. The large copper cables already connected were found to be entirely inadequate. The danger points lay, one 1,500 ft. north and the other 1,800 ft. east of the power house, with deliveries of 1,000 and 3,000 amperes respectively. To bring this current to the power-house with only 5 volts loss, would have required the use of $8,000 worth of copper. In this emergency the expert recommended the use of some old tram-rails on hand, worn down to 50 lbs. per yard, high in carbon and brittle. Their conductivity was tested to 1,500 amperes, and finally four rails laid parallel were tried on the 1,500 ft. length. Mr. Rusling describes the connection of these rails as follows:

> The rails were bolted in pairs back to back and arranged so that the end of one rail was at the center of its mate. The bonding was effected by scraping contact spots with a file near the end of each rail and amalgamating them with the Edison solid alloy. A steel washer, ¼-in. thick, 1⅓ in. inside diameter and 4 ins. outside, was dipped into hot insulating compound and placed against one rail so as to enclose the contact spot. The hole in the washer was then filled with the Edison-Brown plastic alloy, inclosing an amalgamated steel spiral spring. The upper rail was then bolted on and the completed conductor lowered to the bottom of a wooden trough, resting on one edge so that gravity would maintain the contacts. It will be evident that with this arrangement, two of the bonds on any one rail would have to give way before the circuit could be broken; each bond was made sufficient to transmit 1,500 amperes. When the second set of rails was lowered into place, the trough was filled with a hot insulating compound and a cover nailed down. This compound was cheaper and better than asphaltum; it remains viscous even in cold weather and has high insulating qualities. It is a product of petroleum distillation much lighter than asphaltum and costing about $25 per ton.

This four-rail conduit carried at heavy load 1,100 amperes 1,500 ft. with a loss of 4 volts, as ascertained by repeated and careful testing. A copper insulation would have weighed 20,532 lbs. and cost $2,462.83; the rail lengths weighed 50 tons and cost as scrap but $400. The steel resistance, with 50 bonds in each length, was about 5.63 to 1. The 1,800 ft. length was then treated by laying a 14-rail conduit, with some improvements in the method of assembling them. When tested the performance was again satisfactory, as the 14 rails transmitted 3,250 amperes 1,800 ft. with but 4 volts loss. The rails used weighed 210 tons, and, at $8 per ton, cost $1,680. A copper installation would have cost $10,389 for the same work. The total cost of both rail conduits was $3,322, as compared with $12,852 for equivalent copper. Mr. Rusling does not advise the use of buried rails if copper is used for connections, as it is impossible to get the full conductivity of the rails and the copper oxides rapidly in many soils. There was no discussion on this paper.

The next paper considered was on "Railway Power Stations," presented by Mr. Thomas Henning, of Buffalo, dealing generally with the points to be observed in managing a power station. Mr. W. G. Clark, of New York, then addressed the meeting upon the general subject of "Electrical Development." The convention voted to hold the next annual meeting at Niagara Falls, on the second Tuesday in September, 1897, and to devote two days to it. The officers elected for the ensuing year were: President, G. Tracy Rogers; First Vice-President, W. Caryl Ely; Second Vice-President, John H. Beckley; Executive Committee, H. H. Vreeland, John W. McNamara, Henry M. Watson, C. L. Rossiter; Secretary and Treasurer, H. A. Robinson. The convention closed with a banquet in the evening.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

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THE BROOKLYN WATER SUPPLY has recently been the subject of complaint on account of objectionable taste and odor. A report by Prof. A. R. Leeds, of Stevens' Institute, states that the taste and odor are due to the decomposition of vegetable organisms in the water; which though objectionable are not harmful or dangerous. Mr. I. M. De Varona, Chief Engineer of the Brooklyn Water-Works, in transmitting Mr. Leeds' report, calls attention to the need of laboratories equipped for systematic chemical and biological examinations of the water supply. He has recommended the establishment of such laboratories in his last two annual reports, and believes that the present trouble could have been avoided had such laboratories been in operation. The widespread complaints respecting the quality of the water, however, have resulted in appropriations for needed work in the water department. On Sept. 18 the aldermen appropriated $150,000 for diverting Horse Brook, a polluted stream, which now enters one of the reservoirs, $75,000 for buying and cleaning ponds not now owned by the city, and $311,555 for current expenses, included in which is $45,000 for cleaning ponds and reservoirs now owned by the city.

We note that in the debate over appropriations one of the aldermen expressed his conviction that some of the bad taste of the water was due "to the effect on the water mains of waste electricity from the trolley wires!"

◆

MILWAUKEE'S WATER SUPPLY has been assailed as to its quality by Dr. Kemster, the City Health Commissioner, who declared in a report dated Sept. 12 that the water had been contaminated by sewage from the city and by the dumping of garbage into the lake. Analyses of the water, however, by Prof. Victor C. Vaughn, of the Michigan University; Prof. E. G, Smith, of Beloit College, and A. S. Mitchell, State Chemist of Wisconsin, all show that the water is pure and wholesome.

◆

THE WATER SUPPLY TO JERSEY CITY, which has been furnished by the East Jersey Water Co. since April 12, is now the subject of controversy as respects payment. The company claims that the city is bound to pay for all the water it has received the full price of $43 per million gallons. The city officials hold that as the company did not furnish the full supply on April 12, which it agreed to furnish, the city is not bound to pay the full contract price per million gallons for the partial supply it has received.. It has not been able to shut down its Belleville pumping station as it would have done had the full supply been furnished, and as it has not been able to make this saving it should not be compelled to pay the full price for the partial supply.

◆

IMPURITIES IN CHICAGO'S WATER SUPPLY are claimed to have caused the death of over 3,000 infants and young children during the past twelve months. The Chicago Health Department has made a careful study of the subject of infant mortality and has concluded that the efforts which the department has made to secure a pure milk supply will avail little to secure a decrease in infant mortality till the quality of the water supply is improved. The Chicago "Record" quotes as follows from the department's report for August:

> It is not unreasonable to infer that if the Chicago water supply had been as good during the last twelve months as the Chicago milk supply, the death of infants and young children, instead of aggregating nearly 10,000 during the period, would not exceed two-thirds that number, which implies an avoidable loss of more than 3,000 lives in this age period alone.

Besides infantile diseases, typhoid is increasing of late. In the first 21 days of September there were 64 deaths from this disease; and there are said to be over 600 cases in the city.

◆

WATER METERS have scored a great success in Atlantic City this year. At the beginning of the year about 350 were in use. The city appropriated $25,000 for the purchase of additional meters, and 1,520 additional meters have been put in service since that time, so that 70 of the consumers now take water through meters. The result has been a decrease in water consumption of nearly 20%, the average daily consumption for August, 1896, having been 6,285,460 gallons, against 7,726,000 gallons in August, 1895. The laying of an additional supply main across the meadows, which was deemed necessary some time ago, has been indefinitely postponed by the decreased consumption due to the use of meters.

◆

BIDS FOR SIX LARGE PUMPING ENGINES are asked in our advertising columns by the city of Chicago. Each engine will be of the vertical condensing triple-expansion type and capable of pumping 20,000,000 gallons of water per 24 hours, with a total lift of 150 ft. Three of the pumping engines will be installed at the new pumping station to be built at the corner of Central Park Ave. and Fillmore St., and the other three at the new station to be built at Springfield Ave. and Bloomingdale Road. Mr. Joseph Downey is the Commissioner of Public Works.

◆

AN ENGLISH TANK LOCOMOTIVE built for the Wirral Railway has twelve wheels, of which only four are driving wheels, there being a leading and a trailing four-wheel truck. The engine has side tanks and a rear coal bunker, and its general dimensions are as follows:

Driving wheels (4)	5 ft. 2 ins.
Truck wheels (8)	3 " 0 "
Wheelbase, driving	7 " 6 "
Wheelbase, total	30 " 2 "
Length over all	38 " 9¼ "
Weight on driving wheels (Front, 33,908 lbs.; rear, 34,188 lbs.)	68,096 lbs.
Weight on leading truck	30,576 "
" on trailing truck	35,308 "
" total, in working order	133,980 "
Cylinders	17 × 24 ins.
Valve gear	Link motion.
Boiler pressure	160 lbs. per sq. in.
Boiler plates	Steel.
Tubes	Iron.
Firebox	Copper.
Heating surface, tubes	928 sq. ft.
" " firebox	93 " "
" " total	1,021 " "
Capacity of bunker	132 cu. ft.
Capacity of tanks	2,280 U. S. gallons
Brakes	Vacuum.

◆

THE ATLANTIC & PACIFIC RAILWAY TUNNEL CO., which was organized some years ago by the late "Brick" Pomeroy, is now in difficulties and it does not seem likely that its purposes will ever be carried out. The project was to construct a tunnel five miles long through a ridge of the Rocky Mountains in Colorado, for the combined purpose of tapping alleged great deposits of gold and other ores, and of opening a short line of railway communication which would cut down the distance between Denver and Salt Lake City from 770 to 520 miles. The company was organized in 1880 and work went slowly on for some years, but at present only about 1½ miles of tunnel are completed, and this tunnel is, it is understood, only a heading and not of full-sized section for railway purposes. The project was most extensively advertised and a large aggregate amount was subscribed, mainly by small investors. No work has been done for some two or three years, and it is now claimed that owing to non-payment of taxes by the officers of the company the property is liable to be sold to recover the amount of the taxes.

◆

THE INTERLOCKING OF STREET RAILWAY CROSSINGS of steam railways at grade is to be carried out by the Brooklyn Heights Electric Ry. at its grade crossings of the Long Island R. R. The signals will stand normally at "stop" for the electric cars, and will not be lowered by the towerman until he is advised that the block is clear.

◆

THE GROWTH OF STREET RAILWAY TRAFFIC IN New York, in the last 30 years, is thus set forth in the presidential address of Mr. Rogers before the late convention of the New York Street Railway Association at Binghamton:

Date.	No. of lines.	Elevated traffic.	Total traffic.
1865	11	....	79,618,818
1875	13	644,025	140,582,793
1878	15	9,236,670	169,105,739
1883	15	92,124,943	266,164,236
1893	16	219,621,017	453,652,964

The Railway Commission's report of 1895 says that the operating expenses, interest, taxes and rentals of all street railways in the State aggregated 91½% of their gross receipts. At this rate, says President Rogers, the dividend on one 5-ct. fare amounts to 4¼ mills. In New York a passenger can ride 12½ miles for 5 cts.; in Brooklyn, 18 miles; and in Buffalo, 13¾ miles for the same fare. Reduced to mile rates, the transportation charge would be 4, 2.8 and 3.7 mills per mile, which is claimed to be the cheapest transportation rate in the world.

◆

THE CHICAGO & SOUTH SIDE ELEVATED RY., better known as the Alley Elevated, was sold at public auction at Chicago, Ill., Sept. 16, under a decree of foreclosure. The property is capitalized at $18,000,000, but was sold for $4,100,100 to Mr. Leslie Carter representing the first mortgage bondholders' committee and Mr. G. E. Adams, representing the extension bondholders' committee. The company was incorporated in 1888, but the line was only completed in 1893, in time to start with a very heavy traffic of passengers between the city and the Columbian Exposition. Since that time the traffic has been but light and the company has had continuous financial trouble.

◆

A DUST-PROOF CAR has been devised by Mr. E. H. R. Green, General Manager of the Texas Midland R. R., and a car fitted with the necessary appliances has been put in service. According to published descriptions these are water-drenched ventilators located in the walls of the car between the windows, and water-pipes produce a shower of artificial rain in each ventilator. The water is carried under pressure through the pipes to drench each of the wire-fabric air filters in the ventilators. The power is derived from the axle, and is transmitted through the medium of flexible coiled wire bands. The same water is forced through the pipes and ventilators repeatedly, being used over and over again all day. The pumping apparatus is located out of sight under the floor. When the passenger wants a breeze, he turns a knob which throws open the air-deflector on the outside. This catches the breeze produced by the forward motion of the car, and throws it through the water-drenched air-filter into the car. This breeze may be increased, diminished or shut off entirely at the pleasure of the passenger.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a collision between a light engine and an engine with the pay car on the Cincinnati, Hamilton & Dayton R. R., near Connersville, O., Sept. 18. The light engine was running backward and the other engine, with its car, was thrown from the track. The engineman and conductor of the pay train and both firemen were killed, and three or four persons were badly hurt.——The Brantford express train of the Toronto, Hamilton & Buffalo Ry. was derailed at a switch at Hamilton, Ont., Sept. 17, and the engine was overturned, killing the engineman and fireman.——A broken axle on a box car caused a bad freight train wreck on the Conestoga bridge, of the Pennsylvania R. R., near Lancaster, Pa., Sept. 18. About 20 cars were derailed and smashed, but the bridge was not damaged.

◆

A PREMATURE EXPLOSION OF DYNAMITE occurred Sept. 19, on the tunnel work at Shaft No. 2, of the new aqueduct for the metropolitan water supply system of Boston, Mass., the shaft being situated at Clinton, Mass. Four men were killed. The shaft is 100 ft. deep and the tunnel extends 150 ft. in both directions from the bottom, the explosion occurring in the west tunnel. According to press reports and interviews with the survivors, the day shift at 5 p. m. had drilled 22 holes, 6 ft. deep, and in each hole was placed 6 lbs. of dynamite. The foreman adjusted the wires and the gang went to the surface. Two sections of the blast, about 14 holes, were successfully fired. The men went into the shaft to adjust the wires for the third or clearing blast (to clear the face of the work), and had hardly reached the bottom before the explosion occurred.

◆

A POWDER EXPLOSION, caused by lightning, occurred Sept. 19, at the works of the Hazardville Powder Co., Hazardville, Conn., but nobody was hurt, the explosion occurring just before the time for the men to go to work.

◆

A SUBMARINE WRECKING VESSEL is being built at the Malster shipyard in Baltimore. The inventor is Simon Lake, of Baltimore, and the boat is intended to be used in recovering goods from wrecked steamers, at any depth not exceeding 150 ft. below the water surface. The trial vessel now being built will be cigar shaped, built of steel and will be 40 ft. long and 10 to 15 ft. in diameter. Steam will be used for propulsion on the surface and storage batteries for underwater work. The estimated submerged speed is 8 miles per hour, and the boat will be fitted with bottom man-holes, derricks, powerful electric lights, etc. The wreckage would be loaded into sunken trailing boats, which will be made to rise to the surface by forcing out the water by compressed air. At least, this is the plan proposed by Mr. Lake.

AMERICAN LOCOMOTIVES FOR FOREIGN RAILWAYS.

The accompanying illustrations represent four locomotives recently built for foreign railways by the Baldwin Locomotive Works, of Philadelphia, Pa., and we are indebted to the builders for the photographs from which our cuts have been prepared.

Fig. 1 is a double-end engine built for the Spanish Military Engineers at Havana, Cuba, for the Jucaro & Moron military railway. It has six driving wheels and a four-wheel trailing truck under the tank and bunker. It will be noted that there is a feed pump worked from the crosshead in addition to the injector. The cab is armor-clad with ⅜-in. steel plates on the sides and front, and lined with ash. The doors and windows have shutters of ⅜-in. steel to slide over the glass panes when required, the shutters being provided with loop-holes in the center to allow of rifle fire to resist attacks.

Fig. 2 is an engine for the Cazadero & Tepetong Ry., Mexico (narrow gage), having six driving wheels and a leading and trailing pony truck, the wheels being mounted inside the frames. It has a large cab, side tanks and a rear bunker.

Fig. 3 is an engine of very similar type to No. 2, but having the wheels outside the frames. It was built for the Krotovka & Sergievsk Ry., of Russia.

Fig. 4 is a mogul four-cylinder compound engine for the Norwegian State Railways, and is peculiar for the wide spread between the main and rear driving wheels. The tender has trucks of the passenger car type. This engine was No. 15,000 built by the Baldwin Locomotive Works.

The leading dimensions of these engines are given in the table below.

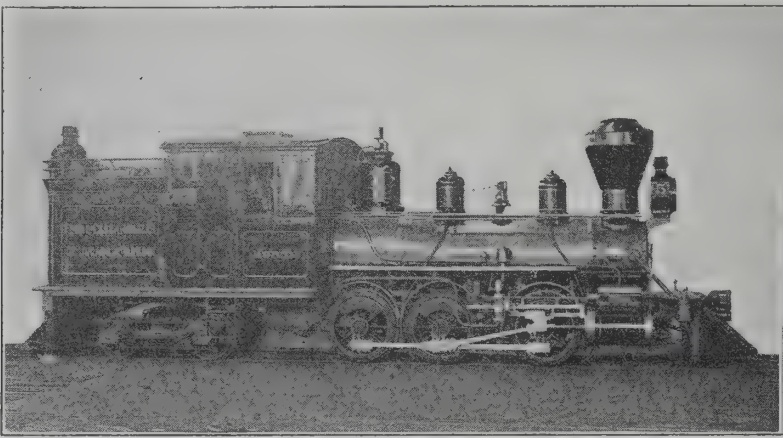

FIG 1.—CUBAN MILITARY RAILWAY.

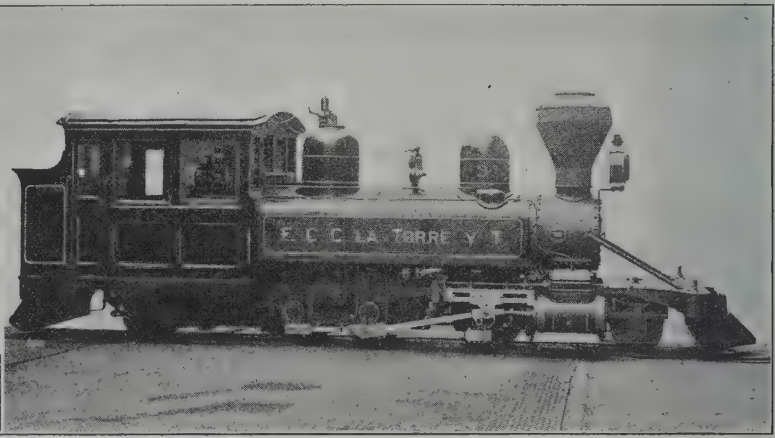

FIG. 2.—CAZADERO AND TEPETONG RAILWAY (MEXICO.)

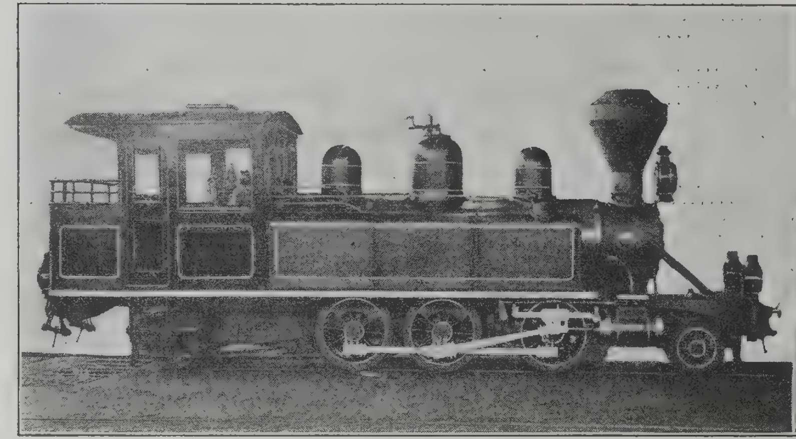

FIG. 3—KROTOVKA AND SERGIEVSK RAILWAY (RUSSIA).

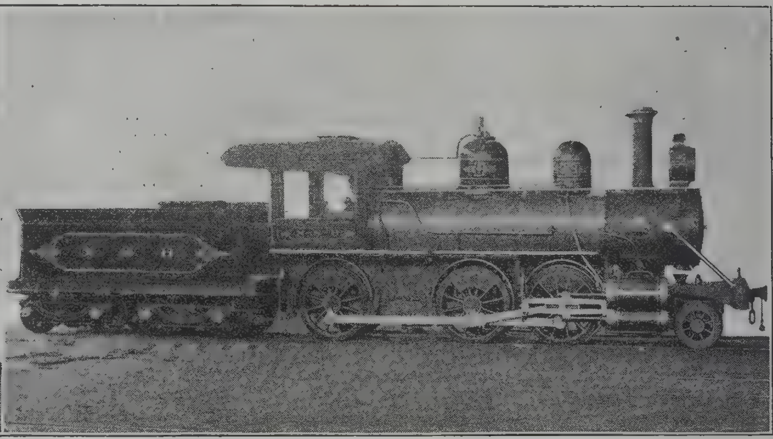

FIG. 4.—NORWEGIAN STATE RAILWAYS.

AMERICAN LOCOMOTIVES FOR FOREIGN RAILWAYS
Baldwin Locomotive Works, Builders.

Dimensions of American Locomotives for Foreign Railways.

	Fig. 1. Cuba.	Fig. 2. Mexico.	Fig. 3. Russia.	Fig. 4. Norway.
Gage	4 ft. 8½ ins.	2 ft. 0 ins.	3 ft. 3⅜ ins.	3 ft. 6 ins.
Driving wheels	3 " 2 "	2 " 9 "	3 " 0¼ "	3 " 10½ "
Truck wheels	2 " 0 "	1 " 10 "	2 " 0¼ "	2 " 2 "
Tender wheels	....	....	....	2 " 2 "
Driving axle journals	5 × 7½ ins.	5 × 6 ins.	4½ × 6 ins.	5½ × 7 ins.
Truck axle journals	3¾ × 7 "	3½ × 6 "	3½ × 6 "	4 × 6 "
Tender axle journals	....	....	....	3½ × 6 "
Wheelbase, driving	8 ft. 1 in.	7 ft. 6 ins.	7 ft. 6 ins.	12 ft. 0 ins.
" total	19 " 5 "	19 " 10 "	19 " 9 "	18 " 7 "
Weight, on driving wheels	45,560 lbs.	31,910 lbs.	33,010 lbs.	42,244 lbs.
" total	71,960 "	43,410 "	47,160 "	51,844 "
Cylinders, high-pressure	12 × 18 ins.	11 × 16 ins.	10 × 16 ins.	9 × 18 ins.
" low-pressure	....	....	....	15 × 18 ins.
Boiler, diameter	3 ft. 0 ins.	2 ft. 10 ins.	2 ft. 10 ins.	3 ft. 8 ins.
Firebox, length	3 " 2 15-16	3 " 1 3-16	3 " 10½ "	4 " 4 7-16
" width	2 " 9⅞ ins.	2 " 6⅝ ins.	1 " 9½ "	2 " 6¼ ins.
" depth	3 " 10½ "	3 " 4½ "	3 " 7 "	4 " 1⅛ "
Tubes, number	94	62	70	157
" diameter	1¾ ins.	2 ins.	1¾ ins.	1½ ins.
" length	11 ft. 0 ins.	10 ft. 11 ins.	10 ft. 1 in.	8 ft. 1 in.
Tank	Rear.	On sides.	On sides.	On tender.
" capacity, gallons	1,600	550	600	1,400

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THE NEW ST. LAWRENCE BRIDGE AT MONTREAL.

In 1859, or nearly 40 years ago, the Grand Trunk Ry. Co. completed the celebrated Victoria Bridge across the St. Lawrence River, opposite the western extremity of the city of Montreal. This structure is a single track tubular bridge, and for some years past its capacity has been strained to accommodate the business of its proprietors. The other railways terminating opposite Montreal have had to pay tribute for years to the Grand Trunk Ry. Co.; and it is stated that $5 per car has been a minimum rate for taking freight across the bridge. The Canadian Pacific Ry. has a bridge of its own at Lachine, which is some miles above the Victoria Bridge, and was completed in 1887. The Montreal Bridge Co. now proposes to build a third bridge, at the east end of the city, about 2½ or 3 miles below the Victoria Bridge, this new structure to be for railway, street railway and highway traffic. The general location was shown in our issue of Feb. 14, 1895, about which time the company advertised for competitive designs for its structure, and after some considerable delay the award has now been made, as noted in our issue of Aug. 27, 1896, the first prize going to Mr. E. S. Shaw, C. E., of Boston, Mass. Mr. C. N. Armstrong is the managing director, and Mr. Walter Shanley is the consulting engineer for the company, the offices being at Montreal.

Apart from the Grand Trunk Ry. and other lines controlled by it, there are now two other railways terminating opposite Montreal, as follows: The Montreal & Province line and the South Shore Ry., and under construction, the Atlantic & Lake Superior Ry. Besides these, the Central Vermont Ry. system and the United Counties Ry. reach St. Johns, about 20 miles from the St. Lawrence; the Drummond County Ry. reaches St. Hyacinthe, about 30 miles; the Delaware & Hudson, about 35 miles; and the Adirondack Caughnawaga line, about 10 miles from the St. Lawrence River, opposite Montreal. Several of these lines will, it is stated, be extended to connect with the new bridge and take advantage of the facilities to be provided by it. On the Montreal side of the river, besides the Atlantic & Lake Superior line, there are several shorter lines, including the Montreal Park & Island Ry., the Chateauguay & Northern Ry. and the Montreal Belt Line Ry.

In addition to the traffic to be obtained from these various railway lines, the bridge will obtain a large amount of traffic from local electric lines, special tracks being provided for their accommodation. In mid river is situated St. Helen's Island, with which the bridge is to be connected. This was formerly a fortified station of the British government, and is still the property of the crown, but the city has been allowed the use of the greater portion of it as a park, and it has now become what may be called the Coney Island of Montreal. Access to it is now had by means of ferry steamers, but as the street car lines do not reach the docks whence the steamers ply, the traffic is not as great as it might be with better facilities, though the daily attendance is large and on special days reaches to between 10,000 and 20,000. The construction of the bridge would allow the electric cars to take passengers from all parts of the city and land them on the island, and it is expected that the number of visitors would in this way be enormously increased.

The most urgent need of the bridge, however, is said to be for vehicular traffic, which is now completely suspended for nearly three months each year. During the summer season ferry steamers ply to several points on the opposite shore, but the advent of winter drives these steamers into shelter, and until the river becomes a solid mass from shore to shore there is no means of taking a vehicle across. This state of things lasts from four to eight weeks, according to circumstances. When the ice roads are opened all goes well until the hot sun of March makes itself felt, and the ice gradually softens and the roads become dangerous and are closed to traffic. Several weeks elapse before the break-up and disappearance of the ice and the opening of navigation, when the ferry boats make their appearance again. As the city of Montreal obtains a very large proportion of its food supplies from the opposite side of the river, this blockade at regular intervals raises the price of commodities, particularly to the poorer classes, who cannot lay by a store for the time of scarcity. The rapid current of the river, six miles an hour, at the place where the bridge is located prevents the placing of a pier in the channel, thus necessitating a span of at least 1,250 ft. in the clear; and as this span crosses the main ship channel, a headway of 150 ft. has to be provided.

The distance from the south shore to the city station of the Grand Trunk Ry., by its own line, is 6½ miles, while by the new bridge to the new central station, which is to be more conveniently situated than that of the Grand Trunk Ry., it will be only 3 miles. The new bridge being double track, and the line in the city being elevated, there will be no delays, while the Grand Trunk Ry. comes into the city on the level, crossing about 20 streets, where gates and watchmen are maintained. The bridge trains will be worked entirely by electricity, and in the city its tracks will be carried through the blocks on land purchased by the company, and it will in no way interfere with the streets. The company is not prepared to make public at present the location of its line or its terminus in the city.

The heavy expenditure necessary for the construction of the bridge has hitherto prevented its being built, but it is said that the Canadian government, the provincial government of Quebec and the city council of Montreal will assist in the construction of the bridge, which the company proposes to complete so as to open it during the great International Exposition to be held in Montreal in 1898.

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THE BERTRAND-THIEL OPEN-HEARTH PROCESS.*

By Joseph Hartshorne, M. Am. Inst. M. E.**

For something over two years past a new development of the open-hearth process has been in operation at the works of the Prager Eisenindustrie-Gesellschaft at Kladno, in Bohemia. It was devised and perfected by Mr. Ernst Bertrand, general superintendent, and Mr. Otto Thiel, steel works superintendent. The results which the inventors wished to obtain were to increase the product per furnace, to reduce the amount of refractories and additions used, to enable a poorer and more varied quality of stock to be employed, to improve the quality of the material produced and to render the control of the operations and product more certain. In all of these objects they have been successful, and have thereby considerably reduced the cost of manufacture and increased the value of the finished material.

The plant consists of one 12-ton and one 20-ton furnace, Through an incident of construction the smaller furnace stands some distance behind and to one side of the larger furnace, and at a height of about 10 ft. above it.

The relative position of the furnaces suggested the experiments by which the process was developed, and also enabled it to be thoroughly tested. The plant is not as convenient and suitable as one especially designed for the process would be, nevertheless the pecuniary and technical results have warranted its continuous operation.

The process consists essentially in dividing the charge between the two furnaces, tapping the metal from the upper into the lower one and removing the slag from this metal during its progress from one furnace to the other.

Both furnaces are at work on the basic system, although this is not an essential feature of the process. Pig-iron high in phosphorus and silicon is charged into the upper furnace with a small portion of the scrap, if desired, and also a certain quantity of ore and limestone. The remainder of the scrap is charged into the lower furnace, together with pig-iron and a small quantity of limestone. A little ore is also added, if necessary.

The upper furnace is first charged and the metal is melted and made hot. This takes about three hours. By the end of this time the metal is hot and fluid, the silicon is all in the slag and the carbon and phosphorus are to a considerable degree eliminated. It is then ready for tapping.

The lower furnace is charged about two hours later than the upper one. By the time the heat in the upper furnace is ready for tapping the metal in the lower one is also fluid.

The primary furnace is then tapped, the slag being carefully skimmed off the metal as it passes down the trough and prevented from entering the secondary furnace. As soon as the two metals mix together a very lively reaction ensues, which quiets down in about quarter of an hour. The phosphorus is then below 0.03% in the bath. The heat is finished by addition of ferro-manganese or spiegel, and is ready to be tapped, if no further improvement in quality be desired. Fifteen minutes longer in the furnace brings the phosphorus below 0.02%.

It is evident that the character of the charges in the two furnaces will vary materially with the local conditions affecting the supply of raw materials. Where scrap is cheap and plentiful, more will be charged into the primary furnace and the charge in the secondary one may contain no pig-iron at all. Where scrap is scarce and dear, none will be charged into the primary furnace, and only the commercially available amount will be used in the secondary furnace. In all cases the material higher in silicon, phosphorus and sulphur will be charged into the primary furnace and the available amount of purer material will be charged into the secondary furnace together with the necessary amount of other stock.

According to the practice now followed the charges are as follows:

	Upper Furnace. Tons.	Lower Furnace. Tons.
Basic Bessemer pig-iron	7.5	1
Steel scrap	5.5	8
Limestone	0.15	0.8
Magnetic iron-ore	0.20	none

The lower furnace is charged about two hours after the upper one. The metal in the upper furnace contains 0.6 to 0.9% of phosphorus when tapped into the lower one, while the metal contained in the lower furnace is already highly oxidized and very low in phosphorus. After uniting the two metals it takes 15 to 20 minutes to reduce the phosphorus to 0.020%.

At present from 5 to 6 heats, of 22 tons of metal charged, are made at Kladno in 24 hours. The lower furnace is empty more than half of the time. It is evident, therefore, that with two primary furnaces at least 10 heats could be made in the 24 hours. The present capacity is from 110 to 132 tons (charged weight) in 24 hours; and this will be doubled by the use of another 12-ton primary furnace, which is now being erected and will soon be at work.

In order to show in more concrete form the advantages derived from the new process, the following extracts, taken from the Kladno reports and cost sheets for the five months immediately before and after its adoption, are here given:

(The paper gives a set of tables with detailed figures. We summarize the principal results as follows.—Ed.)

Comparative results of the ordinary Open-Hearth and the

Bertrand-Thiel Process.

Consumption in lbs.—per 2,240 lbs. of ingots.

	Process, old, average,	Process, new, average,	Decrease,	
	lbs.	lbs.	lbs.	P. c.
Melting-coal	785.3	748.97	336.33	4.63
Heating-coal	126.2	55.64	70.56	55.80
Steam-coal	264.3	212.93	51.37	19.40
Limestone	344.1	162.85	181.25	52.68
Magnesite	53.7	25.09	28.61	53.20
Cost, basic refractories.	$0.597	$0.256	$0.341	$57.10
“ acid “ .	0.708	0.375	0.333	47.00
	Tons.	Tons.	Increase	
Output, ingots, per heat	15.39	18.64	3.25	21.10
“ “ pr 24 hrs.	37.64	64.89	27.25	72.30
Allowing 20 tons inc.*.	.....	64.89	7.25	20.20

*For the small furnace.

These figures give a clear idea as to what was accomplished during the first five months in which the process was at work.

The total cost of conversion was reduced 27.50%. The output increased 72.3%; but, of course, some of this was due directly to the use of a second furnace. A fair allowance for the product of this furnace would be 20 tons per 24 hours. If this be allowed for, the increase in product was 20.20%. The increase under present practice is much greater, being about 50%.

A plant of two 10-ton furnaces and one 20-ton furnace would have a capacity of at least 10 heats in 24 hours, as shown above. This would give from 200 to 240 tons of ingots. A very good product from these furnaces, run separately, would be 5 heats in 48 hours from each, or 2½ per day. This would give 25 tons from each of the small furnaces and 50 tons from the large one, or a total of 100 tons of ingots. It seems reasonable to suppose, therefore, that the capacity of such a plant would be more than doubled, if run under the Bertrand-Thiel process.

Besides these advantages, which are shown by actual figures, it is claimed that the amounts of deoxidizers and recarburizers used are also reduced, and that the loss is smaller. The work of the ten months contained in the table does not show any material difference between the two processes, so far as average loss is concerned; the difference in favor of the Bertrand-Thiel processs being only about 0.10%. It is reasonable to suppose, however, that with more experience this feature may be improved. The secondary furnace contains only a small amount of slag, which is comparatively free from oxide of iron at the end of the operation. There should be, therefore, less loss of metal as oxide; and a smaller amount of oxide in the bath, both of metal and slag, should require a smaller amount of deoxidizer to free the steel from red-shortness. This point, however, is somewhat difficult to determine, since so many specifications require more manganese in the steel than that which is necessary to make it roll well.

The control of the quality of the finished product is very complete. Steel is made to specifications within a range of from 0.06 to 1.25% of carbon. The phosphorus can be run down below 0.02% with ease; the sulphur is kept below 0.03%, and the manganese can be regulated very closely. As an instance, it may be stated that a large amount of steel has been made containing 0.80 to 0.90 carbon. This steel was used for bayonets for the Italian army and the results were very satisfactory.

The work of the past year has shown that from 65 to 75% of the sulphur is removed by this process.

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*Abstract of a paper read at the Colorado meeting of the American Institute of Mining Engineers, Sept., 1896.

**119 South Fourth St., Philadelphia, Pa.

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THE TONNAGE RATING OF FREIGHT TRAINS.*

Mr. Brunn (Erie R. R.).—Our experience with the tonnage system began in the month of June this year, although the system has been under consideration a good many years, but we did not, until that time, make up our minds to follow it. The results have been highly gratifying to the local officers and I believe to the general officers of our company. We keep a very careful record of the number of cars in a train load and by so doing we are able to figure the money value received. A great saving has been made in light loads—that is, we haul on our line a great many cars of merchandise in which we do not get the full capacity of the cars; in some instances where our train load under the old system of loading was 30 cars we have been able to pull as high as 40 cars. Again in some instances where we were hauling heavy dead freight we had to reduce the number of cars in trains, but no doubt this was a great benefit in preventing the stalling of trains on grades, and securing greater regularity in train movements. We first started to load on the ton basis; but we now load trains by the thousand pounds or by the "M." This simplifies the work of getting the load. Instead of taking the number of cars and saying so many tons, one simply takes off the first two figures of the weight of the car. For instance, a car weighs 20,700 lbs. The car is counted as 21 Ms.

In loading a car at the warehouse, the bill of lading or shipping receipt always shows the weight of each shipment, and the shipping clerk makes a note of them, and if it is a mixed car, with different consignments in the same car, he deposits the bill in an envelope and puts the gross weight of the car and contents on the outside of the envelope. If the car is forwarded under that envelope, with the original bills, the yardmaster gets the weight from that envelope. If the bills are sent forward in advance of the car by passenger train, there is a car way bill made out, on which is shown the car and contents.

The first thing done is to take the total weights on the shipping orders before any manifesting is done, and supply the yardmaster with the information. It is a very simple matter for the clerk to take the contents of the car and put it on. The yardmaster gets the total weight and notes it on the card about as quickly as he gets the car itself, and we have loaded out from 75 to 90 cars of mixed merchandise a day, and have experienced no difficulty in the matter.

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*Abstract of the discussion on the report of the Committee on Transportation, of the American Society of Railroad Superintendents, presented at the recent meeting at Niagara Falls. The report was given in the report of the proceedings in our issue of Sept. 17.

On a road on which coal or ore originated along the line, at points close to the terminus of a division, we might not get the weight until we were ready to move, but my understanding is that coal is always weighed at the tables where it is loaded, and in that case we would take the shipper's weight. We do not hesitate in taking the weights of the shippers, as we have found in most instances that their weights are nearer correct than our own. A track scale is not always to be relied upon for weighing coal as it goes over the table.

Mr. C. B. Price (Allegheny Valley R. R.).—On many roads I know the custom is to weigh at a railway track scale generally placed at a point where the product of a great many mines pass over it. The manifesting is made from this weight. The scale on which the most of our weighing has been done is pretty well up the line for the purpose of catching everything originating at that point. We never take the shippers' weights; they take ours, and are only too glad to get them. If they weigh their coal at the mines it is to test the weights received from us.

Mr. Trump (Pennsylvania R. R.).—It is the practice of my division to weigh the coke, for instance, which comes from the southwest branch, at some common point and to do the manifesting on those weights. The coal shippers all have their own scales, but they use our weights for invoice purposes altogether. In the makeup of trains we would be governed by the returns from the official railway scales.

Mr. Roberts.—I think you can arrive at the information you desire by approximating the capacity of the cars; that would not affect the tonnage of the train, as you get the weight sufficiently near to make up your train. Our cars are loaded at a point where there is an accumulated product of the mines; the actual weight is taken there and sent back to the shippers, and they accept our weights. So far as obtaining information for the maximum capacity of our engines is concerned, we take the estimated weight of the load and cars. With the exception of the coal trains we are not loading trains on the tonnage basis. As to trains of empty cars our first method was to add 25% to the weight of cars for an empty train, and it was not enough; it made a bad showing. At a certain point where the tonnage rating showed we could haul 77 empty cars we could actually haul only about 48, then we changed the method and added 60% to empty trains, and that is not enough, and we have about made up our minds that we should add 70 or 75%.

Mr. Knibloe (Buffalo Creek R. R.).—In order to have a perfect application of the tonnage methods we must have the facilities requisite for such application. It was the opinion of the committee, as expressed in its preliminary report a year ago, that the percentage of economies in either direction, in the time the train moved and in the additional number of cars hauled and the decrease in the trains run, was so great that railway companies could afford to go to considerable expense in putting in track scales and the employment of extra clerks in order to secure a substantial conformity to the tonnage standard, whatever it might be for the different classes of engines. As to empty trains it seems to me the number of empty cars should be that which one crew can cover with safety; the crew should be able to pass safely from the rear to the engine and not have the desire to load up to the full capacity of the engine, taking the actual stencil weight of the cars.

Mr. Potter.—The result of that would be to make a very bad showing on the hauling capacity of the engine in a certain direction, and the question is brought to your attention, "Why do you not load your engines to their full capacity?"

Mr. Knibloe.—I never had experience where the movement of loads in one direction was so very much in excess of the other direction as Mr. Potter suggests.

Mr. Price.—The question that arose is one we met the other day on the Allegheny Valley R. R., and therefore I can undertake to give an answer. If the preponderance of tonnage is in one direction, it follows there must be a large percentage of light power movement in the other. If you take one engine, returning in the direction of the light movement, and load it down with the full capacity of empties, the next might go through without any load—it might be what is called "a horse and buggy train." If you limit the load of empties under the conditions specified by Mr. Knibloe, with reference to the length of the train, facilities for signaling, etc., you will strike a fair average of partially light movement.

Mr. Potter.—I agree that there is a limit to what a certain train crew could handle. We do not attempt to handle more than 50 empties. That suggestion is all right providing you can control your empties, but if they are forced on you so that you must run light power after your empties during a certain period, you want that power coming back hauling as many empties as they can.

Mr. Price.—It never happens that we have to send power up after empties. The next train moving in that direction would have perhaps more than the average number of empties.

Mr. Fitch.—The question is a good deal of an experiment. After several months we came to the conclusion that the best way was to build a dynamometer car which told us exactly what the engine could do. It does not cost very much. We are building such a car. A few days' experimenting will tell you exactly what your engine can pull under any conditions.

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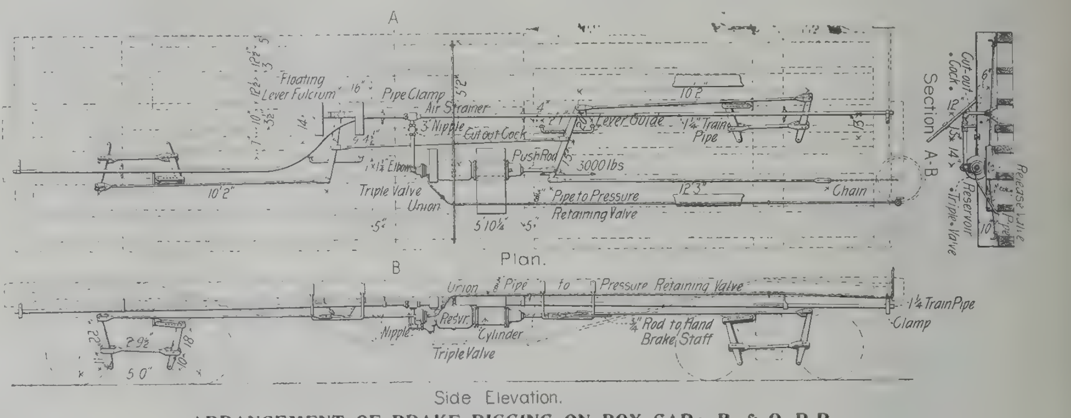
60,000-LB. BOX CARS FOR THE BALTIMORE & OHIO R. R.

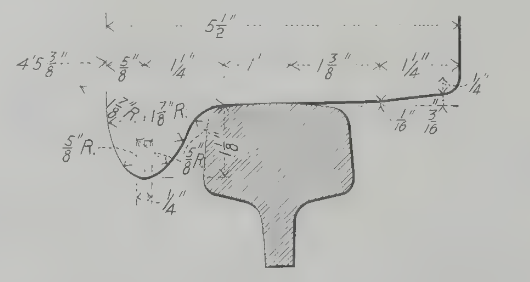
(With inset.)

A few months ago the Baltimore & Ohio R. R. placed orders for 4,600 new freight cars, and these were described somewhat fully in our issue of June 11, 1896, when an abstract of the specifications was given. Of the total number of cars, 2,300 were box cars, and the drawings of these cars are given this week on our inset sheet.



ARRANGEMENT OF BRAKE RIGGING ON BOX CAR; B. & O. R.R.

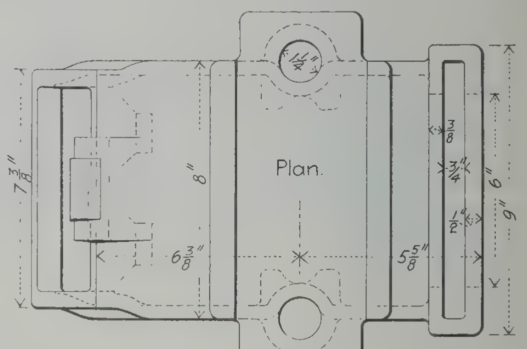
There are two side sills 5 × 8 ins., four intermediate sills 3 × 8 ins., and two center sills 3½ × 9 ins., all of yellow pine and tenoned into oak end sills 8 × 10 ins. The frame is trussed by four body truss rods 1¼ ins. diameter, with threaded ends upset to 1⅜ ins., there being a pair of rods each side 17 ins. c. to c., while the inner rods are 4 ft. 2 ins. apart. The truss depth is 22 ins. and the distance between truss-rod bearings is 6 ft. 3¼ ins. These bearings are bolted to tie-timbers 5 × 10 ins., set on edge below the sills. To the end sills are bolted oak buffer blocks 5 × 11¾ ins., 3 ft. 1 in. long, with malleable iron buffer heads. The draft timbers are 4 × 9½ ins., placed under the center sills and extending back to the body bolsters, the Buckeye M. C. B. couplers being connected up by the American continuous draw-bar. The body bolsters are built up of three white oak sticks, 4½ × 6½ ins., and two wrought-iron plates, ¾ × 6 ins., and each bolster is trussed by two 1-in. rods, with 1⅛-in. upset ends, passing through the bolster and the intermediate sills.

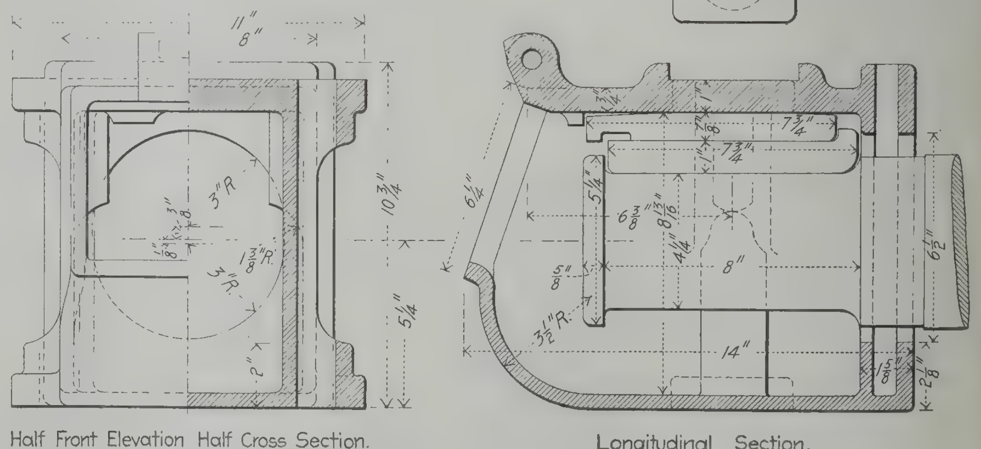


Wheel Tread and Rail Head; B. & O. R.R.

The side framing consists of posts and body braces 3 × 5 ins., with ¾-in. vertical rods; the end posts are 4 × 5 ins., and corner posts 5 × 5 ins. The outside sheathing is of ⅞-in. tongued and grooved planks 3 to 4 ins. wide, placed vertically, and inside these is a lining of ⅞-in. tongued and grooved plank laid horizontally; this lining extending from 2½ ins. above the floor up to the side girth, and is 5 × 4 ins. The end plate is a 4-in. plank, 14 ins. deep at the middle. The loading limit is marked by black lines, 4 ft. 6½ ins. from the floor for corn and 4 ft 3 ins. for wheat. The roof is of the Chicago pattern, composed of metal and wood, the metal sheets being covered by the outer planking. The floor is of 1¾-in. planks, 5 to 8 ins. wide, laid transversely across the sills and secured by 20-penny nails. The outside of the car is painted with three coats of brown mineral paint, with the lettering in white, and all iron-work is given one coat of asphaltum or smokestack black.

The trucks are of the diamond frame pattern, with top arch bars 1¼ × 4 ins., lower arch bars 1 × 4 ins., and tie-bars ⅝ × 4 ins. The bolster is built up of two white oak sticks 3½ × 11½ ins. and one stick 6 × 11½ ins., flitched by two wrought-iron plates ⅞ × 8 ins, 7 ft. 5 ins. long. This is trussed by two 1⅛-in. rods with 1¼-in. upset ends. Under each end of the bolster is a nest of four spiral springs, resting on the spring plank, this latter being an inverted 12-in. channel iron. Some of the cars have the American cast-steel bolster and others have the Schoen pressed steel bolster. The journals have lead lined brasses and are protected





AXLE BOX FOR BOX CAR; B. & O. R.R.

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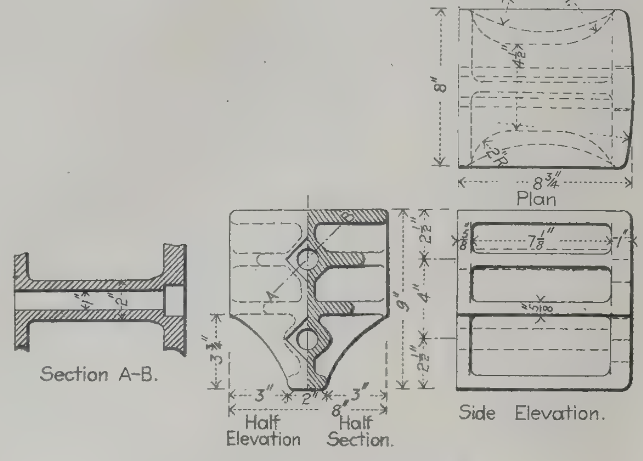
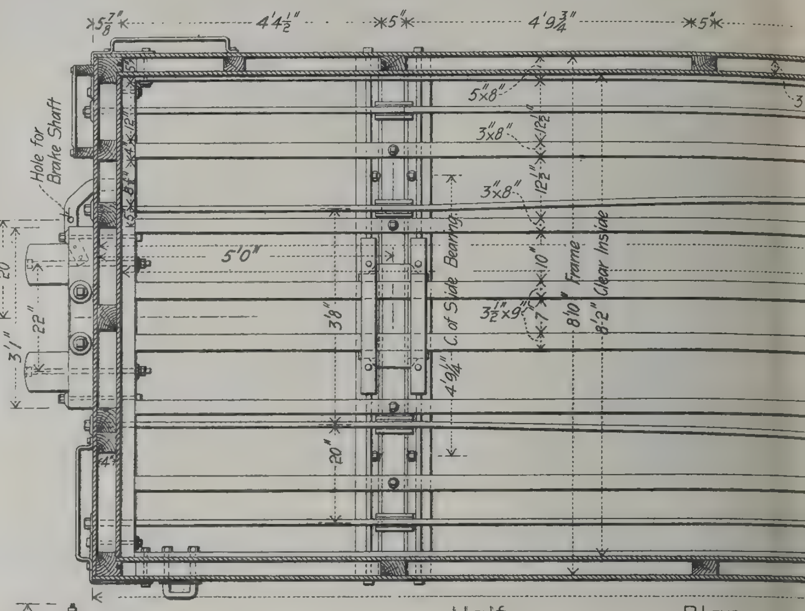
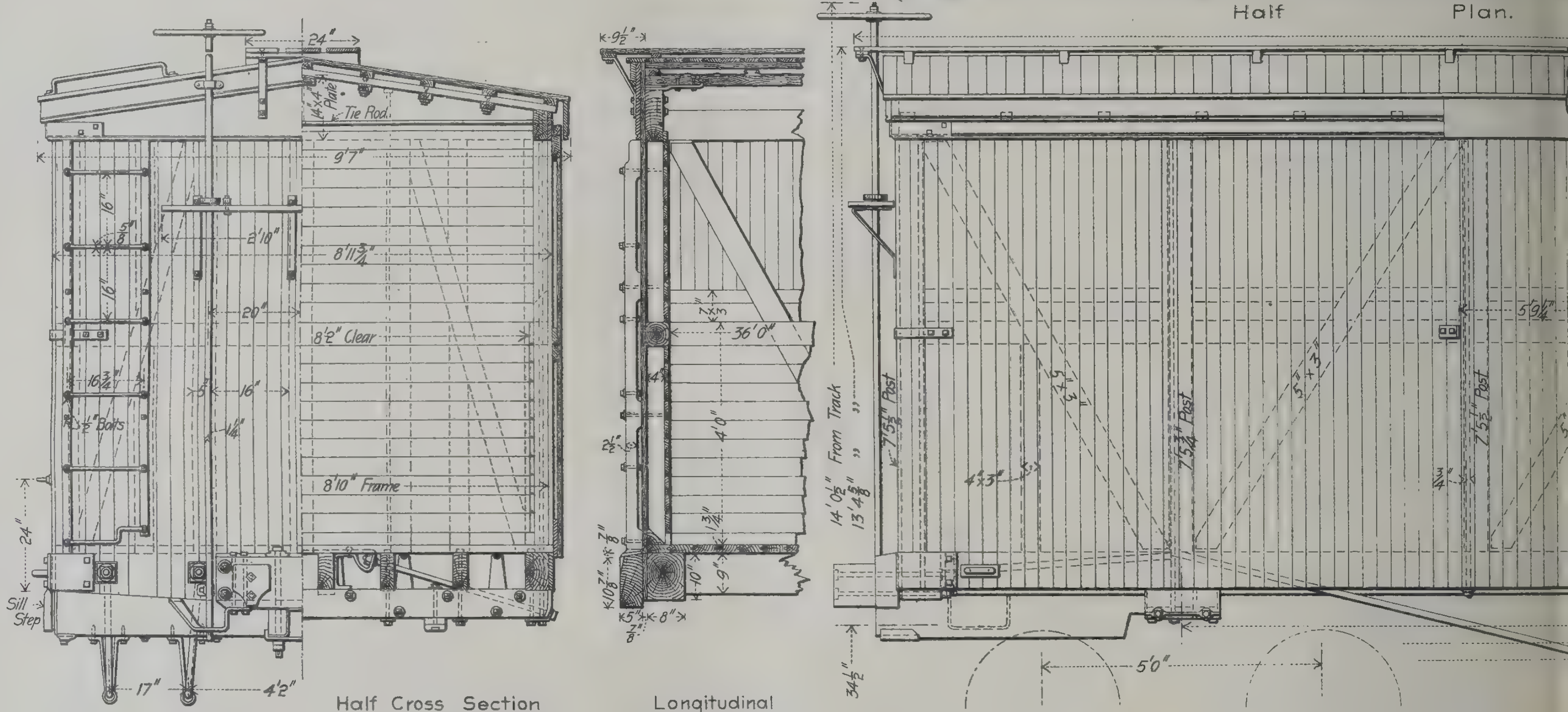


CAST IRON BUFFER BLOCK.



Half Plan.

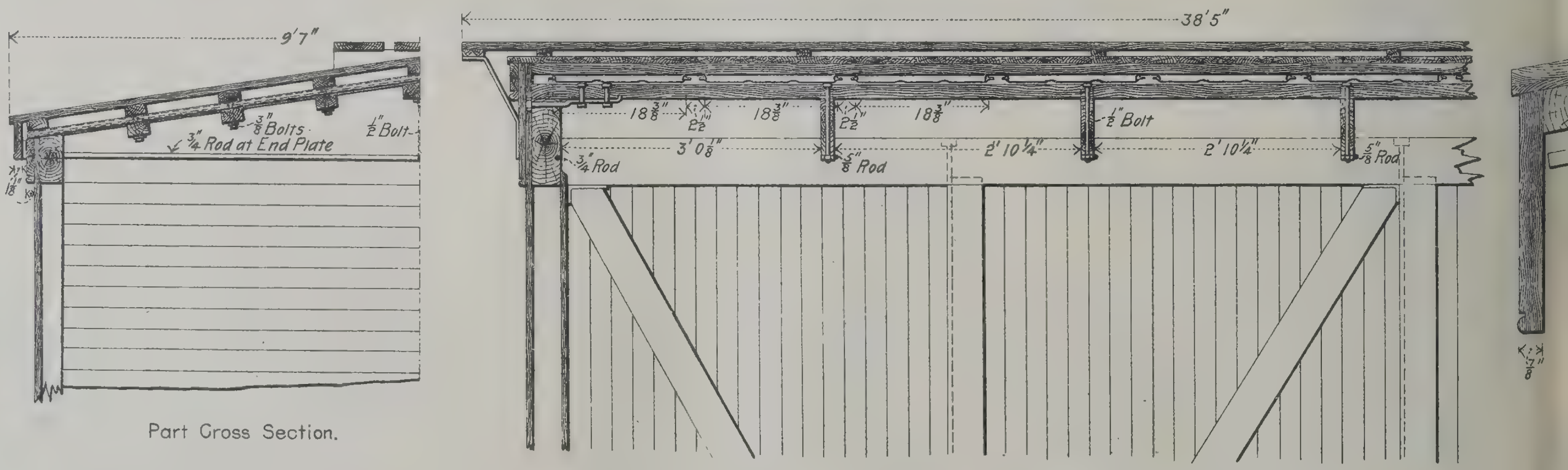


Half End Elevation.

Half Cross Section at Door.

Longitudinal Section at End.

Half Side Elevation.



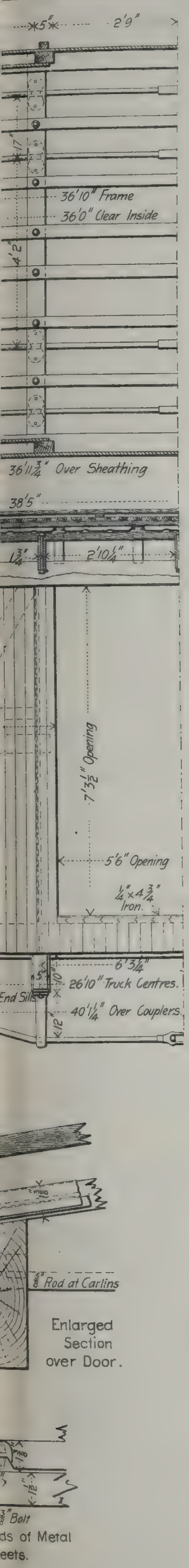
Part Cross Section.

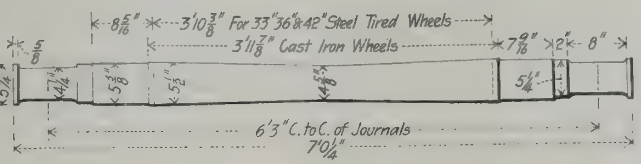
Part Longitudinal Section.

ELEVATIONS AND SECTIONS OF CAR.

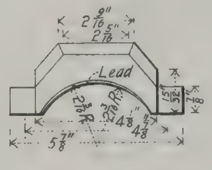
STANDARD BOX CAR OF 60,000 P

Harvey Middleton, General Superintendent of Motive P

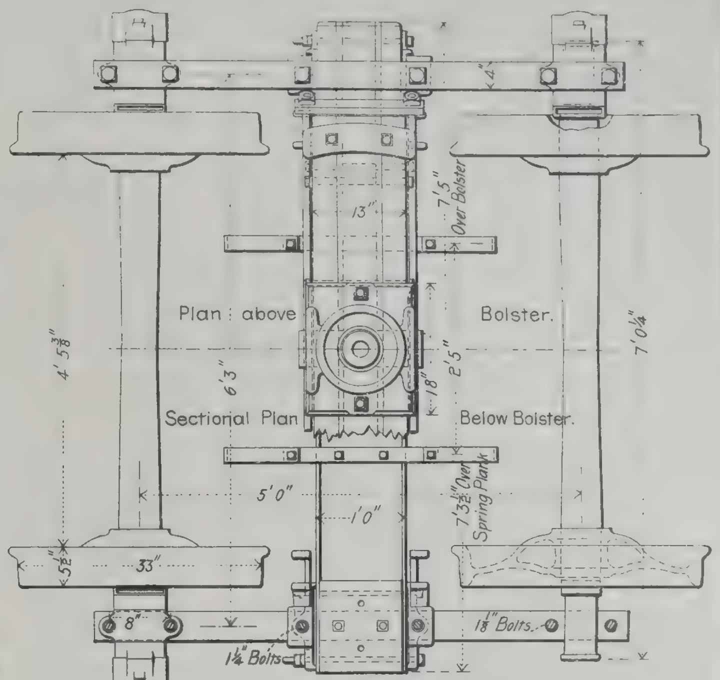


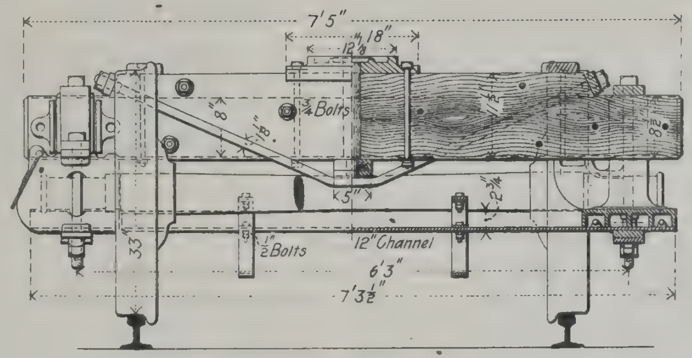

8 5/16"
3'10⅜" For 33" 36" & 42" Steel Tired Wheels
3'11⅞" Cast Iron Wheels
7 9/16"
2"
8"
5¼"
6'3" C. to C. of Journals
7'0¼"

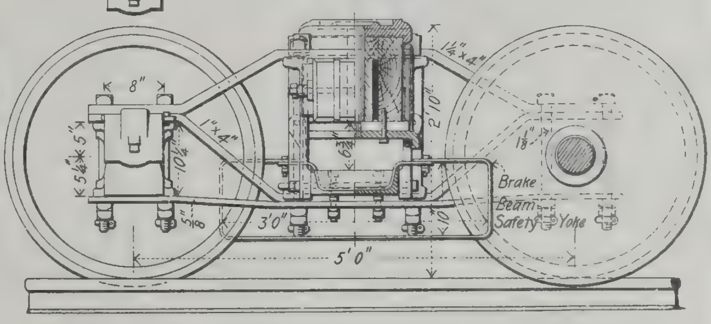
Elevation of Axle.



Journal Bearing.

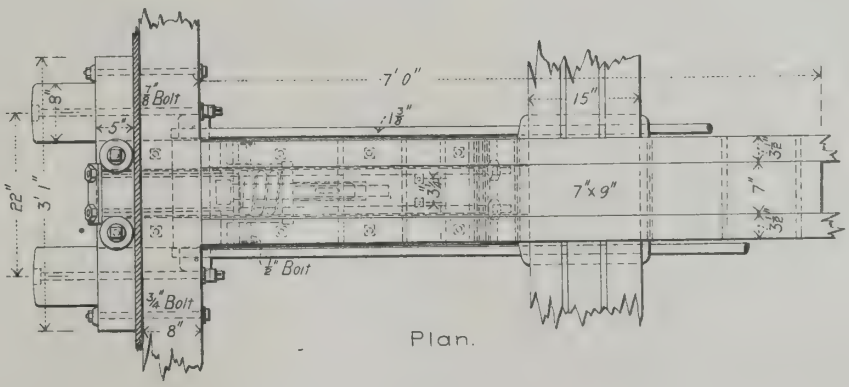




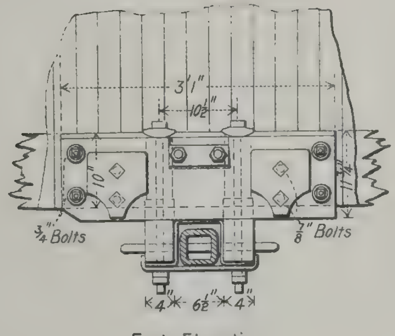


Half End Elevation. Half Section through Bolster. Half Side Elevation. Half Section through Bolster.

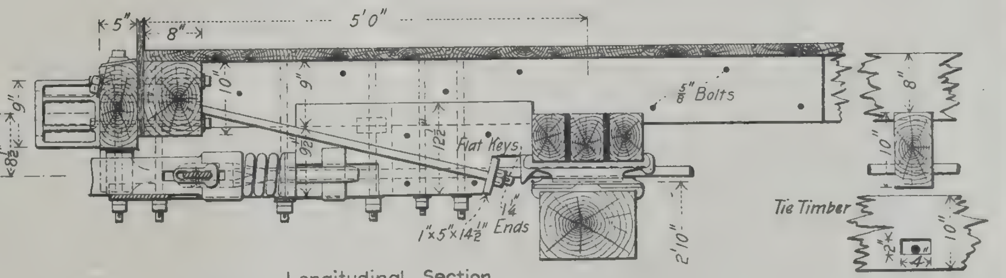
STANDARD TRUCK FOR FREIGHT CARS.



Plan.



End Elevation.



Longitudinal Section.

CONNECTION OF AUTOMATIC COUPLER AND CONTINUOUS DRAFT GEAR.

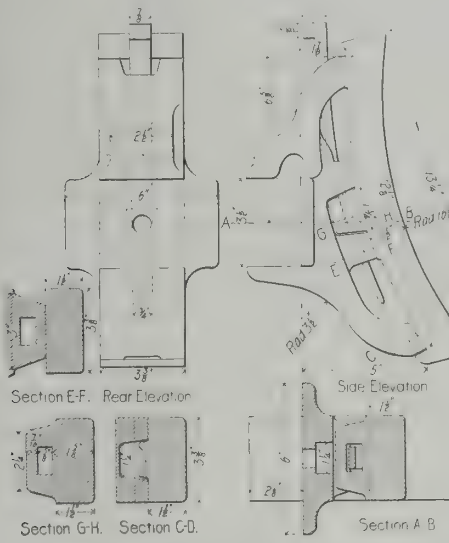
CAPACITY; BALTIMORE & OHIO R. R.

E. W. Grieves, Superintendent of Car Department.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

by Stier's dust guards of yellow poplar or basswood. The cast-iron wheels are pressed on the axles with a pressure of about 60,000 lbs.

The cars are fitted with the Westinghouse brake, and the general layout of the brake apparatus is shown on one of the drawings. The instructions for setting up the air brake apparatus provide that the relative angle of levers must be maintained when attaching the brake rigging to the cars. The pipes are to be blown out with steam after bending, and all connections must be perfectly tight when tested under pressure with soapsuds. Red lead must be used sparingly at joints, and put on the outside of the pipe that screws into the fitting, never on the inside of the fitting, as it is liable to get into the triple-valve and interfere with the working of the brake.



Brake Shoe for Freight Car; B. & O. R.R.

The cars were designed by Mr. Harvey Middleton, General Superintendent of Motive Power, and Mr. E. W. Grieves, Superintendent of the Car Department.

The general dimensions of the cars are as follows:

Length:	
Over end sills	36 ft. 10 ins.
Over body sheathing	36 " 11¾ "
" running board	38 " 5 "
" couplers	40 " . 1¼ "
Inside	36 " .. "
Width:	
Over side sills	8 " 10 "
Over body sheathing	8 " 11¾ "
" eaves	9 " 7 "
Inside (between girths)	8 " 2 "
Extreme (over bottom slides of doors)	9 " 8¼ "
Height:	
Rail to c. line of coupler	2 " 10½ "
Rail to eaves	12 " 6⅛ "
" to running board	13 " 4⅝ "
" to top of brake shaft	14 " 0½ "
Side sill to side plate	7 " 5½ "
Floor to carline	7 " 7¼ "
Doorway	7 ft. 3½ ins. × 5 ft. 6 "
Axles:	
Length, c. to c. of journals	6 ft. 3 "
Diameter at middle	4⅝ "
" at wheel seat	5⅜ "
Journals	4¼ × 8 "
Wheels, diameter	2 ft. 9 "
Wheelbase, truck	5 " .. "
" total	31 " 10 "
Distance c. to c. of trucks	26 " 10 "
Carrying capacity	60,000 lbs.
Cubic capacity	2,254.5 cu. ft.
Weight, empty	32,362 lbs.
Cost (approximate)	$510

BLOCK SIGNALING AND INTERLOCKING.*

Mr. Derr (Erie R. R.).—My division is divided into 43 block sections, ranging from a few hundred feet to 3½ miles. In the yards we operate the block system, the same as on the line. Our block system is largely manual, with electric bells connected between the towers; the signaling being done by the ordinary code, so many taps of the bell meaning certain moves and directions. At the outlying stations where there is a cross-over, we have the distant signal located not less than ¼ mile from the home, and running up as far as 3,200 ft. The home signal is located near the cross-over and protecting the cross-over switches, and the advance signal is about a train length ahead of the home signal. At some cross-overs we also have signals for directing the movements from the cross-over to the advance signal. A great many cross-overs are locked with the home signal, so that no movement can be made over a high speed line except when the switch is set for the line movement. Our rule or direction on signaling to our men is that they may run up to the home signal but not beyond it when at danger; that may be laid down as the fundamental principle of signaling. The home signal governs to the advance signal and no further; after bringing the train to a full stop no clear movement can be made; you give permission to go to the advance signal and no further. In other words, the advance signal cuts the block or section into two parts, and the home signal governs only to the advance signal.

Mr. Trump (Pennsylvania R. R.).—We use the telegraph block system on the main line divisions. The signals are given by the semaphore. We do not use the track circuit except in special cases. We use the automatic electro-pneumatic semaphore system, with the exception of a few electrical signals. In regard to the use of the absolute block, we have been able to do away with this feature, especially on divisions like the Western Division, where we handle heavy trains and grades. We have not money enough to put in the block stations every half mile.

Mr. Brunn (Erie R. R.): On our Buffalo Division when we first started the block signal system we found the expense of adopting an absolute block would be very great, and after considerable arguing with our people, I succeeded in getting them to permit me to put in the block, and made the block positive in reference to passenger trains—that is, a passenger train following a passenger train would block before and behind; a freight train following a passenger train was blocked before and positive block behind, etc., insuring positive safety to the passenger trains. Where a freight followed we allowed the trains to go on the block with caution signal, separating them 15 minutes apart. The blocks in many cases are seven or eight miles long. We operated that system several years with very satisfactory results. Where it was possible we let one train follow another under green signal. We finally decided to introduce the absolute block in reference to freight trains. We often found it was necessary to close up freight trains at important points, where we had ample siding facilities, and let the passenger trains (or trains of superior class) go by. In doing that we never let the following train into the block until we knew absolutely where the leading train was, then we gave the conductor or engineman an order or message indicating just where the obstruction is, and let them proceed under the caution signal. That is, perhaps, as near the absolute block as you can get; tell the man where the train is and let them go to that point by using their own judgment. Our system permits the use of the green signal under the circumstances I have stated. When we know a train is at a siding and about to pull in, then we send the order to the following train, which is delivered to both conductor and engineman, telling them the train is drawing into such siding, and allow them to go into the block under the green signal. We never give them the white or clear signal. The train order is a message which the telegraph operator is required to give to both conductor and engineman, and they cannot proceed without that message.

Mr. Trump.—I would like to see the absolute block on all railways, but with heavy trains and heavier freight trains it seems to us impossible to adopt the absolute block system. It costs us about 25% more to run under this system. Some roads use the siding, and forward trains under caution card; and also use the clearance card in case anything goes wrong. There are cases where they give the engineman a card to stop a train and deliver the card to the next operator. On the division having the Westinghouse automatic signals, with track circuits, we have to provide for the contingency of the signal constantly sticking at "stop." If a train finds the signal at danger, it comes to a full stop, and then proceeds the same as with a caution card, looking out for broken rails, etc. The time of stop required is two minutes, as it takes about that long for a freight train to get stopped and start again. Occasionally a signal may be out of order, and this sometimes occurs by the carelessness of the track-men in handling ties, dumping cinders or something of that kind. They connect the two sides of the track circuit.

Mr. Price (Allegheny Valley R. R.).—We have had, during the last six months, two short sections in the Pittsburg yard equipped with the overlapping block signal apparatus with disk signals, as described by Mr. Schreuder yesterday (Eng. News, Sept, 17, 1896). The sections are short, about ¼ mile each, protecting the operations of the yard, which is considered especially hazardous. They have worked very well, but it happens sometimes that the signal sticks at the red or "stop." It may be on account of wet weather. Wet affects the conductivity of the track sections and makes the signals slow to release from the stop position after the trains have cleared. To cover this contingency we have adopted the regulation that after a certain interval of time a train stopping at the "stop" signal may proceed. With that little regulation supplementary to the mechanical arrangements we have been able to get along very well with the signals. I wish the whole of our railway yards were protected in the same way. I recall instances where passenger trains were held for short intervals, since we had this system in operation. It is connected to the inside of the switches on cross-overs as well as the main track switches. We have had one or two cases where the yard crews, standing on the siding waiting for passenger trains to pass, would open the inside of switch so as to be ready to go ahead; the effect was to keep the signal at "stop," and produced a little delay to the passenger trains. It was due to the ignorance on the part of the trainmen, and it was only necessary to call their attention to it in order to secure its correct working. I mentioned wet weather as one of the conditions affecting the track circuits. On the Pan Handle road, where they have the track circuits, they have had the same experience.

Mr. Schreuder (Union Switch & Signal Co.).—In regard to track circuits in wet weather, we find that where tracks are laid with cinder ballast close to the rail, we have a lag in the track circuit during wet weather. Of course in working the track circuit, you must limit the length of the circuit in accordance with the condition of the track. Where the circuit passes through many switches and yards, the length should be regulated accordingly, and the battery must be located so as to be at the lowest tension possible. We can under ordinary conditions work a track circuit one mile long with one cell of battery, when the rail is not touching the ballast; when close to the ballast, as in yards generally, we are obliged to have more battery. In some cases we have had considerable trouble with the track circuit where it is parallel with trolley roads, but have overcome it by using a double insulation and grounding, in some cases.

THE POLE GAS-MOTOR STREET CAR.

By T. C. J. Baily, Jr.

A street motor car operated by a gasoline engine has been tried recently on the line of the Anacostia Ry. Co., of Anacostia, D. C., and its mechanism is the invention of Mr. T. C. Pole, of Washington, D. C.

This motor may be described as a 20-HP. horizontal gas engine, with cylinder 9×14 ins., mounted in the center of an open car, 20 ft. long and with a seating capacity for 19 passengers. The motorman on the front platform handles a wheel which, being turned to the right engages the sprocket wheel and chain by means of a friction clutch to two 36-in. driving wheels; while turned to the left, it throws off the clutch and puts on the brakes. The cylinder is just above the floor, with a 100-gallon water cylinder, or tank, above it. To one side and on the level with the water cylinder is the gasoline tank, made of ¾-in. boiler iron, 14 ins. outside diameter and with a capacity of 7 gallons. Two heavy fly wheels, 5 ft. 6 ins. diameter, steady the engine, the engine and fly wheels running constantly at a uniform speed independent of the speed of the car. There are two sets of gearing, for speeds of 6 and 12 miles an hour. The explosion is at present accomplished by a spark from four Leclanche cells, and the engine exhausts into a muffler underneath the car, this exhaust being scarcely audible. The entire outfit, including engine and car, weighs about seven tons and is designed to haul one or two trailers. The following results were obtained on a trial trip made about midnight of August 20.

The motor was geared up to a maximum speed of six miles per hour, the test not being for speed so much as for economy and efficiency. It took about a minute to start the engine, after which it ran steadily, the car itself being started and stopped several times to see how quickly it responded. One hill, 1,300 ft. long, beginning from a curve, was climbed, its grade varying from 2.6 to 5.2%, with 4.14% for 600 ft. The car took the hill easily. On a 4.14% grade it was stopped and started with no perceptible slipping. A start was also made from the middle of the sharpest curve on the road. The hill mentioned was the only one encountered on the run of 9,400 ft. The road is a rough one, about half a mile of it not having been used for several years and being covered with sand. Over this part the speed was about 4 miles, but for some distance 6 miles per hour was actually maintained.

As a consequence of the rough track, only when the engine was running and the car at rest could any opinion of the vibrations and noise be formed. This vibration was considerable and mostly longitudinal; heavier fly wheels might lessen it. The wooden casing was taken off, so the noise was far more than it would be in actual service and was very great. It should be remembered, however, that the parts are new and necessarily work stiffly. The gasoline also smoked badly once after a long stop, due to an overcharge, but while running there was only a slight odor.

The inside diameter of the gasoline tank is 12½ ins. At the end of the run the depth of the gasoline was measured and it was found that 1½ ins. had been used. This means 0.8 gallon for a distance of 1.8 miles. Taking the retail price of gasoline at 8 cts. per gallon (what it cost the parties making the test), would give on this run a cost of 3.6 cts. per mile for fuel. The temperature of the water rose from 80° at the start to 120° at the finish.

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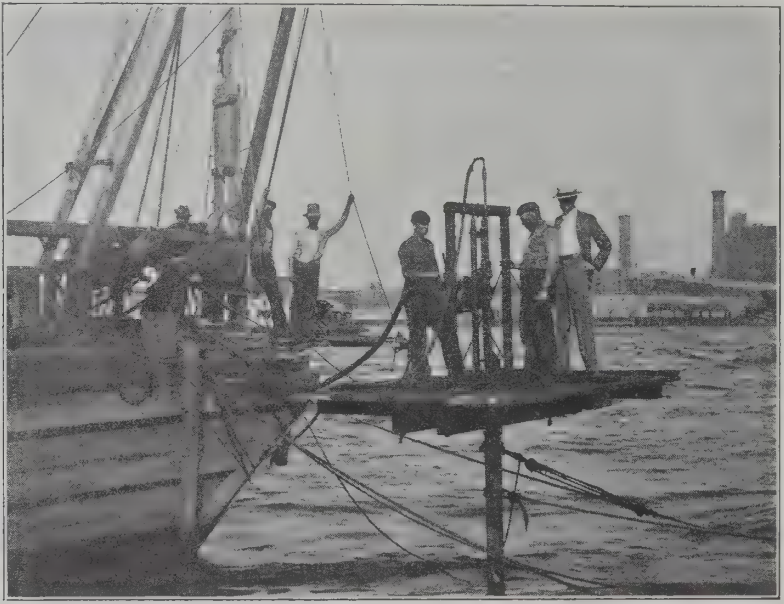
*Abstract of discussion at the meeting of the American Society of Railroad Superintendents, at Niagara Falls, N. Y., Sept. 9, 10, 1896.

Mr. Pole has received permission to run his car over the Belt Line tracks and also those of the Brightwood electric line, which has a smooth track and a couple of long grades.

DIAMOND DRILL BORINGS FOR THE NEW EAST RIVER BRIDGE PIER FOUNDATIONS.

As a preliminary to founding the towers of the new East River bridge, an exploration of the character of the soil and the depth to the solid rock at each tower site was essential. This was at first attempted by driving pipe to the rock, or to what appeared to be rock, and then exploding a dynamite cartridge on the surface of the supposed rock. If the pipe failed to sink any further the testing party assumed that bed-rock was reached; and on this supposition rock was indicated at 50 ft. below the water surface on the New York side, and at 75 to 80 ft. on the Brooklyn side.



MAKING DIAMOND DRILL BORINGS FOR THE FOUNDATIONS OF THE NEW EAST RIVER BRIDGE PIERS.
The New York & New Jersey Well Co. and the American Diamond Rock Drill Co., Contractors.

These tests, however, were not satisfactory and conclusive to the engineer of the bridge, and he decided to have borings made with a diamond drill to such depth as would establish beyond doubt the true position and character of the rock foundations. Bids were called for and the contract was let to the New York & New Jersey Well Co. and the American Diamond Rock Drill Co., of New York.

The method of carrying on the diamond drill work is indicated in the accompanying photograph. The strong tideway and the heavy swell from passing steamers made work from a floating platform impossible, and to drive piles for each boring would have added heavily to the expense when the depth of water was considered; this depth was comparatively small on the New York side, but on the Brooklyn side the water ranged from 49 to 60 ft. deep. The use of a trussed and anchored pipe, similar to that employed on the test-borings in the Northumberland Straits, was also rejected, owing to the variation in depth and the desirability of starting some of the holes with small pipe and others with pipe of large diameter.

The plan of the work finally adopted was as follows: A pipe was first jetted and driven to the bed-rock by the use of the boring machines of the New York & New Jersey Well Co. These machines were mounted on the bow and stern of a large scow; and heavy drive-pipe was used, with the holes usually started with a 6-in. pipe, though 8-in. pipe was driven down in some places. On reaching a boulder that could not be broken up, or driven aside, a hole was drilled through it with the drop-tools, and a smaller pipe was inserted and driven down; and this process was repeated until bed-rock was assured. In several instances a boulder was mistaken for solid rock, until the diamond drill exposed its pretensions. Bed-rock once actually reached a 2-in. pipe was seated in the rock in such a manner as to form a sand-tight joint; the scow was drawn back a few feet from the hole and a platform, 8 by 10 ft., made of 6 by 6-in. timbers and floored with 2 by 6-in. plank, was lowered over the top of the 6-in. pipe and firmly clamped to it by bolts. The pipe, with its platform, was stayed against vibration by means of separate anchors and by purchases attached to the anchor lines of the scow. The diamond drill and its frame was then mounted upon the platform; and for these borings a very light drill, designed for underground mining exploration, was adopted and proved well suited to the work. Steam hose and water hose connected the drill on the platform with the boiler and pump on the scow.

The original pipe-borings were found to be misleading, after the diamond drill had been set to work. Instead of 50 ft. to bed-rock, on the New York side, the true depth was found to vary from 46.1 ft. to 68.3 ft.; and on the Brooklyn side, the true depth ranged from 80 ft. to 104 ft. In only one case out of 22 holes bored did the two sets of borings agree; in all other cases the supposed solid rock proved to be merely a boulder. The actual distances bored into the bed-rock by the diamond drill ranged from 10 ft. to 20 ft., these depths being considered sufficient to prove the character of the foundation. In nearly every case a few hours' work, after setting up the drill on the platform, was all that was required to complete the hole, and no difficulty was experienced in working from the platform, notwithstanding an unusually strong tide and heavy swells from passing boats. A core was furnished for each hole, showing conclusively the character of the rock. As the small drill used had a capacity of 350 ft. the holes could easily have been carried deeper, had this been deemed desirable. In all, 22 holes were drilled; 10 on the New York side, at the foot of Delancey St., and 12 on the Brooklyn side, at the foot of South Fifth St.

The use of the fixed platform proved entirely successful, and is believed to have been more economical than any other method that could have been proposed; and the results indicate that this method should have an extended application to problems of submarine boring. During the progress of the borings at this place, a new process for shutting off seams in bore-holes was successfully tried and much facilitated the work. This process was invented by Mr. Garvey, in charge of the diamond drill work of the American Diamond Rock Drill Co.; but details of the process have not yet been made public.

HIGHWAY BRIDGES.*

By Carl Gayler.**

In preparing a paper on this subject I have endeavored to bring out a few points which might explain the very limited success of former agitations for an improvement in the building of highway bridges, and to discuss at some length the present practice, not of the highway bridge companies, but of the structural engineers who have made highway bridges a specialty.

It is now four or five years since the movement for a reform in the highway bridge business was at its height. The technical papers of that time are full of editorials and letters on this question; several prominent engineers and professors of civil engineering devoted their time and influence to it; the engineers' clubs of Chicago, St. Louis and Kansas City had committees appointed and reports adopted, and in several states drafts of proposed acts of legislature were prepared and came very near being introduced. And with this the movement came to an end, after having accomplished very little; and highway bridges are being built about in the same manner as before.

As there is no doubt that an improvement in the building of highway bridges is desirable, this failure is remarkable and seems to indicate that the fault lay with the proposed remedies. There is a good deal of force in the objections first raised by Mr. Horton, of the Western Society of Engineers, against the principal proposed remedy, i. e., legislative enactments. It seems unjust to transfer the control over highway bridges from the cities and counties to the state, as the former originate the work, pay for it and have to maintain it.

A perusal of what has been written and proposed at that time leaves, furthermore, the impression that the movement was not sufficiently comprehensive; it might be characterized as efforts to secure legislation providing for expert examinations of the strain sheets of proposed new highway bridges, and examinations of such old ones, the safety of which had given rise to doubts. But how about the preliminary work, deciding on the length of span, clear waterway, foundations, character of masonry, and—assuming the superstructure to be built according to the proposed state official's directions—the maintenance of the bridge? Surely, every one of these points requires the services of the bridge engineer. Counties will have to follow the example of our large cities, and employ capable engineers for their highway bridges. Wherever in cities and counties public works are in the hands of engineers, state supervision is unwarranted; where county commissioners rely on their own wisdom a limited supervision, as proposed at the time of the late reform movements, is insufficient.

Whenever one of the periodical unusually heavy rains flood a section of the country, we read about a number of bridges having been washed out; such occurrences are generally regarded by the profession with considerable equanimity, as if it were in the natural order of things that abutments and piers are underwashed, or superstructures carried away by floods which surely should never have reached them, whilst the occasional breaking down of a highway bridge is carefully noted, and still gives rise to spasmodic appeals for legislation. Why this important question of sub-foundations was never included in the efforts of the reformers, why it is likewise hardly ever mentioned in books and treatises on highway bridges, has always been a mystery to the writer. Some remarks on this subject may not be out of place.

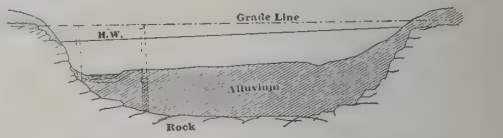


Fig. 1.—Typical Cross-section of a Stream Bed.

The cross section of a valley, as shown in Fig. 1, through which a road is supposed to be built, requiring the crossing of a creek or stream, is typical with the cases with which I had experience; it is probably also typical of the greater number of cases in this part of the country. It is a broad valley, with steep banks and an alluvial bottom. The rock is near the surface on both bluffs, the alluvium extends down to considerable depth, and the water-course is near one of the two banks. A glance will show this valley to have been in former ages the bed of a great river, which, probably assisted by the action of ice, hollowed out its immense bed in the rocks. Subsequent sinking of the land or diminishing of the volume of water, or both causes combined, raised the level of the bed of the river, and the valley filled up with boulders, gravel or sand, or with clay, from the ice period, and, closer to the present water-course, with more recent deposits. To form an intelligent judgment of the contemplated foundations, an insight into the history of the valley in by-gone ages, assisted by some general knowledge of geology, is necessary. Borings or test pits will complete what is necessary to plan the foundations and estimate their cost. The grading of the highway and the building of the substructure reduces the free waterway in time of floods, a deepening of the water channel, often, also, a shifting of the water-course, caused by the dying out of the vegetation, takes place, and these changes in the water-course are most important in designing the foundations, and,unless taken well into consideration, may cause the destruction of the bridge in short time. That this preliminary work, as well as the building of the abutments and piers, should be in the hands of the bridge engineer, will be readily conceded.

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*From the Journal of the Association of Engineering Societies, June, 1896.

**Member of the Engineers' Club of St. Louis.

The superstructure of the American highway bridge has been developed by the highway-bridge companies, and it has been truly stated in regard to the best examples among them, that "greater strength and safety are obtained from a given amount of materials than with the methods of construction which prevail abroad." During late years, some of our leading structural engineers have given their attention to this subject, and have published books and specifications on highway bridges. A subdivision of the latter into three classes, according to their proximity to cities, assuming different live loads for each of them, is now the accepted rule. Being more familiar with Class I (or A), i. e., bridges in cities, I will confine part of the following remarks to this class:

It is generally agreed to assume for the live load, beside a concentrated load by which the dimensions of the flooring, stringers, floor-beams and hangers are obtained, a uniform load per square foot, covering the whole and portions of the bridge, ranging from 100 lbs. for short spans to 50 lbs. for longer spans. It is worth while to consider what this assumed uniform live load really means.

In the case of railway bridges the live load is simply the weight of the trains, and the unit strains in the truss members have been selected of such magnitude as to give a structure of reasonable rigidity. For the principal tensile members, 10,000 to 12,000 lbs. are customary, and for the compression members a reduction is made in the units according to the laws of the strength of columns. These unit strains are far lower than the elastic limit of the material would seem to warrant; they bear no relation to the breaking strength, and the so-called factor of safety may as well be abandoned as an antiquated expression without meaning; they have been evolved from the behavior of bridges under their daily duties. As Prof. J. P. Snow, in a recent discussion on the strength of iron railway bridges, puts it: "What is the basis of the present units? Examinations of bridges in service. In order that a bridge may be satisfactory it must remain rigid under trains and deflect but very little. These conditions can only be obtained by using low units." Now, with highway bridges, the case has just been reversed. We start out with unit strains borrowed from the railway bridge practice (increasing them, however, about 25%, for some reason not easily explained) and then choose the live load with the view of obtaining a satisfactory structure. It is well to keep this in mind; attempts to explain the customary live loads for highway bridges in any other way are misleading, if not dangerous.

Since the substitution of steel for iron, some engineers specify for highway bridges of the former material an increase in the unit strains of 20%. Granted that the ultimate strength of steel is 20% greater than that of iron, and the elastic limit even more, this increase in the units is, for the reasons stated above, not justified, as the modulus of elasticity of steel exceeds that of iron but little. By far the greater number of highway bridges, with their plank floors, are light structures; there is little mass in the metal to overcome the effects of the jolting of wagons over the rough planks, or of the trotting of horses; the vibrations are accumulative and we should be slow in adopting an increase of units. Increasing or doubling the units for the dead load should only be resorted to for very long spans, or for bridges with extremely heavy floors. I may be permitted to state here that my experience in this city with four steel spans of 120, 135, 150 and 220 ft. length, designed for the live load of Cooper's A, but for unit strains of iron railway bridges, no increase in them being made for units under dead load, has been such that I have never felt guilty of a waste of material in designing them, and that they have convinced me that the usual specifications for this class are too light.

Specifications and books on highway bridges and standard details for the same, as published in the latest works, have left the impression on the writer that this subject has not been treated with the conscientious care bestowed on other structural work. Whether the temporary and unsatisfactory character of most of the floors, or the fact that bridges built in accordance with these books and specifications are still far above the general practice all over the country, or the certainty that the bridges when completed will in nine cases out of ten be neglected and go to wreck and ruin anyway, can explain their neglect, I am unable to say.

The consideration of rigidity, which have led to the selection of these live loads, should be the guide in regard to lateral connections and the results of our experience with railway bridges should with equal care be applied to the highway bridge. In all through spans rigid connections of floor beams with posts and bottom chords should be insisted upon, not that perfectly safe hangers could not be designed—the latter having even a slight advantage in applying the load centrally to the posts—but the gain in lateral stiffness is too great to be thrown away. It is impossible to prevent altogether a distortion of the structure in a storm or under a load applied close to one of the two trusses; but with deep floor beams well riveted to the posts and top lateral struts firmly attached to top and bottom of the top chord, as sketched in Fig. 2, considerable resistance is gained; with details as shown in Fig. 3, next to none.

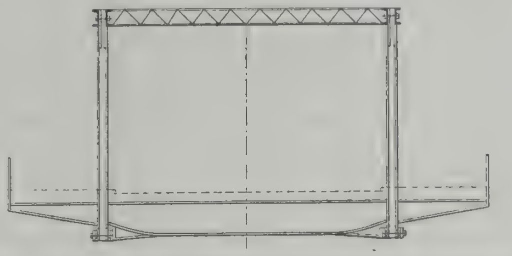
Fig. 2.—Cross-section of Bridge Truss, with Riveted Floor-Beam Connections.

There is one feature in through bridges to which full justice has never yet been done; it is the top lateral bracing. The universal custom is to design it to withstand the wind pressure (generally assumed to be 150 lbs. per linear foot of top chord). Now, there is not the least doubt that it should be made strong enough to resist the wind forces, but there is just as little doubt that if a bridge were thoroughly protected against wind, the top lateral system would still have to prevent the top chord from buckling; more than that, I am convinced that no storm ever strains it as the top chords do under their full duty. Anyone standing on a railway bridge with a train moving over it can satisfy himself on this point. It seems to be against sound judgment to design the top lateral system of a through span on the same supposition as the bottom lateral system of the deck span. This is one of the many instances where the strain sheet alone is no sufficient guide. The engineer has to use his experience and judgment to design a lateral system of sufficient rigidity; no theory in the world will enlighten him on the amount of lateral pressure exerted by an exceedingly long column. Mr. Waddell, in his book on highway bridges, states in this respect, without, however, entering into the question, that the top lateral rods in highway bridges up to 200 or 230 ft. length, if proportioned for wind pressure alone, are too light.

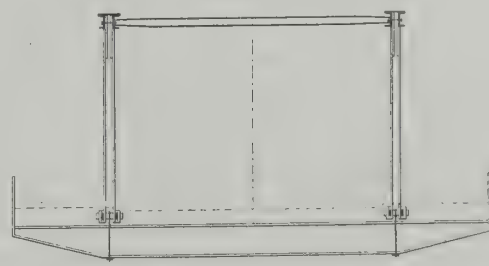
Fig. 3.—Cross-section of Bridge Truss with Floor-Beams Hung.

The above remark that the strain sheet does not cover every case applies with equal force to the specifications. It has been too much the custom to let highway bridges under a set of specifications, limiting the work of the consulting engineer—in case an engineer is consulted at all—to checking the figures and sizes. This custom, more than anything else, has made a highway bridge superstructure a mere merchandise. Nothing is, for instance, easier than to specify "a substantial railing" for a bridge, yet nothing is more indefinite and more difficult to enforce. Specifications are necessary, but we need even more the judgment of the engineer; we need more designing and less standards.

I have no intention of entering into the question of the relative superiority of pin-connected or riveted highway bridges, but there is one type in which the later are infinitely superior to the former, i. e., the short span pony truss. If designed with pin conections the lack of lateral stiffness is exceedingly difficult to overcome; with a riveted design we easily obtain a most excellent structure.

The subject of floor systems could easily be made to take up your whole time for an evening, and will not be discussed beyond calling attention to the new departure which has been occasioned through the advent of the electric motor car. That it will be of the greatest moment is apparent; we have in this city motor cars, weighing, when crowded with people, 24 tons, carried on two trucks 25 ft. apart; we have others of 18 tons weight when full of people, the trucks being spaced 14 ft. c. to c. In the first motor cars the load on each truck was distributed equally on both axles; to gain in tractive force the pin was then shifted so that about 75% of the load came on one axle, and in the latest cars (on Jefferson and Grand Aves.) the whole weight is caried on the driving axles. The first motors of 15-HP. have been succeeded by 25 and 50 HP. motors; girder rails, 6, 8 and 10 ins. deep have taken the place of the flat rail of the old street cars. It is not more than six years since electricity began to be generally applied to the city and suburban transportation, and it is not likely that the motor car, especially on long suburban lines with heavy grades, has attained its greatest weight.

Assuming now a bridge to be completed, the work of the engineer is still not over. In a few years the floor will need looking after, parts of the ironwork and railing require attention and the paint will begin to show those ugly spots which indicate that the work of deterioration has begun. This question of painting is the bane of the structural engineer's life, the one point where his knowledge is at fault and where his only recourse is to get the rust scratched off and new paint smeared over it. It does not matter very much what kind of paint he uses, iron oxide, lead paint or asphalt, so long as he tries to get a good brand and makes the most of his limited knowledge of the oil and the pigment; in all probability he will use them all in turns and in turns be disappointed. Protection of metal against atmospheric influences by paint applied cold is temporary. Rusting is most to be feared and most difficult to prevent on surfaces which are close together without being in close contact throughout, as at pin joints between the heads and eyebars and the adjacent portions of the posts and chords. Taking apart old pin-connected trusses we find the greatest corrosion on the sides of eyebar heads. It would not seem to be impossible to remedy this by filling these spaces with impervious material; to my knowledge this has been successfully done on the lower chords of the heavy Pauli trusses of the Monongahela bridge at Pittsburg. In riveted work there is no excuse for such dangerous spaces between different members, but we still find too often, through faulty riveting or where rivets have been spaced too far apart, that we can insert the blade of a knife between angles and plates, especially at the stiffeners of large web sheets.

Such weak points will probably never be quite overcome; the wonderful example of the Eads bridge, where the sides of the eyebar heads of the main arches and the adjacent sides of the joint blocks were planed and all the exposed joints of the covers of the tubes were carefully calked, will never be imitated, but the designer of structural work should keep this question always in mind.

The action of corrosion in wrought-iron work in cases where painting is utterly unavailing—and it has been my luck to have a number of such cases under my charge—is peculiar. A hard shell of corroded iron of pretty uniform thickness forms over the whole exposed surface; this shell scales off to make room for the formation of another shell, and this process goes on until nothing is left to scale off. It might not unreasonably be supposed that this process of scaling off in layers is peculiar to wrought iron as a material rolled and welded in layers, and that steel, being a homogeneous crystalline metal, would better resist the attack of rust. Should this prove to be true, what a splendid bargain did we make in exchanging iron for steel!

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BIDS FOR TORPEDO BOATS were opened at Washington on Sept. 18. The proposals covered three 30-knot boats on builder's own plans and smaller boats of 20 and 22½ knots on both department and builders' plans. The prices bid were as follows:

	30-knot boats.		
	Price for each, for		
	One.	Two.	Three.
Union Iron Wks., San Francisco.	$227,500	....	....
Bath Iron Wks., Bath, Me.	....	$194,000	$189,000
“ “ another proposition.	....	235,000	....
Herreshoff Company	218,000	....	206,000
J. H. Dialogue Co., Camden, N. J.	260,000	255,000	......

	22½-knot boats.		
	Prices for each, for		
	One.	Two.	Three.
Columbian Iron Wks., Baltimore.	$79,000	$79,000	$79,000
Moran Bros., Seattle, Wash.	.....	.....	94,255
Bath Co., Bath, Me.	.....	.....	80,000
“ “ for 3 25-knot boats.	.....	.....	123,000
Herreshoff Co.	.....	.....	80,000
“ “ Cushing design.	.....	.....	92,500
“ “ Cushing modified.	.....	.....	78,500
Wolf & Zwicker, Portland, Ore.	.....	.....	75,100
G. Lawley & Son, Boston, Mass.	83,500	.....	78,800

	20-knot boats.		
	Price for each, for		
	One.	Two.	Three.
Columbian Works	$49,000	$49,000	$49,000
“ “ on their own design	45,000	45,000	45,000
Moran Bros., Seattle	59,640	.....	56,928
Herreshoff Company	40,000	.....	37,500
Wolf & Zwicker, Portland	.....	.....	45,000
Providence Steam Engine Co., R. I.	.....	51,600	48,650
Lewis Nixon, Elizabeth, N. J., on his own design	69,000	.....	68,000
C. Hillman Ship & Eng. Co., Phila	.....	48,000	.....
J. H. Dialogue Co.	.....	58,500	.....
G. Lawley & Sons, own design.	61,500	.....	54,835

The proposals were much complicated, by combinations of classes and by alternate designs of several types. These will have to be carefully examined before any award can be made. The bids were in the main reasonable and the number of bids gives general satisfaction.

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Immediately upon the heels of an announcement that the New East River Bridge Commissioners would receive proposals for constructing the foundations of the New York tower, on Oct. 7, comes a statement that work will probably be delayed owing to a lack of funds. The work contemplated is to cost approximately $500,000, and this official, "high in authority in the Commission," says that this money is not on hand, and they do not know when it will be available. The late advertisement for bids for bonds brings out the unpleasant fact that $50,000 of the bridge bonds recently offered by Controller Fitch are yet unsold, and the $100,000 previously disposed of were taken by the Uhlmann syndicate and paid for with a portion of the money received by that syndicate in return for the right of way. Both New York and Brooklyn are having difficulty now in advantageously disposing of their bonds, and until the financial horizon clears up somewhat the sale of $15,000,000 bridge bonds, upon which construction depends, is problemetical, to say the least.

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In the purchase and laying out of plant on large construction works, it is comparatively rare to find much consideration given to the questions of efficiency and economy in operation, the general impression being that the temporary character of the work, the shifting of the plant during the work, and the rough handling to which the plant is subjected, make it not worth while to go to much expense to secure economical operation. This is no doubt true to some extent, especially on smaller jobs, though even in such cases gross and unnecessary waste and inefficiency (with consequent increased expense and reduction in profit) are too often evident, owing in general to the failure of the contractor or his subordinates to see the relation between an inefficient or badly handled tool or machine and the net financial results of the work. On large works, however, where large sums of money are involved, where a considerable amount of plant is required, and which will continue for many months or even years, it is manifestly to the contractor's interest to carefully consider the most efficient and economical plan of operating his plant, taking into consideration the conditions under which it will be worked. In another column of this issue we describe at some length the compressed air power plant and power transmission system installed for operating the tools and machines on the Jerome Park reservoir contract, a piece of work which involves an expenditure of about $5,500,000, and will extend over nearly seven years. Instead of having a number of small steam boilers scattered over the work, which is the common arrangement on construction contracts, there is one central power plant, which requires the attention of but two men and may be operated almost as economically as the permanent power plant of a factory. The result will almost necessarily be a great saving in fuel as compared with a plant using separate boilers, as the numerous small boilers generally employed are not adapted for nor handled with any view to economical fuel consumption, the main thing in the attendant's mind being usually to keep the steam up to the blowing-off point. The pipe line transmission system is very flexible and can be shifted and extended to reach any part of the work with little trouble or expense. We believe this is the first case in which compressed air power transmission has been employed on any such extensive scale for contract work, and it certainly seems to be well adapted for the conditions under which it has been established.

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An interesting question connected with the launching of corporations and the early marketing of their stocks and bonds came up in the late hearing of the Maritime Canal Co. before the Massachusetts Railway and the Harbor and Land Commissions. This company was incorporated by the last Legislature to build a ship canal across the Cape Cod peninsula, and the act stated that the issues of stock and bonds should be subject to the law of 1894 relating to similar issues by street and steam railways. The company petitioned that the joint boards approve of the total issue authorized, or $6,000,000 in stocks and $6,000,000 in bonds. But the law of 1894, in dealing with street and steam railways, distinctly says that the Commissioners shall approve "from time to time" such amounts as shall be deemed by them to be reasonably requisite for the purposes intended. The Commission holds that it cannot, under this law, approve of the whole issue at once; and the company says that without the whole of the issue to put up as collateral they cannot raise the money necessary for the work; and here the matter rests. Ex-Governor George S. Boutwell, in arguing the case of the Maritime Company, contended that this was an enterprise entirely differing from a railway; that the projectors could not go into the market for subscriptions, but that bonds must be sold in such a way that the issues will go hand-in-hand with the enterprise. Contracts must be made with contractors for the whole issue, or the canal would never be built. He also explained that the contracts were to be paid for in stocks, and the stock and bonds would be issued to pay for work done on the engineers' certificates. Chairman Sanford of the Railway Commission, held that the law applied in this case and the Commissioners could not say at this time that $12,000,000 was a reasonable amount for the total issue. Mr. Sanford held that if the stocks and bonds were thus approved by the Commissioners, they would go to the contractor who would sell them to the public with the board's approval upon them, and market them mainly upon this approval. Nor would he consent to approve of the issue of $250,000 of stock and $250,000 in bonds, which the petitioners finally asked for to pay for preliminary surveys, for the reason "that there was not one cent's worth of property to secure these bonds;" and he suggested that if the promotors had the faith in their enterprise which they professed, they should raise this necessary $500,000 among themselves. But even if they did this he would not advocate the approval of the entire issue, but would do as the law prescribed.

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To the average promotor this is a new and most objectionable manner of handling an issue of stocks and bonds. Under former and well-established usage it was the general public, and not the promotor, who took all the financial risk of any similar enterprise; and it was the business of the "construction company" to place the issues where money could be obtained for them—and to reap the profit, if any profit there was. Massachusetts is far in advance of other states in her laws regulating the marketing of bonds by railway and other public corporations and in her attempts to regulate a privilege too often abused. The law of 1894 may be annoying to those managing certain enterprises of this character in compelling them to resort to new methods of raising the preliminary funds required; but its tendency will also be to eliminate projects depending more or less upon chance for success, and also to lessen the amount of money sunk by the public, here and abroad, in investments of doubtful merit. It is true, that no one can foresee the outcome of every enterprise of large dimensions, nor can any one tell whether it will ultimately be a profitable or a losing affair. But it is time that the investors of this country took fewer chances than in the years past; and any laws should be welcome that tend to lessen these chances by placing more responsibility upon the promotors of an enterprise and by establishing honest and intelligent supervision over the preliminary stages of undertakings that are ultimately to cost millions.

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The new open-hearth process of steel making, described on another page of this issue, is really only a moderate variation from present current practice; but the results obtained, amounting to a reduction in the cost of conversion of over one-fourth, make the process deserving of study. The many improvements in open-hearth work which have been introduced during the past few years, among which we may note especially the American tipping furnace, are tending all the time to reduce the cost of open-hearth work and to make it more similar in economy and enormous output to work with the Bessemer converter.

EFFECT OF THE RATE OF COMBUSTION UPON THE EFFICIENCY OF STEAM BOILERS.

The paper of Prof. W. F. M. Goss, published elsewhere in this issue is an important contribution to our knowledge of the effect of high rates of combustion upon the efficiency of locomotive boilers. It has long been known that if there is no change in the ratio of heating to grate surface in a steam boiler an increase of the rate of combustion beyond a certain limit (which limit is somewhere in the neighborhood of that required to produce an evaporation of about 4 lbs. of water per sq. ft. of heating surface per hour), will make a decrease in economy. One of the causes of this decrease is clearly revealed in the increase of temperature of the chimney gases which is commonly found when the boiler is driven beyond the rate named—and is the insufficiency of the heating surface to abstract the heat generated in the furnace. In such a case the decrease of economy is not due strictly to increasing the rate of combustion on the grate, but to the generation in the furnace of a total quantity of heat so great that the heating surface of the boiler is not capable of absorbing as great a percentage of it as it does when the amount of heat generated is less. The question has often been raised whether a high rate of combustion of itself is not favorable to high economy. For example, suppose a certain stationary boiler to have a ratio of 30 sq. ft. of heating surface to 1 sq. ft. of grate surface, that 15 lbs. of coal are burned per hour per sq. ft. of grate, and that 4 lbs. of water are evaporated per sq. ft. of heating surface, equivalent to an evaporation of 8 lbs. of water per lb. of coal, might not the economy be improved by cutting down the grate surface one-half, making a ratio of 60 to 1, and by increasing the force of the draft so as to burn the original quantity of coal on the reduced grate, that is to burn it at double the original rate, or 30 lbs. per sq. ft. of grate? The answers to this question in hitherto have shown quite a difference of opinion, but the tendency in recent years, especially among those experienced in the use of bituminous coal, seems to be toward a belief in the greater efficiency of high rates of combustion on a relatively small sized grate, that is with a high ratio of heating to grate surface. The experiments of Prof. Goss give no definite answer to this question as far as stationary boilers, with rates of combustion ranging from 10 lbs. to 40 lbs. per sq. ft. of grate are concerned, but they do show some of the reasons why in locomotive practice very high rates of combustion tend to decrease of efficiency. His experiments were with four different rates of combustion; viz.: approximately 60, 80, 120 and 240 lbs. per sq. ft. of grate per hour, the grate surface being cut down in the tests after the first respectively to ¾, ½ and ¼ the full size, so as to make the total amount of coal burned per hour approximately the same in each of the four tests. The results of the tests, expressed in terms of efficiency of the boiler, 100% representing perfect efficiency, or the absorption by the boiler of the total heating value of the coal, were respectively 61, 59, 56 and 50%.

Prof. Goss makes an attempt to determine to what the increased losses in the three last tests, as compared with the first, were due. The total amount of coal burned, and presumptively the heat generated in the furnace, in each case being the same in each of the four tests, the question of possible deficiency in extent of heating surface is eliminated. The possible conditions which may cause the decreased economy with increased rate of combustion are thus apparently narrowed to these three; viz., 1, imperfect combustion of the coal; 2, excessive air supply beyond that required for proper burning of the coal; 3, loss of coal in the sparks blown out of the smokestack. The investigation as to the effect of the first two of these conditions was made by analyzing the gases, and as to the third by weighing the sparks collected in the smoke box and those discharged from certain selected portions of the total area of the top of the stack which are considered to be representative of the whole area, calculating therefrom the total spark loss, and analyzing the sparks to determine their heat value.

The result of these investigations Prof. Goss has graphically shown in Fig. 2 of his paper. The greatest source of loss by high rates of combustion in ordinary practice, when the grate surface is not cut down, is due to insufficient extent of heating surface. When this source is eliminated by cutting down the grate surface in proportion to the increased rate of combustion the next important source of loss is in the sparks blown into the smoke box and out of the stack. With about 6,500 lbs. of coal burned in each of the four tests, the total amount of sparks lost was respectively 369, 571, 772 and 1,058 lbs., the loss increasing as the rate of combustion increased.

Prof. Goss's diagram, and also the text of the paper, show that he considers that the losses due to imperfect combustion and to excessive admission of air increased with the increased rate of combustion. With this statement we regret to be compelled to take exception, and to say that it is not proved by his data. On the contrary, his results appear to us to indicate that with the reduced grate surface the only loss which increases with the rate of combustion is the spark loss, which is serious enough, and that the loss of efficiency due to excessive admission of air or to imperfect combustion was practically constant in all four of the tests. In support of this opinion we have the following data:

Test No.	1.	2.	3.	4.
Lbs. of dry coal fired	6,443.0	6,522.0	6,514.0	6,227.0
Lbs. coal equivalent in heating value, total w't. sparks	277.0	457.0	664.0	963.0
Total heating value coal lost in sparks, %	4.3	7.0	10.2	15.5
Total heating value coal absorbed by water in boiler, %	61.4	58.5	55.9	49.6
Sum of the last two items	65.7	65.5	66.1	65.1
Loss, efficiency, all causes,* %	34.3	34.5	33.9	34.9

*Other than sparks.

The last line of figures shows the total loss due to heat carried away in the chimney gases, to imperfect combustion and to radiation. There is no evidence here that any one of these losses tends to increase with an increase of rate of combustion, for the differences between any two of the four figures given above are well within the limits of error of the observations. If our view of the matter is correct, then the diagram, Fig. 2, given by Prof. Goss, should be modified by causing the triangular area a d e, which he says represent the extra loss by driving the rate of combustion above 50 lbs. per sq. ft. of grate per hour, to disappear, and the line a d to become horizontal.

Prof. Goss calls attention to the great excess of air passing through the fire in the third and fourth tests, and says " it would appear that this cause must have operated to reduce the performance of the boiler as the rate of combustion is increased." He also says that the presence of carbon monoxide (C O), which occurs in the fourth test only, is accepted as proof of imperfect combustion. Undoubtedly either a great excess of air supply or the presence of carbon monoxide in the chimney gases would be accepted, if they were conclusively shown by the analyses of the gases, as accounting for loss of economy. These two causes of loss are, however, usually supposed to be antagonistic to each other, that is it is supposed that both cannot take place at the same time, excessive air supply will preclude the finding of C O in the chimney gases, and the finding of C O is in itself proof of an insufficient air supply. Nevertheless Prof. Goss's chemist has found C O in the fourth test only, in which the air was in greater excess than in any other of the tests. Attempting to account for this Prof. Goss has recourse to a theory of Herr R. Ernst, that C O is formed under very high rates of combustion, "or more specifically when the temperature of the fire is above 1,800° F." We have looked up the reference to this theory given by Prof. Goss, and find it only in the shape of an editorial in "The Engineer" (London) of Aug. 4, 1893, which gives no details of the experiments upon which Herr Ernst based his theory. In the absence of the experimental proof of the theory we must decline to accept it, and in fact the editorial referred to appears to us to contain more rank heresy on the subject of combustion than we had ever before seen.

We have a theory of our own to explain the analyses given by Prof. Goss, and that is that either the sampling of the gases or the analyses were incorrect, and for proof of this we submit the following calculation: Prof. Goss correctly states that "all air admitted to the furnace in excess of that required for combustion is heated from the temperature of the atmosphere to that of the smoke box, and by this process heat is taken from the furnace." The analyses of the gases give us the data by which we can obtain the amount of air supplied to the fire per lb. of carbon. The formula is

$$\text{Lbs. of air per lb. carbon} = \frac{4}{3}\left[\frac{2(CO_2 + O) + CO}{CO_2 + CO}\right] \div 0.23.$$

Applying this formula to the analyses we obtain for the amount of air supplied to the fire per lb. of carbon in each of the four tests:

No. 1, 38.4 lbs.; No. 2, 33.5 lbs.; No. 3, 46.9 lbs.; No. 4, 102.5 lbs.

Since the ultimate analyses of the coal is not given, we cannot say accurately how much total carbon was in the coal, but if we assume that 5% of the weight of the coal was hydrogen, nitrogen and oxygen, and that the remainder of the volatile matter was carbon, we will have the percentage of total carbon in the coal nearly enough for the purposes of the calculation, as follows:

No. 1, 84.9% No. 2, 85.8% No. 3, 85.0% No. 4, 85.4%

Multiplying the weight of air per lb. of carbon by these figures we have for the weight of air per lb. coal burned:

No. 1, 32.6 lbs.; No. 2, 28.7 lbs.; No. 3, 39.9 lbs.; No. 4, 87.5 lbs.

But this calculation assumes that all the carbon in the coal was burned, whereas the fact was that a considerable portion escaped in the form of sparks, and a small portion, according to the analyses in the shape of heavy hydrocarbon. If we take as the percentage of this carbon loss the percentage of loss of heating value in the sparks, a close enough approximation, we will have for the carbon actually burned, expressed as a percentage of the total weight of coal:

No. 1, 80.6% No. 2, 78.8% No. 3. 74.8% No. 4, 69.9%

and for the weight of air supplied to the fire per lb. of coal used

No. 1, 31.0 lbs.; No. 2, 26.4 lbs.; No. 3, 35.1 lbs.; No. 4, 71.6 lbs.

The weight of gases per lb. of coal used would be the same as the weight of air plus the weight of the combustible portion of the coal which entered into the gases, or approximately,

No. 1, 31.9 lbs.; No. 2, 27.2 lbs.; No. 3, 35.9 lbs.; No. 4, 72.3 lbs.

The loss of heat in the gases passing out of the stack is the product of their weight into their average specific heat (say 0.24) into the difference between the temperature of the smoke box and that of the atmosphere (say 60°). The difference of temperature in the four tests respectively is

587°, 569°, 550° and 440° F.

Multiplying these figures by the weight of gas per pound of coal and by the specific heat we have for the heat loss, in units of heat per lb. of coal burned,

No. 1, 4,493. No. 2, 3,814. No. 3, 5,139. No. 4, 7,635.

As the total heating value per pound of dry coal was 13,000 B. T. U., these figures give as the percentage of the total heat of the coal, which was lost in the gases discharged from the stack,

No. 1, 34.6% No. 2, 29.3% No. 3. 39.5% No. 4, 58.7%

We have already found that the sum of the heat absorbed by the water in the boiler and the spark loss was

No. 1, 65.7% No. 2, 65.5% No. 3. 66.1% No. 4, 65.1%

Adding these figures together we have

No. 1, 100.3% No. 2, 94.8% No. 3. 105.6% No. 4, 123.8%

No account has been taken of loss by radiation, which, if obtained, would increase these figures. The meaning of the last figure is that without considering the losses by radiation and by imperfect combustion the heat absorbed by the boiler, that lost by unburned sparks, and that lost in the gases discharged from the stack, accounts for all the heating value of the coal and 23.8% more. The most reasonable explanation of this absurd result, it seems to us, is that there was something wrong with the analyses of the gases.

The results of these four tests, as we read them, are valuable in showing that the efficiency of this particular locomotive is reduced only from 61% to 50% by increasing the rate of combustion from 60 to 240 lbs. per sq. ft. of grate per hour, and that the whole of this loss of efficiency is due to the loss from sparks, which loss increased from 4% to 15% of the total heating value of the coal used.

It does not appear from these tests that rapidity of combustion has any bad effect upon the combustion itself, or any bad effect whatever, except that when the rate of combustion is high sparks are more apt to be driven out of the stack. There appears to us to be no reason why very rapid driving should make any difference in the economy, other than the loss by sparks, provided the grate surface is cut down proportionately to the increased rate of driving, and the thickness of the bed of fire is proportioned to the speed of the current of air passing through it. This thickness of bed is really the most important element. With a given air supply if the fire bed is too thick, carbon monoxide will be formed; if too thin, the combustion may be perfect, but there is apt to be a great excess of air, which will cause an excessive amount of heat to be carried up the stack. With a thin bed of coal and a very low draft pressure there may be perfect combustion and not too great an excess of air. With a very thick bed and with a strong draft there may also be perfect combustion and no great excess of air. Opposite conditions, thick fire bed with strong draft and thin fire bed with light draft, may produce identical results as far as economy is concerned. Whether in any particular case a high rate or a low rate of combustion should be adopted will depend not on the theoretical consideration of which will insure the most perfect combustion, but on other circumstances which relate entirely to convenience or to practice. In stationary boilers low rates of combustion may be adopted with the best results, but if a low rate means too long a fire grate for a fireman to fire properly, then a higher rate with a shorter grate should be adopted. Higher rates of combustion are adopted on locomotives than in stationary boilers, not because they give more perfect combustion, but because they cause the boiler to generate steam in sufficient quantity. Prof. Goss has shown that the spark loss limits the rate of combustion which may be used without great loss of economy. If there was any possible way of returning the sparks to the furnace, there seems to be no reason why still higher rates than any he has tried might not be adopted. In a blast furnace for making iron, as much as 15 tons of coal per hour may be burned, the total area of the zone of combustion not exceeding 30 sq. ft. This is equivalent to a rate of combustion of over 1,000 lbs. per sq. ft. of sectional area per hour, or about five times the highest rate used in locomotive boilers, and more than fifty times the usual rate in stationary boilers. If any necessity should arise for burning 1,000 lbs. of coal per sq. ft. of grate area per hour under a steam boiler it might be done without sacrifice of economy if only proper procession could be made for getting rid of the ashes and for preventing loss by sparks. High rates of combustion of themselves do not mean imperfect combustion, undue excess of air, or loss of economy, nor do they mean the reverse. Their use is therefore permissible if circumstances require.

In the case of locomotives there is an additional cause of loss of economy by high rates of combustion, besides the spark loss, and that is that these high rates require increased draft, which is only secured by increased back pressure in the cylinders of the engine. In the four tests by Prof. Goss the draft pressure was respectively 2.2, 2.5, 3.3 and 5.6 ins. of water. It is probable that indicator diagrams from the cylinders would show that the loss of power in the engine due to the increased back pressure required to provide the strong draft amounted to quite an appreciable percentage of the total power developed.

LETTERS TO THE EDITOR.

Driving Logs Upstream.

Sir: In your issue of Sept. 10 information is asked with reference to "driving" logs upstream. An old "shanty" foreman, Wm. Scott, tells me that though very unusual this has been done. His experience was on Deep River, a tributary of the Ottawa, the distance over which the logs were moved was comparatively short. A line was let down stream to which ring "dogs" were attached, two to each log, Each log butted closely to the preceding one and this log "snake" was drawn up the stream by a sort of crab capstan. The chief feature is that the current only impinges on the butt of the leading log. Assembling the "tow" is somewhat difficult as is also the withdrawing of the "ring dogs." These consist of a flat spike with a loose ring normal to the plane of the knife-shaped blade. I remain, yours, etc.

C. R. Coutlee.

Cascades Point, Quebec, Sept. 19, 1896.

A Cheap Bridge.

Sir: I send you herewith a photograph which, I think, may be of interest to your readers as an unique and efficient structure of very low cost. The severe freshet of last spring washed away the bridge over the Little Androscoggin River at Snow Falls in the town of Paris, Me., and this bridge was built by me for the town for a temporary foot bridge pending the erection of the new structure. The fir-balsam logs were cut in the adjacent woods and strung across the gorge; towers were built on each bank of hemlock logs; and cables of twisted wire fence ribbon were passed from anchorages on either bank over the towers and under pieces of iron pipe passed under the stringers. One anchorage is shown in the photograph, the wires being nailed to a timber braced under the bracket of an old boiler, while the other ends are fastened to the bottoms of tree trunks. The wires were drawn tight by means of the usual fence stretchers in use by farmers. A few old planks, which did not follow the bridge down stream made the floor, and rails were found within a few feet. I did no figuring of strains, the work being hastily contrived, but I was satisfied by seeing the bridge sustain, without noticeably deflecting, a load of a little over 500 lbs. concentrated at the center.

Temporary Foot Bridge over Little Androscoggin River, at Snow's Falls, Maine. Span between Towers, 40 ft.

The cost of this bridge was almost entirely in labor, the material, with the exception of the fence ribbon and a few pounds of nails and spikes, being picked up in the immediate vicinity, the items being as follows:

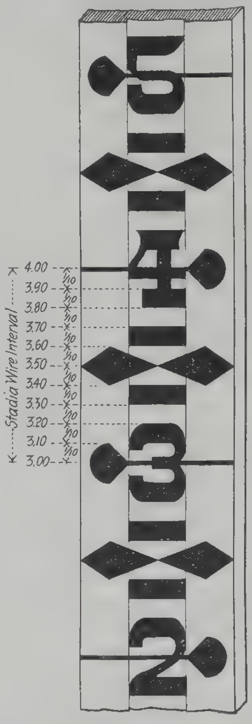
26 lbs. twisted wire fence ribbon @ .04	$1.04
1 lb. staples	.10
1 lb. 50d. spikes	.05
1 lb. 10d. nails	.04
Labor, men and oxen	$10.50
Total	$11.73

Yours very truly, Fred. J. Wood.

Snow Falls, Me., Sept. 5, 1896.

Another Stadia Rod.

Sir: I enclose herewith a sketch of a self-reading long-distance stadia rod, which I designed for use on the preliminary survey for the "Kern River & Los Angeles Electric Power Company."



Rod Marking.

Self-Reading, Long-Distance Stadia Rod, used on Preliminary Survey for the Kern River & Los Angeles Electric Power Co. Designed by Burr Bassell, C. E.

This rod was used for the entire distance of about 108 miles, crossing desert and mountains (both for stadia distances and vertical angles), and gave entire satisfaction. It cost a little less than $5 and was as serviceable at the end of the survey as at the beginning.

The criticism may be made that one cannot read close or fine enough. In actual work it was found that the rod could be easily read at long distances to 1-20 of an interval (representing 5 ft. with a 1-ft. interval, or 2½ ft. on the rod used on above-mentioned survey), and since the errors are not cumulative, but, as in leveling, tend to balance each other, very good work was done.

Permit me to call attention to the graduation, which must be studied and used to be fully appreciated.

There are no numerals excepting at the stadia wire intervals (for 100 ft.), The half intervals marked by double diamond figures are exceptionally clear to read at long range. The circular dart at each numeral alternate to right and left side of rod—the right hand being opposite even numerals and the left hand opposite the odd. This lessens the liability to err in reading, when rod is partially hid from view.

I am well aware that almost every engineer has his "pet rod." If you think this worthy the space in your valuable paper, you are welcome to use it. I claim the following for this rod: (1) Simplicity and ease of reading. (2) Cheapness and facility of transportation over rough mountainous country. (3) Durability.

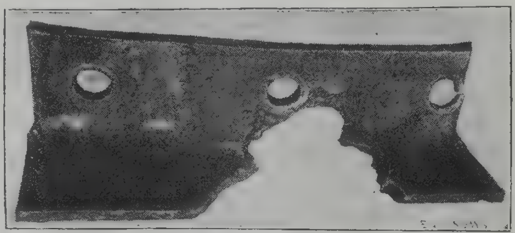
Yours truly, Burr Bassell.

Los Angeles, Cal., Aug. 31, 1896.

A Bridge Angle Iron Melted by Lightning.

Sir: I send you herewith a photograph of a piece of angle iron recently taken from a railway bridge over a street in Lowell, Mass. It was evidently melted by lightning, although no one knew that the bridge had been struck until the damage was discovered by the bridge inspector in making his periodical examination.

The bridge is in one of the freight yards at Lowell and a switchman is stationed very near one end of it, but he was unaware that lightning had visited his vicinity. This bridge carries five tracks on four pony trusses. Four of these tracks are used by regular passenger and freight trains and one, where the damage occurred, for yard shifting only.



A Bridge Angle-Iron Melted by Lightning.

The angle iron in question was in the top flange of a floor beam under this side track; the flange being made up of two 3½ × 3½ × ⅜-in. angles. The rail crossed the floor beam directly over the place burned out and about 2¼ ins. above it. Half of the rail base for a space of about 6 ins. and part of the thickness of the web was melted, a hole about 4 ins. in diameter was burned through the 1-in. board floor and the hard pine tie lying against the edge of the floor beam flange was charred into about 1 in. The paint was burned off clean over a space about 1 ft. in diameter below the burned angle, but was not affected on the other side of the floor beam web. There was no further trace of the current.

A double track electric line passes under this bridge with overhead trolley wire attached to the ironwork by insulated connections. One of these wires passes about 6 ft. from the point of the bridge attacked, but there is no evidence of the current traveling to the wire and there is no record in the office of the electric road of any disturbance to the wires or the insulation.

Yours truly, J. P. Snow,
Bridge Engineer, Boston & Maine R. R.

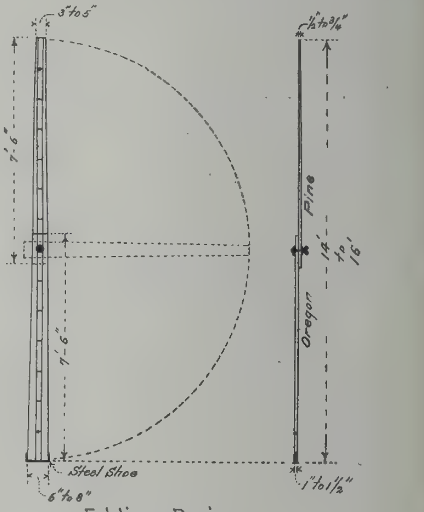
Boston, Sept. 5, 1896.

Subjects for Theses on Municipal Engineering.

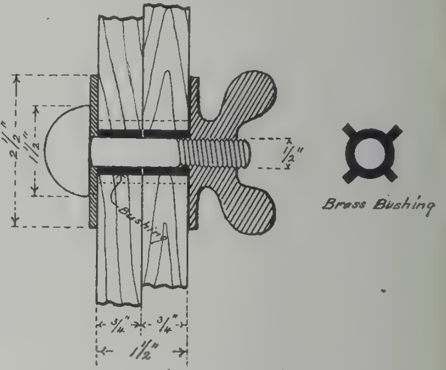
Sir: Will you kindly suggest some lines of investigation in matters pertaining to municipal or sanitary engineering that would furnish subjects for theses? Subjects that advanced students might deal with in a manner to be of value to the profession, in the time usually allowed for thesis work in the best colleges of civil engineering.

Yours, etc., X. Y. Z.

Ithaca, N. Y., Aug. 31, 1896.



Folding Device.



Details of Clamp Screw.

Interval between digits 1 foot, or distance intercepted by stadia wires with the rod 100 feet from instrument.
Vertical thickness of figures and bars 1/10 the interval between digits.
Width of digits 2/10 or 3/10 of the interval.
Height of digits 4/10 of the interval.

Details of Stadia Rod.

(There is no end to the list of municipal and sanitary engineering subjects which need careful investigation, although it may not be easy to name many which are in every way suitable to college thesis work. The truth of the matter is, though, that more depends upon the way the college student handles his subject than upon what he chooses. We give a few subjects, more in the way of suggesting other, allied ones, or modifications of these, than with the idea of finalities, as follows:

(1) Sewer flushing, with special reference to the efficiency of automatic flush tanks.

(2) Paving materials: Not an attempt to cover

the whole subject, but a careful study of some phase of it, or some particular material, based on experiments by the author as well as the results of actual practice.

(3) Water rates, including the proper method of distributing the cost of water between private consumers and the general public.

(4) Dams and reservoir failures; actual incidents with their causes and lessons.

(5) Studies of actual typhoid epidemics in relation to water, milk and food supplies. As the epidemics taken up should be such as had not been carefully investigated, and would need to be studied while actually in progress, the availability of this subject would be uncertain in any particular case.—Ed.)

Testing Steel Tapes.

Sir: Kindly state the standard temperature and pull at which steel tapes (100 ft.) are correct; whether the tape is suspended or laid on a level surface; the practice of the U. S. Government in these particulars; and the standard temperature at which steel bridges are laid out in the shops or at which they have their correct length.

Respectfully, Oscar Erlandsen,
Assoc. M. Am. Soc. C. E.

136 Liberty St., New York, Sept. 15, 1896.

(By applying to the U. S. Coast and Geodetic Survey, Washington, D. C., our correspondent can obtain a copy of Bulletin No. 15, issued in 1889, describing the U. S. Bench Standard, by which the errors of tapes are determined. It is there explained that an iron bar, 100 ft. long, has been selected in preference to a wall standard, as in the latter case the effect of temperature on the wall is difficult to ascertain. The material in the tape and bar is also so nearly identical that temperature observations are almost, if not quite, unnecessary. One end of the tape is secured to this bar and laid out flat upon the bar, so that it quickly reaches the same temperature. The tape is then stretched by a spring-balance, sensitive to a half-ounce, and the usual pull is 12 lbs., and this pull is stated in the certificate given by the Bureau. Inserted in the bar are two parallel series of German silver plugs, on the polished surface of which the graduation is marked in fine lines. One series of plugs carries the graduation in yards, and is intended to be standard at 62° Fahr.; and the other series carries meters, standard at 32° Fahr., or 0° Centigrade. The correction to the tape is read by a finely divided scale; sometimes with a low-power microscope, when the graduation on the tape is sufficiently fine to justify its use. The charge for testing a tape at Washington is $25. As to the standard temperature for bridge work, we assume that the U. S. standard is generally employed; but we would ask for a reply to this question from those more familiar with current practice in bridge shops. In the published transactions of the Ohio Society of Surveyors and Civil Engineers, for 1893 and 1894, will be found some very useful matter upon the subject of testing steel tapes, including valuable communications upon this subject from Prof. T. C. Mendenhall and the late J. E. Hilgard, each of whom have been at the head of the U. S. Coast and Geodetic Survey.—Ed.)

The Link Movement Engine.

Sir: The description of Chapman's link movement engine, copied from "The Engineer" (London), in your issue of Aug. 13, p. 101, contains a surprising number of misstatements, considering its brevity.

Taking them in order; the pistons do not "move diagonally" but perpendicularly to each other. The crossheads and not the pistons "cross and recross midway at every stroke," and the crossheads and not the pistons are connected by a link, which, by the way, is not half the length of each piston but of their stroke. "A pin at each end of the link passing through the crossheads" does not "form the respective cranks." The statement that "circular motions cause the rotation of the shafts" is probably correct, though its connection with the reduction to a minimum of the pressure on the slippers is not very clear.

The "known geometrical fact" is correctly stated, but is perfectly irrelevant. It formed the basis of an old and now discarded parallel motion, but Mr. Chapman's engine does not utilize this principle in any way whatever. On the contrary, the principle of the "link movement" is that of the ordinary trammel for drawing ellipses. If the extremities of a straight line move in lines at right angles to each other then all points on the line will describe ellipses and the point at the center of the line will describe an ellipse of no eccentricity, or, in other words, a circle. Any of your "readers accustomed to geometrical work will see without further description" that this is not a parallel motion of any sort.

Fig. 1 does not "show the pistons (or either of them) at the ends of their strokes." They cannot both be at the ends of their strokes at the same time. It is true that "it is not possible to dispense with guides," but the Chicago nominations have as much to do with it as the reason which is given.

Finally, the link, now called a "flying crank," whatever that may be, cannot possibly "act like an ordinary drag link." The writer kindly says in conclusion that "this seems to be a very meritorious attempt to solve a difficult problem." Difficult attempt to solve a meritorious problem would be nearer the mark and more in keeping with some previous statements. The problem of driving a crank by two cylinders at right angles to each other is simple and common enough. It has been made difficult by the unusual method adopted for its solution, which seems much more ingenious than useful. A still more difficult problem would be to crowd a greater number of bulls and blunders into a mechanical description of equal length. In a somewhat extensive reading of engineering literature I have never seen anything approaching this except from "The Engineer." It is a gem in its way.

New York, Aug. 22, 1896. H. W. B.

Mr. Donaldson's Proposed Standard Specification for Portland Cement.

Sir: In your issue of Sept. 10 I read the reply Mr. W. J. Donaldson makes to my criticism of his specification for Portland cement. In view of the series of errors he makes in quoting me and making me say directly the reverse from what your publication shows I did say in the clearest of English, I must trespass again on your valuable space for the purpose of correcting these errors.

I suggested no new specification, but gave to the engineering community, through your journal, a summary of what the leading engineers, chemists and scientists of the world had contributed to this subject, believing that in a matter such as the use of cement, which certainly is one wherein the questions of permanence and endurance enter, that the experience of years, and the concentrated wisdom of great men in the field, should carry weight and be of value to the profession.

In the conclusion of his argument for the adoption by the government of his new specification, Mr. Donaldson says:

> In conclusion we have only stated facts as they now exist and urged the adoption of one standard and that high in the specifications for quality, together with a uniform and specific method of testing which shall prove advantageous to the United States Government.

He says further in your issue of Sept. 10:

> It is a well-known fact that the recommendations of the Committee of the American Society of Civil Engineers are indefinite and altogether incapable of producing uniform results. The requirements are on the whole too low, and inadequate, which allow of second grade cements going into work where the highest grade Portland cements are intended.

Finally, in referring to the specifications cited by me on the subject of tensile strains, Mr. Donaldson says:

> The majority are old specifications whose requirements were favored some ten years ago when Portland cement, as an industry, was still in its infancy.

Now, from the above, it is certainly a fair criticism to say that Mr. Donaldson is "going it alone" in the matter of specifications. For a man, who proposes "one standard, and that a high one;" who objects to the American Society's specifications on account of "indefiniteness" and "inadequacy," and who finally has the hardihood to state that "ten years ago the Portland cement industry was still in its infancy," certainly lays himself open to comment on the boldness of his unsupported statements.

Will any engineer of standing, such as those who have constructed the monumental and colossal bridges, buildings, reservoirs, aqueducts and tunnels, railways and other public works done in the United States since June 21, 1885, the date of the American Society's specification. admit what Mr. Donaldson says of its requirements? Is it possible that all this work has been badly done with cement of "second grade," though done by such distinguished engineers as Fteley, Morrison, MacDonald, T. C. Clarke, Bogart, Herschel, Sayre, Becker, Wainwright, Burbank, John A. Wilson, Joseph M. Wilson, Eads, Stedman, Sooysmith, Craven, Nichols, Rodd, W. H. Brown. Douglas, Gowan, Boller, Richards, as well as by hundreds of other well-known engineers? It cannot be the case. but it IS possible that Mr. Donaldson may be wrong in this, as well as in his statement as to the Portland cement industry, which he says "was still in its infancy" ten years ago, shortly before the time Mr. Donaldson appeared upon the scene as a cement dealer, though the works with which he is connected are only about four or five years old. As against Vicat, who wrote a book of 300 pages on the subject of limes and natural and artificial cements, published in London in 1837; C. W. Pasley, C. B., whose work was published in London in 1838; against the patents granted to Aspdin in 1824; Frost in 1822; against Reid, Faija and other early writers; against that long series of scientific papers on Portland cement, in the proceedings of the Institution of Civil Engineers, London; the American Society of Civil Engineers; the French Annales des Ponts et Chaussees; the German Cement Makers' Association Proceedings, beginning with John Grant's paper of 1865 and continued down to the present day, it is futile to talk as a scientific proposition of the Portland cement industry being in its infancy "ten years ago." As a commercial proposition it is equally preposterous, for the reports of the Bureau of Statistics of the Treasury show that in 1886 915,255 barrels of Portland cement were imported into the United States, while in 1887 and 1888 the figures were respectively 1,514,095 and 1,835,504 barrels, and the report of the German Cement Makers' Association for 1885 shows a production of 4,700,000 barrels, and Candlot, writing in Paris in 1891, puts the French product prior to 1880 at 700,000 barrels per annum, and the German production for 1888 at 6,000,000 barrels; the "Revue du Genie," Jan., Feb., 1888, puts the English product for 1887 at 7,500,000 barrels, and Rothwell in his book on the Mining Industry in the United States puts the American product of Portland cement for 1886 and 1887 at 150,000 and 250,000 barrels respectively. Infantile figures these!

So much for the "infancy of the Portland cement industry ten years ago." Mr. Donaldson's statement reminds one of the fly who, alighting on the wheel of a moving vehicle, remarked ecstatically, "See how I make it go." The industry was going when he came into it, the established specifications were in successful use then, and it would seem that to reverse established standards, not of one country, but of the civilized world, because of some "improvements made in grinding machinery and in modes of burning" only a few years in use is asking too much, especially as against the long time records of cement made under well-known methods.

From the above it will certainly appear that Mr. Donaldson is hardly the proper party to make a new specification, or even, as he now says, to "present the subject in the light of suggestion and thereby open up scientific discussion." Certainly if there were a doubt on this question, what follows will effectually remove it.

I criticised Mr. Donaldson's specification on four principal elements—chemical composition, fineness, checking and cracking, and tensile strength.

It must be admitted that if, in so serious a matter as the chemical composition of a cement, the proposer of a new specification fails, the bulk of what follows is of no use because the chemical composition would govern largely the other elements of the specification, and especially those relating to specific gravity, checking and cracking, and tensile strength. When, therefore, in reply to sixteen (16) authorities, viz., Candlot, Le Chatelier, Feret, de Rochemont, Tetmajer, Preussing, Redgrave, W. F. Reid, Henry Reid, Faija, Carey, Collins, DeSmedt. Spaulding, Jameson and Gilmore, giving analyses of nearly two hundred (200) brands of Portland cements of France, Belgium, Germany, England and America, Mr. Donaldson states that he "bases his requirements on the average results of the analyses of the best German, French and American brands, with a few Belgian and English cements," and fails to state the brands used in such analyses, the place of analysis, the time of analysis, and the chemist making such analyses, his case certainly falls, and he is right in stating and admitting what he does in reply to the writer and Professor Newberry, i. e., "The criticism on chemical composition appears to be well founded." So much therefore for this basic and most important branch of Mr. Donaldson's specification.

As to the question of fineness, I named 21 different specifications, embracing the official specifications of Belgium, Germany, Switzerland, France, Roumania, England, the United States, the recommendations of the American Society of Civil Engineers, and a number of other specifications in this country, against which Mr. Donaldson cites Henry Faija in his book on "Portland Cement for Users," dated 1890, who recommends fine grinding; but this same Henry Faija, whom I quoted under date of August 2, 1893 (three years later), recommends in his paper read before the World's Fair Congress, 8% on a 2,500 mesh sieve. On this branch of the case, certainly I am right when I say that Mr. Donaldson is arrayed against the world's scientific opinion.

Mr. Donaldson's specification on the subject of checking and cracking requires that a "cake of neat cement, after having set hard, is to be immersed in water at 212° F. and allowed to remain in the water at that temperature from 24 to 36 hours." This I interpret, and this I think can hardly be gainsaid, as a boiling test. In answering, I state: "The last report of the Committee of the German Cement Makers' Association, presented at the 1896 meeting on this subject, asks until 1898 to report, and meanwhile the normal cold water tests remain unassailed."

> Germany: After three years' discussion, the boiling test was finally reported against at the session of 1893, by the German Cement Association, operating in conjunction with the Prussian Minister (Gary's paper, World's Fair Congress, Aug. 1893)."
>
> French Government: Conference of engineers Ponts et Chaussees Cahier Guillan, Service de la Marine, Service de Colonie. None of these contain boiling tests. The French Government report is above referred to.

England: Faija's paper, World's Fair Congress, Aug. 2, 1893, Trans. Am. Soc. C. E., Oct. 1893; Trans. Am. Soc. C. E., Oct. 1893, recommends steaming tests only, and immersion at 116° and requires no boiling test, which he admits he has abandoned as unreliable, though first proposed by himself.

United States: U. S. Govt., District of Columbia specification, 1896, abandons boiling test. F. H. Lewis (Booth, Garret & Blair testing laboratory), Philadelphia, Proc. Am. Soc. C. E., Vol. XXXII., page 321, abandons boiling as "unreliable in indicating quality of cement." Am. Soc. C. E. specification recommends cold water and air tests only.

In reply to this Mr. Donaldson says: "Upon the question of hot test take up the first country, Germany. He (Mr. Lesley) admits that investigations are still being made on its reliability, and in the meantime the test is still made." Mr. Donaldson also cites what I quoted of Mr. Faija, and says "he immerses and steams in water at 116°, thereby showing that he must still have faith in the hot water test;" and finally Mr. Donaldson says, "from a brief summary of the above, it will be seen that the German, French and English authorities still adhere to the hot test, while the only two doubtful authorities are quoted for the United States."

Now the issue between Mr. Donaldson and myself is on the "boiling test," which he specifically recommends and nothing else, and a reading of what I wrote will show that the authorities I quoted are against that test absolutely and unequivocally.

As to the change in the District of Columbia specification, the authority for which Mr. Donaldson asks, I can only reply that the specification is signed, J. W. Ross, George Truesdell, Charles F. Powell, Commissioners, and of these, Mr. Powell is Engineer Commissioner. As this change was made after Mr. Donaldson's cement was rejected on the 1895 specifications requiring the boiling test, it would seem possible that he might have the latest information in that quarter.

As to the attempt to belittle the scientific reputation of Mr. F. H. Lewis, the well-known testing expert, I will say that if Mr. Donaldson had read Proc. Engineer's Club of Philadelphia, Vol. XI., No. 5, he would have found a second paper on cement by the writer mentioned, and if he had examined "Municipal Engineering" for August, 1896, he would also have discovered a controversial discussion between Mr. Lewis' firm and a Mr. W. J. Donaldson, in which Mr. Lewis' standing certainly did not suffer.

On the question of tensile strain, I cited the official specifications of France, Russia, Belgium, England, Germany and the Am. Soc. C. E. I also cited 21 specifications of leading engineers in this country, some requiring high and some low tensile strains, as mere indications of what leading authorities considered a specification should be. In reply to this, Mr. Donaldson, without citing a single authority, says broadly that "the majority are old specifications whose requirements were favored some 10 years ago, when Portland cement was an industry still in its infancy."

The specifications cited by me are all public and open to Mr. Donaldson's inspection, and it is only necessary to say that instead of "the majority being old ones" and "favored ten years ago," they are, with but possibly a single exception, in use at the present time or within at least two years, and by such engineers as Fteley, of the New York Aqueduct; Brown, of the Pennsylvania Railroad; Sayre, of the Lehigh Valley Railroad; Katte, of the New York Central Railroad; T. C. Clarke, of the Third Ave. Bridge; McNulty, of the Metropolitan Street Railway, New York; and a number of other equally distinguished engineers. Not a single specification is refuted by Mr. Donaldson, nor its accuracy questioned, nor a word of proof given as to the statement that the specifications are "old," but against this mass of testimony he states that "in the City of Philadelphia alone, five of the leading architects are using large quantities of Portland cement under specifications equally as high as those quoted by the writer," and still he fails to mention any single one of the architects in question, by name, or the work on which the cement is being used.

This sort of a reply is hardly sufficient to overthrow the mass of evidence I have adduced, and is on a par with his other statement as to the long time tests on the New York Aqueduct being on one brand of cement "exclusively." A glance at Mr. McCulloh's paper on the Sodom Dam ("Proc. Am. Soc. C. E.," April 5, 1893), would have shown him the absolute inaccuracy of such a statement, while an examination of the official records from which Mr. McCulloh's figures were taken, would have shown an enumeration of some 30 odd brands of Portland cement.

In conclusion, I am asked by Mr. Donaldson to state in what manner the "crude specifications" would prove harmful to "inexperienced engineers and architects." Having, I think, shown that the specification is crude and ill-digested, inasmuch as it is admittedly wrong chemically, and fails to find scientific support for its other members against the authorities cited by me, I can safely say that with the experience of the Aberdeen breakwater and the Saint Nazaire Bridge, in France, before us, that if any engineer were to use in salt water a cement containing 66% lime, and 2% sulphuric acid and 3½% magnesia, he would under Feret's experiments, as well as the papers describing the failures above mentioned, be in danger of having his work fail, especially as Mr. Donaldson does not in treating the question of sulphuric acid draw the proper distinction between salt and fresh water work.

Now engineers and architects, being professional men, stake their name, honor and reputation on every piece of work they do. Such a failure as I have mentioned would mean to an engineer or architect the loss of those things which are dearer than life itself. I think this makes it clear how a "crude" specification may do great harm.

Respectfully,
Robert W. Lesley, Assoc. Am. Soc. C. E.
22 South 15th St., Philadelphia, Pa., Sept. 21, 1896.

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Notes and Queries.

E. B., Montreal, P. Q., desires information as to the construction of continuous lime-kilns using coal as fuel, and desires the address of manufacturers or contractors who will undertake the construction of such kilns, or engineers who will furnish designs for them.

◆

THE LARGEST BUILDING EVER MOVED IN THIS country was a freight warehouse of the B. & O. R. R. in Baltimore, which was moved Sept. 8 to 12. The building is 440 ft. long, 120 ft. wide and 60 ft. high. It is a wood and iron structure and was moved to make room for a new dock. The work consumed 5½ days. The building contained a great quantity of freight, among which was 3,000 cases of china and crockery, but not a dish was cracked in the moving. The men were engaged five weeks making preparations for the move. On top of the old and the new foundations were placed the sills or tracks upon which the building was to run. These tracks numbered 40, each consisting of two 6 × 12-in. timbers. On top of these were placed the 1,000 rollers, each a piece of 5-in. pipe 3 ft. in length. There were 25 rollers to each of the 40 tracks. Between the top of the rollers and the floor beams of the building were arranged more of the 6 × 12-in. timbers. In all 6,600 of the 6 × 12-in. timbers were used, each about 30 ft. long. The 255 wooden pallars which supported the warehouse were then sawed away and the structure rested upon the rollers. Along one side of the building were placed 40 5-ton screw jacks. They were braced against a railroad track, an adjoining warehouse and the tracks upon which the rollers ran. Two men stood at each jack. At a given signal the men responded with military precision, and each jack was given a quarter of a turn, moving the great building a fraction of an inch, Afterward the progress averaged 2 ft. an hour for 5½ days. The structure arrived at its new foundation without a strained timber or a bolt. The jacks were again used in raising the warehouse enough to allow the removal of the jacks, after which it was lowered to the new foundations. The structure cost $35,000 ten years ago, and it cost $15,000 to make the removal.

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AN IMPROVED HOWELL AUTOMOBILE TORPEDO has been lately tested by the U. S. Government and the results are highly satisfactory. The new torpedo is 14½ ft. long, 17 ins. in greatest diameter, has a launching weight of 1,130 lbs., with a reserve buoyancy of 20 lbs., and an immersed displacement in sea water of 1,150 lbs. It carries a charge of 174 lbs. of gun cotton. The mean speed over a range of 400 yds. is 33 knots; over a 600-yd. range, 30 knots, and over 800 yds., 28.5 knots. The extreme effective range for regular service is 1,000 yds. The older Howell torpedo was 11 ft. 2 ins. long, and 14 ins. in diameter, and had an effective range of 600 yds., with a speed of 18 knots. It carried only 82.75 lbs. of gun cotton. Instead of being propelled by compressed air stored in the torpedo itself, as in other types, the Howell torpedo has a turbine motor attached to the launching tube, which gives an exceedingly high speed to a heavy steel fly-wheel within the tube; the stored-up energy of this fly-wheel is then transmitted to two propellers by gearing. The torpedo is launched by indirect gun powder impulse, with the fly-wheel revolving at a speed of about 10,000 revolutions per minute. Out of 346 shots, with the launching tube 2½ ft. above the water, there were 332 hits, 10 misses, and 4 accidents; with the tube 9½ ft. above the water there were 63 hits out of 69 shots. The target was a rectangle 21 yds. long by 1 yd. wide, 8 ft. below the water surface.

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THE ARMORED CRUISER "BROOKLYN" is officially declared to have made 21.9117 knots per hour as the average of her late trial run, and the Navy Department awards the builders, the Cramps, of Philadelphia, a premium of $350,000. The contract speed was 20 knots. The Inspection Board also says that the weights are in accordance with the contract, the machinery performance was satisfactory and her steering qualities in smooth water were excellent. Owing to the absence of heavy weather during her trial trip the behavior of the ship as respects rolling and pitching was not tested.

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A NEW TRANSATLANTIC STEAMSHIP LINE, formed by the consolidation of the line of the Wilson Bros., at Hull, England, and the Leyland-Furness line, of London, is announced to run a weekly service between Brooklyn and London, and also between Boston and London. Contracts for five new vessels have been given out, to be ready for service next June. They will have a cargo capacity of 8,000 tons, and accommodations for 80 saloon passengers. The speed will be 14 knots per hour.

◆

AN ARMOR-PIERCING PROJECTILE designed by Isaac G. Johnson & Co., of Spuyten Duyvil, has again been successfully tested at Indian Head upon a 10-in. rerolled Harveyized steel plate made by Carnegie & Co. for the Russian government. A 6-in. projectile of solid steel was used, hardened by a special process and capped by soft steel. The projectile weighed 100 lbs., including the 5-lb. cap, and smokeless powder was employed to impart an initial velocity of 2,540 ft. sec. The projectile went clear through the 10-in. plate, through 12 ins. of oak and three steel plates, 7-16-in. thick each, and 8 ft. into the dirt back of the target. The cap alone was seriously injured, the shot being almost intact when dug out of the earth.

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THE DES MOINES, IA., WATER-WORKS are likely to be purchased by the city from the private company which owns them. The city has offered $800,000 for the works. Litigation between the city and the company has been in progress for some time.

WEATHER TABLE FOR AUGUST, 1896. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.)				Wind.			Precipitation—rain or melted snow—inches.		
						Velocity in miles per hour.		Direction at time of max. velocity.			
		Average.	Max.	Min.	Range.	Average.	Max.		Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities	Northfield, Vt.	64.0	90	37	53	7.0	27	NW	2.27	.51	12
	Portland, Me.	66.1	90	49	41	5.7	24	S	2.57	.82	18
	New York City	73.0	94	56	38	10.1	50	NW	2.46	.74	10
	Pittsburg, Pa.	72.6	94	50	44	4.6	20	S	4.09	2.31	12
	Chicago, Ill.	72.8	98	54	44	14.1	36	NW	3.52	1.24	6
	Omaha, Neb.	73.9	96	54	42	7.6	54	NE	3.50	1.71	11
	St. Paul, Minn.	70.0	100	45	55	6.5	60	NW	4.48	1.68	10
	Duluth, Minn.	65.4	90	46	44	9.2	33	SW	2.41	.93	9
	Bismarck, N. Dak.	67.2	98	40	58	8.9	36	NW	1.77	.85	10
	Average	69.6	94	48	47	8.2	38		3.01	1.20	11
Southern Cities.	Washington, D. C.	75.8	98	50	48	5.0	24	N	2.65	1.91	7
	Louisville, Ky.	77.7	98	55	43	6.1	37	NW	4.51	2.00	7
	St Louis, Mo.	79.4	100	60	40	8.9	45	W	2.12	1.36	7
	Savannah, Ga.	81.8	98	61	37	6.4	32	NW	5.78	2.72	11
	Kansas City, Mo.	77.4	103	58	45	4.6	29	SE	3.33	1.80	6
	Jacksonville, Fla.	82.8	96	64	32	6.5	26	W	6.16	2.38	10
	Chattanooga, Tenn.	80.4	97	63	34	5.1	25	NW	1.90	1.61	7
	New Orleans, La.	83.0	96	70	26	6.3	28	NE	3.31	.90	12
	Memphis, Tenn.	82.3	101	60	41	7.5	42	W	0.84	.25	9
	Palestine, Tex.	84.3	102	60	42	5.7	23	NW	1.19	.58	5
	Average	80.5	99	60	39	6.2	31		3.18	1.55	8
Western Cities.	Helena, Mont.	65.2	92	42	50	7.0	45	SW	0.86	.32	8
	Port Angeles, Wash.	58.2	77	45	32	5.2	20	W	0.47	.36	6
	San Francisco, Cal.	59.5	72	52	20	13.9	36	W	0.09	.06	3
	Salt Lake City, Utah.	73.7	96	55	41	5.6	26	SE	1.47	.65	8
	Santa Fe, N. Mex.	68.0	88	49	39	6.2	32	NE	1.47	.44	14
	Denver, Colo.	71.8	94	43	51	6.8	39	SW	0.97	.65	7
	Yuma, Ariz.	90.0	113	71	42	6.4	40	SW	0.32	.12	7
	Average	69.5	90	51	39	7.3	34		0.81	.37	8

COMPRESSED-AIR PLANT ON THE CONSTRUCTION OF THE JEROME PARK RESERVOIR.

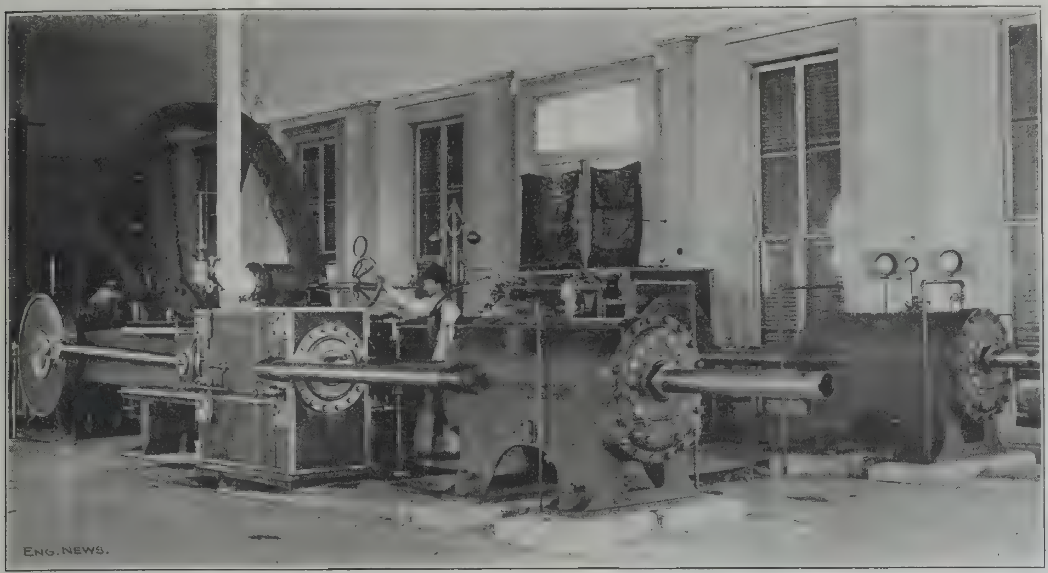

FIG. 1.—AIR COMPRESSING PLANT FOR THE WORK ON THE JEROME PARK RESERVOIR.

The use of compressed air for power purposes and power transmission has had a very great and comprehensive growth within the past few years, and one of the most recent and interesting applications of this power is on the extensive contract work for the construction of the Jerome Park reservoir, for the water supply system of New York city. As the contract amounts to nearly $5,500,000, and will extend over about seven years, there was ample reason for carefully considering the comparative advantages and economy of different methods of supplying power for the drills, hoists, pumps, etc., to be used on the work, and as a result of this investigation it was decided to use compressed air, distributed to all parts of the work by pipe lines from a central power plant. This plant is operated by one engineman and one fireman. The main pipe lines will remain practically permanent during the work, the branches being shifted, and extended as required by the progress made in excavation. This system will undoubtedly effect a considerable saving in fuel and labor expenses as compared with the more common methods.

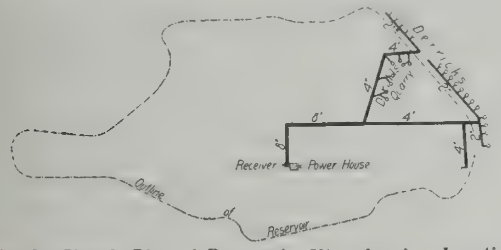

Fig. 2.—Sketch Plan of Reservoir Site, showing Location of Power House, Transmission Pipes and Working Plant.

On such construction work the general practice is to use steam power, with separate boilers for each one or two hoists, and other boilers near groups of drills. This practice is necessarily wasteful in fuel, as the amount of fuel used is excessive, the boilers not being adapted for or worked with a view to economical consumption, and much fuel being burned without doing any work during dinner hours and when the machines are stopped for any cause, while leaky joints and condensation in the long lines of pipes always cause considerable waste and trouble. Besides this a separate attendant is required for every boiler.

The Jerome Park reservoir, where this compressed air plant has been installed, was described in our issue of July 18, 1895. It is situated near Van Cortlandt Park, on the New York & Putnam Division of the New York Central R. R., about 11 miles from the Grand Central Station on 42d St., and 5 miles north of the Harlem River. It will cover about 300 acres of land and will have a capacity of 2,000,000,000 gallons. The construction will require about 4,000,000 cu. yds. of earth excavation, 3,200,000 cu. yds. of rock excavation, 150,000 cu. yds. of concrete masonry, 82,000 cu. yds. of brick masonry, 113,000 cu. yds. of rubble masonry and 250,000 sq. yds. of rubble masonry facework. The masonry includes heavy core walls for the embankments. The bids for the work ranged from about $5,000,000 to $13,000,000, and the contract was awarded in August, 1895, to Mr. John B. McDonald, of Baltimore, Md., and New York city, at $5,473,060. Preparations for commencing the work were at once started, and the work is now in active progress. At the present time about 550 men are at work, while the plant includes 8 narrow gage contractors' steam locomotives, 2 steam shovels, 18 derrick hoists, 10 drills and a number of wagons, teams, dump cars, etc. Besides this, offices, living quarters, stables and stores of all kinds of material and supplies have been established, as the work will last for about seven years, the date set for the completion of the contract being Nov. 1, 1902.

The contract for the air compressing plant was placed by Mr. McDonald with the Ingersoll-Sergeant Drill Co., of New York city, and this has now been installed and put in operation, having been started on May 14. For a power house, one of the large buildings of the club at the old Jerome Park racecourse is used; the building having been removed bodily to a convenient situation. In this are installed a cross-compound Corliss engine of 600-HP., with a compressing cylinder behind each of the steam cylinders. The engine drives a flywheel 25 ft. diameter, weighing 50,000 lbs., mounted on a shaft 14 ins. diameter, the shaft having an eccentric keyed on each side of the wheel and being driven by means of a crank disk at each end. The main shaft bearings are 14 × 26 ins. The steam cylinders are 24 × 48 ins. and 44 × 48 ins.; while the air cylinders are 24¼ × 48 ins. The cylinders are 6 ft. apart, longitudinally, and 14 ft. c. to c. transversely. The walls of the air cylinders are cooled by water jackets. The compressor is of the company's standard design, which is probably familiar to most of our readers. The air enters the cylinder through a hollow tail-rod, and the piston has an annular disk valve in each face, the space between the open valve and its seat being about ¼-in. On the forward stroke the front inlet valve is closed and the air in front of the piston is forced through the front discharge valves as soon as the cylinder pressure exceeds the receiver pressure, while at the same time air is passing through the tail-rod and open rear valve into the space behind the piston. On the return stroke the rear inlet valve is closed and the air is forced through the rear discharge valves, while the air entering through the tail-rod passes through the open inlet valve in the front face of the piston and fills the forward end of the cylinder. This arrangement was shown and described in detail in our issue of Sept. 27, 1890. Each air cylinder is also fitted with a regulator or loaded relief valve by which the load is thrown off when the normal receiver pressure is exceeded owing to the air not being used. The normal pressure in this case is 75 lbs., and when it rises to 80 lbs. a passage is opened connecting both ends of the cylinder, so that the piston has an equal air pressure on both sides, both inlet valves being thus kept closed and the piston moving to and fro without doing any work. When the air pressure has fallen a trifle below 80 lbs. the regulator closes, and compression is then resumed. This device was fully illustrated and described in our issue of March 28, 1891. The cut-off of the steam cylinders is regulated automatically by the load, as in all Corliss engines. From the compressor cylinders the air passes to the receiver, which is a riveted steel cylinder or tank 5 ft. 6 ins. diameter and 18 ft. long, placed just outside the engine house.

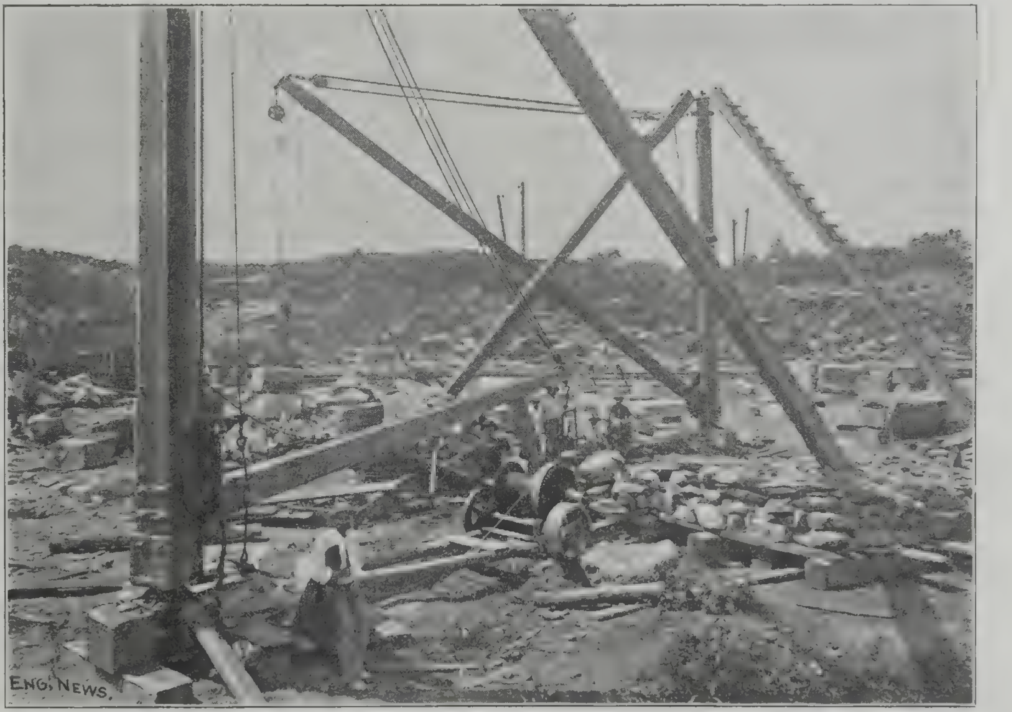

FIG. 3.—GROUP OF DERRICKS OPERATED BY COMPRESSED AIR.

The engine is intended to work as a condensing engine, but is not being so worked at present, and the connecting rod to the rocking lever of the condenser pump is disconnected. The reason for this is that there is not now a supply of water available for condensing purposes, but, of course, the engine cannot meanwhile work so economically in fuel consumption. The water for the boiler is taken from a well sunk near the engine house and a reservoir for the condensing water has been built. Steam is supplied by a single water-tube boiler made by the Hogan Boiler Co., of Middletown, N. Y., the boiler having three furnaces. The boiler is rated at 250 HP., and carries a pressure of 120 lbs. The entire power plant is handled by one engineman and one fireman. The engine and compressor were built at the works of the Ingersoll-Sergeant Drill Co., at Easton, Pa. This plant, shown in Fig 1, was started up on May 14, and later on, when a larger force is at work on the reservoir, it is intended to put in a duplicate plant, working the air cylinders compound.

Fig. 2 is a plan of the work, with an outline of the boundaries of the reservoir, and showing the positions of the pipe line, drills, hoists, etc., as at present existing. From the receiver an 8-in. pipe extends for a distance of 1,500 ft., and is followed by two main lines of 4-in. pipe, from which again run 2-in. pipes aggregating about 2,000 ft. in length. The branch pipes to the machines are 1½ ins. diameter, this being the smallest size used. The aggregate length of the piping system is now about 6,300 ft. Another 8-in. main is intended to be laid later, in a direction opposite to that taken by the present 8-in. main. All the pipe has screwed joints. There is one reheater on the 4-in. pipe line, this being of the Sergeant pattern, described in our issue of May 9, 1895. The heater is a truncated cone 3 ft. 6 in. in diameter at the base and 4 ft. 6 ins. high, the center of which forms a stove; the air enters at the top and passes down over the heating surface, the volume of air space increasing as the air expands, so that the velocity and friction remain practically constant. The use of this reheater is said to increase the efficiency 33% over work done by the same volume of air used cold. The air pressure is designed to be 75 lbs. per sq. in. at the compressor and 70 lbs. at the tools.

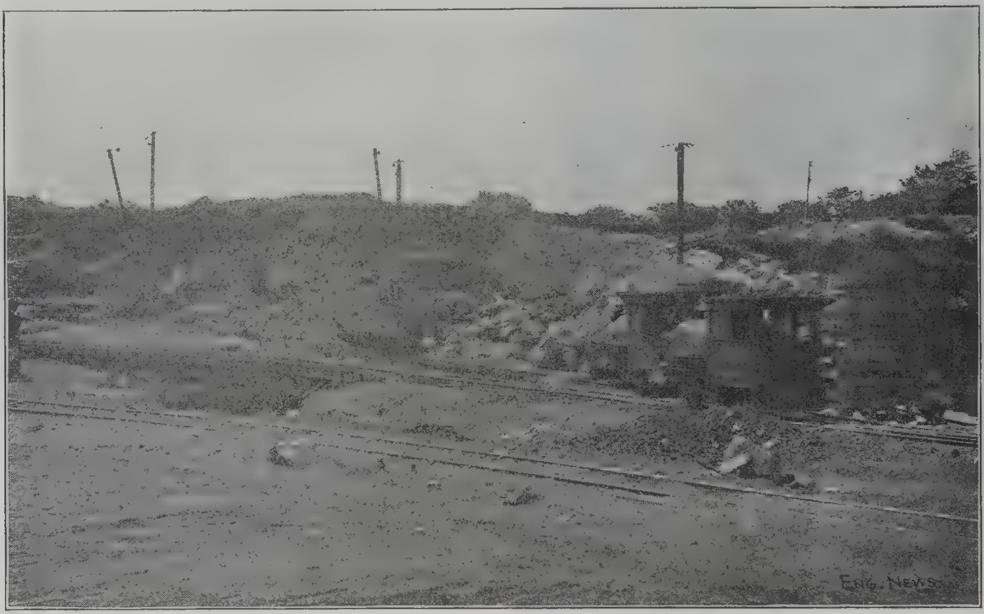

FIG. 4.—EXCAVATION AND LOADING OF ROCK BY COMPRESSED AIR PLANT.

There are now in use 10 drills, 18 derrick hoists and 2 pumps. The drills are of the well-known Ingersoll-Sergeant make. The hoisting engines are of the Lidgerwood make, with two cylinders 7 × 10 ins. and double drums. In the building of the masonry core walls for the embankments a row of derricks is erected, each derrick being operated by a hoisting engine, but the booms are swung by hand by means of guy ropes. The masts and booms are sticks 14 × 14 ins., the masts being 65 ft. long, and the booms are 62 ft. long. The derricks have a lift of 57 ft., a working radius of 118 ft., and a hoisting capacity of 10 tons. The pumps are small horizontal pumps placed in the trenches for the core wall foundations.

Figs. 3 and 4 show two views of the work now in progress. The derricks are all operated by compressed air, and the rock excavation shown was effected by groups of drills operated by air. For photographs and other information used in this article we are indebted to the Ingersoll-Sergeant Drill Co., and to Mr. Henry B. Reed, C. E., who is superintendent for Mr. McDonald, the contractor.

THE EFFECT OF HIGH RATES OF COMBUSTION UPON THE EFFICIENCY OF LOCOMOTIVE BOILERS.*

By Prof. W. F. M. Goss.**

The experiments with which this paper is concerned were carried out a few months ago in the locomotive laboratory of Purdue University.

The boiler of any given locomotive is most efficient when worked at the lowest power practicable; that is, when the rate of combustion in its firebox is minimum. For the development of a higher power, the rate of combustion must be increased, and, as a result, the efficiency of the boiler is lowered.

The relation between the rate of combustion and the weight of water per pound of coal for the Purdue locomotive "Schenectady," while using Brazil block coal, is shown by Fig. 1. From this diagram it appears that when coal is burned at the rate of 50 lbs. per sq. ft. of grate per hour, 8 lbs. of water are evaporated for each pound of coal; while if the rate of combustion is increased to 180 lbs. per sq. ft. of grate, the evaporation falls to about 5 lbs.—a loss in water evaporated per pound of coal of nearly 40%. This loss may be due to a failure of the heating surfaces to absorb properly the increased volume of heat passing over them, or to the imperfect combustion of the fuel upon the grate, or it may be due to a combination of these causes.

That a portion of the loss occurs along the heating surfaces hardly admits of question, since it is well known that any increase in the rate of combustion results in a rise in the temperature of the smokebox gases; but whether, under ordinary conditions, any considerable portion of the loss shown by Fig. 1 is due to imperfect combustion, has not been demonstrated, and it is this question especially that the present paper attempts to treat.

The importance of the subject is emphasized by the varying practice of locomotive designers, who, in some cases, have so designed large boilers as to allow a large grate; while in others they have been content to use a grate of moderate size, upon which they have forced the combustion beyond limits which had hitherto been customary.

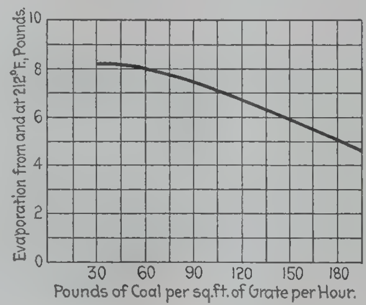

Fig. 1.—Relation between Rate of Combustion and Weight of Water Evaporated per Pound of Coal in Locomotive "Schenectady."

A separation of the losses which may occur at the grate from those which take place along the heating surface cannot be accomplished by boiler tests alone, because the results of such tests give the combined effect of both these losses. There are two variables involved, and in order that either may be determined one must be given a constant value. In the tests described, action along the heating surface was maintained constant, while conditions at the grate were varied.

As a preliminary step, a number of tests were outlined in which the total weight of fuel fired was to be constant throughout the series, while the rate of combustion was to be made different for each test by changing the area of the grate. It is evident that if the action at the grate were equally efficient during the several tests—that is; for different rates of combustion—this provision would cause the same volume of heat to pass over the heating surfaces of the boiler, and hence would produce the same evaporation and the same smokebox temperature. If, on the other hand, the combustion should prove less efficient for any one test than for others, a smaller volume of heat would sweep the heating surface, less water would be evaporated, and the smokebox temperature would prabably be lower.

The outline provided for all observations usual in boiler testing, and, in addition to these, for a determination of the weight of fuel lost in the form of sparks, and for chemical analyses of the fuel used, of the sparks caught and of the smokebox gases.

The first test was run with the locomotive under normal conditions. The whole grate was covered with fuel, the throttle was fully open, the cut-off approximately 6 ins. and the load such as to make the speed 25 miles per hour. These conditions gave a rate of combustion of 61 lbs. of coal per sq. ft. of grate per hour.

In preparation for the second test, one-quarter of the grate was made non-effective, or "deadened" by a covering of fire-brick. The exhaust tip was reduced, so that while the engine was running as before and using approximately the same amount of steam, the same total weight of fuel could be burned on the reduced grate as in the first test had been burned on the whole grate. Trial tests were run until it was known that the changes made would permit the desired conditions to be maintained. The rate of combustion in this test was 84 lbs. per sq. ft. of grate.

In preparation for the third test, the grate surface was reduced to half its original area, and the rate of combustion was increased to 124 lbs. per sq. ft. of grate; and during the fourth test only one-quarter of the original grate was used, the combustion in this case rising to 241 lbs. per sq. ft. of grate.

It should be evident from what precedes, that the prescribed conditions were designed to make each test a duplicate of every other test, excepting in the matter of grate area, this being the one variable for the series.

The coal used in the several tests was of uniform quality, the chemical analyses showing no greater variation than might occur in different samples from a single shipment. The maximum weight of coal fired per hour in any test was 1,087 lbs. and the minimum was 1,038 lbs., a difference of less than 50 lbs. in more than 1,000, while the variation during three of the four tests does not exceed 1.2% of the weight fired. All external conditions affecting the action of the boiler were uniform throughout the series.

The one variable for the series—namely, a different rate of combustion—was secured by keeping constant the weight of coal fired and by varying the area of the grate. There were burned each hour on each square foot of effective grate surface, 61 lbs. during the first test, 84 during the second, 124 during the third, and 241 during the fourth. These values more than cover the entire range of rates usual in locomotives.

Evidence of losses at the grate with increased rates of combustion is to be found in the record of water evaporated per pound of coal, which, for the several tests, is as follows:

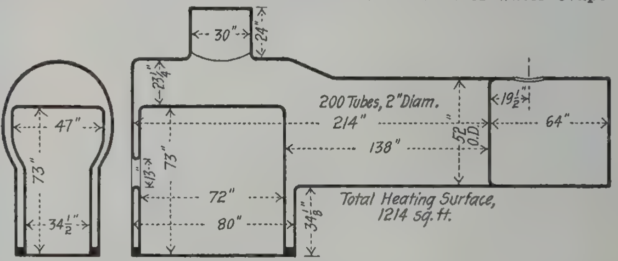

Fig. 3.—Sections of Locomotive "Schenectady" at Purdue University.

Number of test	1	2	3	4
Rate of combustion; lbs. of coal per sq. ft. of grate surface	61	84	124	241
Equivalent evaporation from and at 212° F.; lbs. of water per lb. of coal	8.26	7.87	7.52	6.67
Loss of evaporation in terms of the evaporation for Test No. 1, per cent		4.7	9.0	19.2

In consideration of all the conditions governing the experiments, it would seem fair to assume that the decrease of 19% in the weight of water evaporated, a result which comes from increasing the rate of combustion from 61 to 241, is a loss which occurs wholly at the grate.

A large fraction of this loss is to be accounted for by the escape of sparks, and it is significant that, as the sparks increase in volume, their heating value also increases.

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*Abstract of a paper presented at the meeting of the New York Railroad Club, Sept. 17, 1896.

**Professor of Mechanical Engineering, Purdue University, Lafayette, Ind.

By reducing the weight of sparks to an equivalent weight of coal, on the basis of their relative heating value, it is possible to make the following comparison:

Number of test	1	2	3	4
Rate of combustion	61	84	124	241
Total lbs. of coal per hour	1,074	1,078	1,086	1,038
Total lbs. of sparks per hour	61.5	95.1	128.6	176.3
Lbs. of coal equivalent to spark losses per hour	46	77	111	161
Value of spark losses in per cent. of coal fired	4.3	7.2	10.2	15.5

According to popular judgment, the loss of heat by sparks has always appeared small; while the data show that, under conditions which are now common, it may represent more than 10% of the fuel value of coal fired. It is evident, however, that these losses will in general depend very much upon the quality of coal, and it should be noted that the Brazil block which was used in the tests under consideration is quite friable.

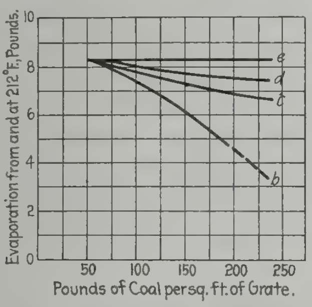

Fig. 2.—Relation Between Rate of Combustion and Losses of Heat by Different Causes in Locomotive Boilers.

Without attempting a full discussion of the analyses of the smokebox gases, attention may be directed to two important facts. These are, first, the large percentage of oxygen shown, indicating a supply of air greatly in excess of that required for combustion; and secondly, the absence of carbon-monoxide (C O) in all excepting the last test.

All air admitted to the furnace in excess of that required for combustion is heated from the temperature of the atmosphere to that of the smokebox, and by this process heat is taken from the furnace. As the data show an increasing amount of air during the third and fourth tests of the series, it would appear that this cause must have operated to reduce the performance of the boiler as the rate of combustion was increased.

The presence of carbon-monoxide (C O) in the smokebox gases is accepted as proof of imperfect combustion. This gas, as already noted, occurs only in Test No. 4. It has long been supposed that its formation is due to thick firing, and its failure to burn after it is formed, to deficient air supply, or to a temperature too low to ignite it. Upon this theory, its presence in Test No. 4, and its absence in the other three, are difficult to explain.

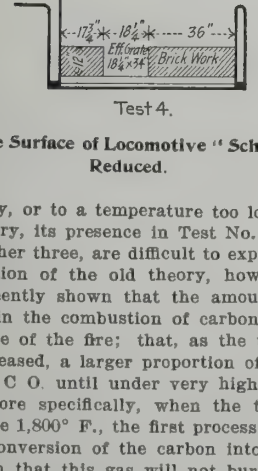

Fig. 4.—Grate Surface of Locomotive "Schenectady" as Reduced.

In contradiction of the old theory, however, Herr R. Ernst* has recently shown that the amount of this gas (C O) formed in the combustion of carbon depends upon the temperature of the fire; that, as the temperature of the fire is increased, a larger proportion of the carbon is converted into C O. until under very high rates of combustion, or, more specifically, when the temperature of the fire is above 1,800° F., the first process of combustion is the entire conversion of the carbon into this gas. He has also shown that this gas will not burn, even in the presence of air, so long as its temperature is above 1,800° F.; it must be cooled before it will burn. But, theory aside, the facts remain that the tests show very small losses by imperfect combustion, even when the rate of combustion is highest.

Conclusions.

The results show that the most efficient furnace action accompanies the lowest rates of combustion; and while the precise relationships established by the experiments may not hold for fuel which is different from that employed, nevertheless they enforce the general conclusion that very high rates of combustion are not desirable, and, consequently, that the grate of a locomotive should be made so large that exceptionally high rates will not be necessary. They emphasize, also, the importance of spark losses, which, during the experiments under discussion, practically equalled in value all other losses occurring at the grate.

Leaving the conditions peculiar to the experiments, and assuming that the results obtained from them may be applied to the locomotive "Schenectady," when working under normal conditions, we find that the losses in evaporative efficiency which occur when the rate of combustion is increased above 50 lbs., may be accounted for approximately as follows: The relation between the rate of combustion and the water evaporated per pound of coal, under normal conditions, is represented by the line a b, Fig. 2. If it could be assumed that the heat developed in the furnace would be absorbed with the same degree of completeness for all rates of combustion, the evaporation would rise to the line a c; if, in addition to this, it could also be assumed that there were no spark losses, the evaporation would rise to the line a d; finally, if, in addition to these, it could be assumed that there were no losses by the excessive admission of air, or by incomplete combustion, then the evaporation would remain constant for all rates of combustion, and would be represented by the line a e.

That is, with the boiler under normal conditions, the area a b c represents the loss occasioned by deficient heating surface, the area a c d that occasioned by spark losses, and the area a d e that occasioned by excessive amounts of air and by imperfect combustion.

Apparatus and Methods.

The apparatus employed constitutes a portion of the permanent equipment of the locomotive laboratory of Purdue University. The locomotive is of the eight-wheeled type, with 17 × 24-in. cylinders, and weighs 85,000 lbs. The boiler, with which the present work especially concerns itself, is shown in outline by Fig. 3.

The deadening, which was employed to cut out portions of the grate, was of brick laid up in fire-clay, the effect being to make the covered portions of the grate as nearly air-tight as possible. The material extended across the breadth of the firebox, the sections of the grate covered being disconnected from the rocking mechanism, so that the remainder could be used with undiminished effect. Its distribution during the several tests is shown by Fig. 4.

Early in the second test, ash piled up on the deadening, as indicated by the line a b, Fig. 4; but as the accumulation did not reach the lower tubes it was not dislodged. During the third test there was less of this deposit, and during the fourth still less, an effect probably due to the presence of a stronger draft.

The thickness of fire for each test was not greater than was necessary to the easy maintenance of the steam pressure. The firing was always at regular intervals, and usually only three shovelfuls were thrown in at one time. In the fourth test the thickness of the fire equaled that of the deadening.

The samples of smokebox gases for analyses were drawn from a point near the center of the smokebox. Ten minutes were occupied in obtaining the sample, a period sufficiently long to cover all conditions of fire.

The smokebox temperatures were obtained by means of a Le Chatelier electric pyrometer.

The weight of sparks or cinders passing the heating surfaces is the sum of those caught in the front end of the locomotive and those passing out at the top of the stack. The sparks which accumulated in the front end were easily collected and weighed. Of those which passed out of the stack, a portion only were collected, the sample being so chosen as to serve as a basis from which the value of the whole could be estimated. The apparatus employed in this latter process is shown by Fig. 5. It consists of an inverted U-tube of galvanized iron, securely fastened to a movable frame, by means of which the tip, which constitutes one extremity of the tube, can be projected across the top of the locomotive smokestack. The outer end of the tube may thus be made completely to intercept a portion of the stream issuing from the stack, and the continuous action of this stream is sufficient to drive the intercepted portion through the tube and out at the other end. The gases passing the tube bear the sparks on their current, and they are collected in a bucket set to entrap them. Reference marks upon the sliding and the fixed frames permit the tubes to be placed in definite locations relative to the center of the stack. This device, when in service, catches everything excepting the lightest soot, which is allowed to escape unaccounted for.

After assuming the cross-section of the stream issuing from the stack to be cut up, by a series of concentric circles, into one circular and several annular areas, as shown by Fig. 6, the small end of the U-tube was placed in the position marked I and held there for thirty minutes, the sparks collected during this interval being credited to this position. The tube was then moved to the position II, where it remained for another period of thirty minutes. In like manner, it was made to occupy, successively, the positions III and IV, and also the positions I_1, II_1, III_1 and IV_1, the weight of sparks caught during each interval being credited to the corresponding position occupied by the small end of the tube. This end of the tube had an area of 1 sq. in., and it was assumed that the average weight of sparks passing the tube while in the positions I and I_1 would be the same as that passing every square inch in the annular space in which these positions are located.

The engines of the locomotive were not involved in the tests, excepting as they served to shake the boiler, to furnish draft and to consume the steam generated. While

Observed and Calculated Data.

Test number	1.	2.	3.	4.
Month and day (1896)	Feb. 8.	Feb. 11.	Feb. 15.	Feb. 22.
Duration of test, hours	6.	6.	6.	6.
Approximate portion of whole grate used	Full.	¾	½	¼
Exact area of effective grate, sq. ft.	17.50	13.01	8.74	4.31
Analysis of Coal.—Fixed carbon, %	49.65	51.84	51.09	51.59
Volatile matter, %	40.29	39.00	38.93	38.87
Combined moisture, %	3.15	3.62	2.35	3.44
Ash, %	6.91	5.54	7.63	6.10
Coal (Brazil block)—Fired, lbs.	6,522.00	6,628.00	6,716.00	6,328.00
Dry coal for test, lbs.	6,443.00	6,522.00	6,514.00	6,227.00
Dry coal per hour, lbs.	1,074.00	1,087.00	1,086.00	1,038.00
Dry coal per hour per sq. ft. of grate, lbs.	61.40	83.50	124.20	240.80
Fixed carbon in coal, dry and free from ash, %	56.00	57.00	57.00	57.00
Approximate B. T. U. per lbs. of combustible	13,800.00	14.040.00	14,040.00	14,040.00
Approximate B. T. U. per lbs of dry coal	13,000.00	13,000.00	13,000.00	13,000.00
Theoretical evap. from and at 212° per lb. of dry coal	13.46	13.46	13.46	13.46
Ash.—Dry ash in ash-pan, lbs.	446.00	396.00	297.00	164.00
Ash in coal fired as shown by analysis of coal, lbs.	445.00	361.00	497.00	380.00
Ash by analysis, minus lbs. found in ash-pan, lbs.	—1.00	—35.00	200.00	216.00
Analysis of sparks.—Fixed carbon, %	61.74	64.88	71.32	76.44
Volatile matter, %	4.36	4.16	3.45	3.29
Combined moisture, %	1.82	1.82	1.66	1.86
Ash, %	32.08	29.14	23.57	18.41
Sparks.—Caught in front-end during test, lbs.	75.00	213.00	494.00	566.00
Passing out of stack for test, lbs	294.00	358.00	278.00	492.00
Total lbs. of sparks for test	369.00	571.00	772.00	1,058.00
Sparks per sq. ft. of grate per hour, lbs.	3.50	7.30	14.70	41.00
Approximate B. T. U. per lbs. of sparks	9,870.00	10,360.00	11,200.00	11,880.00
Coal equivalent in heating value to 1 lb. of sparks	.75	.80	.86	.91
Coal equiv. in heat'g value to total weight of sparks, lbs.	277.00	457.00	664.00	963.00
Analysis of Smokebox Gases.—Carbon dioxide, %	5.25	6.25	4.80	1.80
Heavy hydro-carbons, %	.50	.40	.40	.50
Oxygen, %	12.15	11.80	14.60	18.70
Carbon monoxide, %	...	...	...	.55
Nitrogen, %	81.90	81.55	80.20	78.45
Other Smokebox Data.—Diameter of double exhaust tip	3.00	2.75	2.35	1.75
Draft in ins. of water	2.20	2.50	3.30	5.60
Temperature of smokebox, deg. F.	647.00	629.00	610.00	500.00
Water and Steam.—Water delivered to boiler, lbs.	44,756.00	43,081.00	40,710.00	43,770.00
Temperature of feed, deg. F.	54.00	53.00	53.50	52.70
Boiler pressure, by gage, lbs.	129.40	127.20	127.20	129.10
Quality of steam in dime	.982	.981	.984	.983
Evaporation.—Water evaporated per lb. of dry coal, lbs.	6.94	6.60	6.30	5.58
Equivalent evaporation from and at 212° F.	8.26	7.87	7.52	6.67
Horse-Power.—Boiler, HP.	257.00	248.00	226.00	201.00
Per sq. ft. of grate	15.00	19.00	26.00	47.00
Ratio heat developed in furnace to heat absorbed by water*	.61	.59	.56	.50

*Approximate Efficiency.—The efficiency is approximate only, since the heating value of the coal is only approximately known. Since the same coal was used for all tests there can be no error in using this factor for purposes of comparison within the limits of the present series of tests.

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*"The Principles of Combustion," a paper by R. Ernst, published as an inaugural dissertation at the University of Giessen, Hamburg, 1892. (See "The Engineer," London, Aug. 4, 1893.)

the speed was varied slightly in different tests as a means by which desired rates of combustion might be the more readily secured, it was approximately 25 miles per hour for all tests. The running for each test, therefore, was equivalent to 150 miles.

As a rule, all important observations were checked by independent means. It is believed that these and other precautions taken were sufficient to insure accuracy in the observations recorded for the several tests.

Aside from their use as a means of checking other readings, the record of the Bristol recording gages was useful, also, in showing with what degree of constancy the desired conditions were maintained. In test No. 4, for which the rate of combustion was maximum, while the firing was difficult, the pressure did not often vary 5 lbs. from 130, which was the pressure desired.

As shown by the data obtained from frequent readings of a manometer attached to the smokebox, the normal draft for this test was equal to 5.6 ins. of water. The chart shows the maximum draft to have been 7 ins., and the minimum to have been about 3 ins. The results of the tests show that this draft of 5.6 ins. resulted in a rate of combustion of 241 lbs. per sq. ft. of grate per hour. It would at first appear impossible that so light a draft could produce so high a rate of combustion. The explanation is to be found in the fact that the effective area of the grate was small, the volume of furnace gases moved was much below normal for such a rate of combustion, and their velocity through the tubes was consequently low. The effect of the draft was, therefore, not greatly diminished by work done in the tubes, but was concentrated upon the fire, with the effect noted.

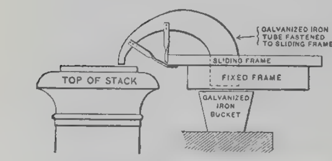

Fig. 5.—Apparatus for Collecting Samples of Sparks.

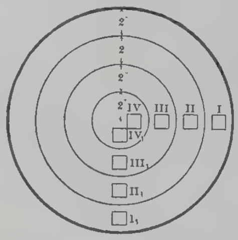

Fig. 6.—Sections of Area of Top of Stack From Which Sparks Were Collected.

These recording gages were not used to supply the data used for the test, but the comparisons just described are sufficient to indicate the great value of self-recording apparatus, as a check against gross errors in readings taken from the more usual and more accurate instruments, and as a means of tracing the relations of cause and effect. It should be noted, also, that it is only since the advent of the laboratory that it has been possible to use such delicate instruments in locomotive work.

LAYING WATER MAINS.*

By J. H. Decker, Deputy Water Purveyor, Brooklyn, N. Y.

One of the most important considerations (in pipe line construction) is the reduction to the minimum of the frictional resistance to flow of water. To this end the writer has all pipe of 12 ins. diameter and over enlarged at the joints, chamfering both at the spigot and hub ends of the pipe. This chamfer is for 12 to 30-in. pipes, 1¼ and ⅛-ins., and for 36 to 48-in., 1½ and 3-16-ins., respectively, the greater figures denoting measurements along the length and the lesser along the thickness of the pipe.

All loose rock and boulders should be removed from the trench; a rock surface should not be permitted to remain within 1 ft. of the pipe, except in cases where the trench is put through solid rock. In such cases the pipe should be raised clear of the rock surface with blocks of good sound timber and imbedded to a depth of at least 1 ft. from its upper surface in sand, loam or clay, which should be thoroughly tamped and rammed in about it. Whenever water should occur in a trench it should be drawn out and kept out until a firm foundation for the pipe shall have been obtained and until the joints have been properly calked. If the bottom should be soft or marshy, and liable to be insecure, it should be made safe and stable with masonry or concrete. In many cases it may be necessary to put in pile foundations for the pipe.

Each pipe, special, or gate of 24 ins. diameter and over should be laid upon two blocks firmly and evenly imbedded in the ground and should be adjusted to line and grade by means of wedges, which should be left in place. The blocks must be sound spruce or other good timber, as the locality may afford, and of a length equal to the diameter of the pipe. For 24 and 30-in. pipe the blocks should be 6 ins. wide and 6 ins. thick; for 36 to 42-in., 8 ins. wide and 6 ins. thick; for 48-in. and upwards, 8 × 8 ins. There should be for each block two wedges made from good sound 4-in. yellow pine or other equally good timber, sawn diagonally from end to end, and of length sufficient to cause the angle of the wedge to conform to the periphery of the pipe.

The spigots of the pipe should be so adjusted in the hub as to give a uniform space for lead all around. If from eccentricity of the hub or spigot, or from other cause, such space cannot be obtained, the defective pipe should be rejected. The width of this lead space should at all points be not less than ¼-in. for all pipes of 20 ins. diameter and under; not less than 5-16-in. for pipes 24 to 36 ins., and not less than ⅜-in. for pipes of 40 ins. and upwards. The depth of the lead in each joint should be, for 20 ins. and lesser diameters, 2 ins.; 24 to 36 ins., 2½ ins.; and for 40 ins. and greater diameters, 3 ins.

The gaskets should be of clean, sound hemp yarn, free from tar, braided or twisted and tightly drawn and should be driven firmly against the bead of the spigot and solidly calked up to the depth to receive the lead.

The lead should be of the best quality of pure soft metal, without admixture of any kind. No joint should be poured until the lead has been heated to a temperature of not less than 720° F. and all scoria has been removed.

Gates of 20 ins. or less diameter may be made with direct spindles and be set vertically, and should be covered with a good large iron gate box. All gates over 20 ins. should preferably be geared and set horizontally, and should also be provided with bypasses of suitable diameter. These should be set in good roomy brick vaults fitted with proper manholes with iron frames and covers.

On all trunk mains blow-offs of suitable size should be placed at all low points. At all high points air-cocks should be put in to free the main from any accumulation of air.

The writer is now in charge of the laying of about nine miles of 48-in. main for the city of Brooklyn. This is the third main of that size in the city, and with two lines of 36-in., comprises the trunk mains of the distribution system. In preparing his specifications he has embodied all of the foregoing points. All of the 30, 36 and 48-in. gates for this line are operated by hydraulic cylinders, which are guaranteed to open or close the gates against a pressure on the main, due to a head of 175 ft., with 25 lbs. pressure. The weight of these 48-in. gates is about twelve tons each; the average weight of the pipe, which is 1 5-16 ins. thick, 8,200 lbs. per length.

POLLUTION OF THE NAUGATUCK RIVER by the city of Waterbury, Conn., may be prevented by a court injunction. The hearing on the petition for the injunction is to be held at New Haven, Oct. 6.

MECHANICAL FILTERS, built by the New York Filter Mfg. Co., have just been put in service at Westerly, R. I. There are three 13-ft. wooden filter tanks with a combined capacity of 1,500,000 gallons per day.

A GREAT INTERCEPTING SEWER is to be put under contract at Cleveland, O., this fall. The sewer will be built along the valley of Walworth Run and will be 14,000 ft. in length. It will be 8 ft. in diameter at the head and 16 ft. 9 ins. diameter at the lower end. It will be of circular section and will be built of brick. The plans for the sewer were prepared by Mr. C. G. Force, M. Am. Soc. C. E. Besides the main sewer a large system of tributaries will be built, aggregating 32 miles in extent.

BIDS FOR GARBAGE COLLECTION AND DISPOSAL for the city of Brooklyn are called for by the Commissioner of City Works and are to be received until Oct. 5. The bidder must undertake the work from Jan. 1 next for a period of five years, and must agree to install some system that has been in successful use in this country for at least three months. The present garbage contractor of Brooklyn receives $129,000 a year.

A WATER POWER AND ELECTRIC PLANT is to be established at Chambly, Que., by the Chambly Water Power Co. There will be a concrete dam 28 ft. high and 1,100 ft. long across the Richelieu River, and the contract for turbines, etc., of 20,000 HP., has been given to the Stilwell-Bierce & Smith-Vaile Co., of Dayton, O. The power house will be at the dam and the power will be transmitted to Montreal, a distance of 15 miles.

THE RENO INCLINED ELEVATOR has been installed experimentally at the old iron pier, Coney Island, at an expense of about $1,000, in order to illustrate the working of the device to officials of the Brooklyn Bridge and the elevated railways. This elevator was described and illustrated in our issue of Aug. 25, 1892.

SMOKE IS NOT A NUISANCE under some circumstances, according to a recent judicial opinion, and the verdict of a jury in Pittsburg, in a suit brought against the Terra Cotta Lumber Co. In his charge to the jury Judge Slagle said that the mills and works along the river and other places, from which smoke and noises issue, were essential to the existence of the community and that every person has a right to carry on a legitimate business, provided it is carried on as such business is usually conducted. Some businesses are a nuisance in themselves, "such as soap boiling establishments, lead works and many others," but these must be located in a spot not in the reach of persons. In a case like the one on trial, his honor said, and when the existence of the so-called nuisance is not necessarily injurious to the health, the surrounding circumstances must be taken into consideration to arrive at a determination, and it must be found that the immediate community is annoyed to convict. The jury accepted the opinion of the judge and returned a verdict of not guilty.

THE CASCADE LOCKS on the Columbia River, Oregon, are practically completed by the U. S. government and the first steamer passed through on Sept. 17. They will be formally opened for traffic on Nov. 15, after being more than 15 years under construction.

A CONNECTICUT WIDE-TIRE LAW went into effect on July 1, 1896, providing that all heavy vehicles made after that date and used upon the highways of that state should have tires from 2½ to 4 ins. wide, according to character. A penalty of $100 was fixed for any violation of this statute. There seems to be considerable opposition to this law and so far it does not seem to be enforced. Individually the wide tire is deemed advantageous; and the fact that the statute requires a departure from old practice appears to be the only reason for noncompliance with its terms.

AN INTERESTING CASE OF RIVER POLLUTION is reported from Indianapolis. The company which supplies that city with water some time ago obtained a perpetual injunction against the American Strawboard Co., prohibiting that concern from discharging into the White River the refuse from its mills at Noblesville. This concern thereupon built a huge reservoir for impounding its refuse by building an embankment across a low place in the river. Into this reservoir 3,000,000 gallons of refuse per day was discharged. The embankment finally broke and the refuse was swept into the stream. The court found the strawboard company guilty of negligence, fined it $250, for contempt, and declared the water company entitled to recover damages, the amount of which should be settled by a jury.

AERATION OF WATER IN A LONG SUPPLY MAIN is being practiced at Norfolk, Va., for the purpose of purifying the water and preventing growth of vegetable organisms.

THE HARRISBURG (PA.) FILTRATION COMMITTEE has reported that mechanical filters are better adapted to conditions there than sand filter beds; but advises postponement of action until the result of the Louisville tests are known and until financial conditions improve.

THE STRENGTH OF A BICYCLE FRAME is shown by the results of competitive tests recently made between steel frames made by E. C. Stearns & Co., of Syracuse, N. Y., and "luminum" frames, made by the St. Louis Refrigerator & Wooden Gutter Co. The steel frame was found superior in every kind of test. The following are the average results of the tests of the steel frames:

	Crippling.	Ultimate.
Static load on crank hanger, lbs....	2,925	4.172
" " on seat post, lbs.	4,275	5,438
" " in line of sprockets, lbs..	.....	2,600
" " on pedal, one side, lbs. ..	845	1,250
Impact on seat post, inch-lbs.......	13,300	15,900
" " crank hanger, inch-lbs...	8,678	9,857
Horizontal impact on front fork....	3,544	4,463

STEAM PUMPS OPERATING WITHOUT OIL in their steam cylinders is a novel practice, adopted, for the first time, we believe, in the pumps furnished by The Geo. F. Blake Mfg. Co., of New York, for the new torpedo boats recently built by the Herreshoffs for the U. S. Navy. The pumps are constructed without any oil holes whatever, so that it is impossible for oil to get into the steam cylinders. They were given an exhaustive test for several days at the works, and they operated with entire satisfaction without using a drop of oil. The main engines of the boats will also be run without oil, but this is not a new idea with vertical engines. If the steam cylinders of both engines and pumps can be run successfully without oil, it will do away with the need for feed-water filters and with the danger of oil injuring the boilers.

A DEVICE FOR LOCATING SUNKEN WRECKS has been invented by a Baltimore man. It consists of a buoy to which is attached a long coil of rope, the whole loosely contained in a metal cage on the deck of the vessel. When the vessel sinks the buoy floats on the surface of the water, one end of the rope remaining fastened to the vessel. The buoy contains a bell which will be rung by the motion of the waves, and also a box in which may be deposited the story of the disaster which led to the sinking of the vessel.

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*Brief abstract of a paper read before the American Water-Works Association in May, 1896.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

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A CONTRACT FOR THREE MILES of 42-in. steel force main at Duluth, Minn., has been awarded to Mr. N. F. Hugo for $117,000. The plates will be rolled by the Ironton Structural Steel Co., of Duluth, and the pipe will be shaped and riveted by Mr. Hugo. A contract will soon be let for laying 1,500 ft. of 60-in. steel intake pipe, now on the shore ready to be put in place. The shore end of the intake will be in 20 ft. and the outer end in 60 ft. of water. The pipe will be laid in a trench excavated in solid rock. Mr. W. B. Patton is city engineer and Mr. E. J. Duffies is assistant engineer.

◆

THE DANUBE SHIP CANAL, through the Iron Gates, was formally opened to traffic, on Sept. 27, in the presence of the Emperor of Austria and the Kings of Roumania and Servia. Owing to the obstructions in the Danube, between Alt-Orsova, in Hungary, and Gladova, in Servia, the passage down the river for boats drawing 5 ft. or more of water was impracticable for 117 days out of the 225 days in which navigation is nominally open. And for boats drawing 6 ft. of water the river was never navigable between Bazias and the Iron Gates, a distance of nearly 80 miles. The rock dikes across the river have been now removed and a canal has been cut through the obstructions at the Iron Gates, this canal being about two miles long, 260 ft. wide and 10 ft. deep. The river has now been made navigable, for vessels drawing not more than 10 ft., from Vienna to the Black Sea, at a cost of about $10,000,000.

◆

THE ERIE CANAL TRACTION CO. is reported as sold to an English syndicate for $3,000,000, though the exact terms and proportion of stock transferred are not yet known. The sale was made by the Cataract General Electric Co. and it covers the right to construct an electric towing system along the canal. Meanwhile the right of the Cataract General Electric Co. to erect poles along the canal and the validity of the franchise generally are being questioned by interested parties, on the ground that the franchise for the installation of an electric towing system was obtained through political intrigue and without compensation to the state.

◆

THE LAKE ERIE AND OHIO RIVER SHIP CANAL report, which cost about $35,000, lies in the vaults of the Pittsburg Chamber of Commerce from lack of funds for compilation and publication. It seems that the city of Pittsburg has not yet turned over its appropriation for the canal and appeals to the public have been as yet unavailing.

◆

THE TWELVE NEW LAKE STEAMERS of the Bessemer Steamship Co., controlled by Mr. John D. Rockefeller, which are designed for carrying the iron ore of the Mesabi range from Duluth to Cleveland and other lake ports, are to be given the names of great engineers. The flagship is the "Sir Henry Bessemer," and the others are to be named "Stephenson," "Ericsson," "Corliss," "Krupp," "Fulton," "Watt," "Siemens," "Bell," "Fairbairn," and "Holley." The steamers are each designed to carry 4,000 gross tons on a draft of 14 ft. It is said that these vessels will be able to carry ore from Duluth to Cleveland as low as 50 cts. per ton, which should materially decrease the cost of making pig iron in Pennsylvania and Ohio from Lake Superior ores.

◆

TWO LARGE STEEL STEAMERS, for use in the Lake trade, are now approaching completion. The largest of these, the "George Stephenson," is being built at Bay City. Its dimensions are 428 ft. long over all, 408 ft. between perpendiculars, 48 ft. beam, 28 ft. depth of hold. The triple expansion engine has cylinders 25, 40 and 67 ins. diameter and 44 ins. stroke. There are three Scotch boilers, each 13 ft. 3 ins. diameter and 12 ft. 3 ins. long. The propeller is 13 ft. 6 ins. diameter and 17 ft. 6 ins. pitch. The estimated carrying capacity of the vessel is 4,000 gross tons on 14 ft. 6 ins. draft. On Sept. 23, the "James Watt," was launched at Cleveland, Ohio. This ship is 426 ft. long over all, 48 ft. beam and 29 ft. in minimum depth of hold. She cost $260,000 and is built to carry 4,000 tons of ore on a draft of 14. ft. 6 ins., and 6,000 tons on 18 ft. 6 ins. Both these huge freight carriers are owned by Mr. John D. Rockefeller, and are to be used to carry ore from his extensive mines in the Mesaba Range.

◆

THE SINGULAR STEAMER "HOWARD CASSARD" has been sold at auction in Baltimore for $1,000. The vessel was long and narrow, so narrow as to be very unstable, but the inventor's idea was to drive it so fast (35 to 40 miles per hour) as to give it an artificial stability. The hull is 220 ft. long, 16 ft. extreme beam, and 18 ft. 6 ins. deep, a very heavy and deep keel being used. The engines drive a four-bladed screw 9 ft. 8 ins. diameter.

◆

A FLOATING DOCK is to be built at Havana, Cuba, and proposals for its construction and operation are being received by the firm of R. Z. Jimenez & Co., 44 Broad St., New York city. The dock will be of mild steel and will have a capacity of 12,000 metric tons.

◆

DRY-DOCK NO. 2, AT THE BROOKLYN NAVY YARD, lately damaged by the lifting of the caisson gate during a change in the ballast, has now been emptied and is being cleaned out. The damage is said to be somewhat greater than was at first reported and a second session of the naval court of inquiry is being held. The rubber gasket from the caisson is an exhibit before the court, and it shows the enormous lifting strain put upon it by being torn in shreds in places.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was caused by the collapse of a bridge under a stock train near Baraboo, Wis., on the Chicago & Northwestern Ry., Sept. 20. The bridge was under repair at the time. The engineman was fatally injured.——A collision between a southbound passenger train and a train of empty flat cars occurred Sept. 20 at the switch for the Breaker Island spur, on the Delaware & Hudson R. R., near Troy, N. Y. Both engines were damaged and the fireman on the passenger engine was badly crushed by the tender, which telescoped the cab.

◆

THE EXPLOSION OF A LOCOMOTIVE BOILER occurred Sept. 23 on the Cleveland, Cincinnati, Chicago & St. Louis Ry. at Pekin, Ill. The engine was a very heavy freight engine, and was standing in the yard at the time. The fireman was fatally injured.

◆

THE CAVING-IN OF A TRENCH on Fifth Ave., near 44th St., New York city, on Sept. 28, caused the death of one man and injuries to two others. The trench was for new water pipes, and is said not to have been sufficiently protected by sheeting, while a platform across the trench carried a steam boiler and derrick in the work.

◆

AN EXPLOSION OF FURNACE GAS occurred at the Duquesne Steel Works, Pittsburg, Pa., Sept. 20, seriously burning and injuring two men.

◆

THE COLLAPSE OF A FLAT BUILDING under construction at 1078 Madison Ave., New York city, on Sept. 26, has revealed a terribly reckless character of construction and disregard of the building laws, while it also appears to show that the Building Department has not a sufficient force of inspectors to properly supervise the building work in progress. The building was 25 × 85 ft. The walls of the first two stories had been erected, three tiers of beams had been laid and the workmen were engaged in building the walls for the third story, when, without the slightest warning, the entire rear of the structure collapsed, and the walls, timbers, scaffolds and men fell to the cellar. One man was killed and eight were injured. An inspection showed extremely faulty work. It is said that the foundations were insufficient and had settled and cracked before the building fell, while the walls were not of proper thickness and the bricks were badly laid in a mortar that did not adhere to them. The lintels were insufficient to properly carry the masonry, and the flues, instead of being lined with tile throughout were lined only at points open to inspection. The combination of bad foundations and superstructure resulted in the sudden collapse without warning. Mr. Constable, Superintendent of the Building Department, has stated that this year the department was allowed only $265,000 to conduct the supervision of over $90,000,000 worth of building investments. It has 4,200 jobs to look after at present, and but 57 inspectors. These men are paid from $1,100 to $1,200 per year, while a foreman on a job gets about $1,500 per year. The inspector of the district in which the fallen building was situated, stated that he had two districts to look after, containing 220 jobs, and, in addition to these, he was obliged to make from 20 to 22 special investigations each day, and report on them. He had been so busy with this special work that he had not been able to visit the Madison Ave. house at all.

◆

AN INCREASE IN ZYMOTIC DISEASES traceable to polluted water supply is again agitating the people of Chicago. Within the last fortnight the chemical analyses of the water from the various supply tunnels has shown it to be in a dangerous condition from sewage pollution, and within the same time the reports of the health officer have shown a rapid and dangerous increase in typhoid fever, so great an increase, indeed, that the health officer seriously considered the closing of the public schools where lake water only is available to the pupils. A committee of the grand jury for Cook Co., Ill., has also recently presented a report to that body which condemns the city water supply as unfit for use. Naturally these conditions have raised considerable discussion in the daily press and under the direction of Mayor Swift the city officials are exerting themselves to find some remedy. At present the most approved plan is to extend all the water supply tunnels to points four miles from the shore, and it is announced that legislation to this end will be urged upon the City Council.

◆

THE U. S. LIFE SAVING SERVICE, in its annual report for 1895, states that there are 251 life saving stations on the Atlantic, Gulf and Pacific coasts and the Great Lakes; 184 of these being on the Atlantic coast line. There is but one river station; at the Falls of the Ohio, at Louisville, Ky. During the year 675 disasters to vessels on these coasts were reported, involving property valued at $10,725,175. Of this property nine-tenths was saved by the life saving stations and salvage and wrecking companies working together. These disasters involved the lives of 5,823 persons, with only 26 lives actually lost. Of the 675 vessels in jeopardy 73 were lost. On the New Jersey coast, with 49 stations, about 1,000 persons were on board ships in danger and only one life was lost; and only $83,535 worth of property was lost out of the $2,000,000 worth in peril. The total net expenditure for the service in 1895 was $1,285,577.

◆

THE ENGLISH TORPEDO BOAT "SPITFIRE," classed as a torpedo boat destroyer, has lately had her full-power speed trial of six runs over the measured mile. She is said to have made an average speed of, 27¾ knots per hour in the six runs; and for the full 3-hour trial the mean speed was 27.46 knots, or about 31½ miles per hour. The contract speed was 27 knots at 4,000 HP.; but she developed 4,527 HP.

◆

OF THE NEW TORPEDO BOATS lately bid for, two of the 30-knot boats have been awarded to the Bath Iron Works, of Maine, and the remaining one goes to the Union Iron Works, of San Francisco. Wolff & Zwicken, of Portland, Oregon, will build two 22½-knot boats; and of the, 20-knot boats, Herreshoff will build three, the Columbian Iron Works, of Baltimore, will build two, and Hillman Brothers, of Philadelphia, will build one. These eleven boats cover the appropriation of $1,300,000 provided for that purpose. The above awards, as made by Commodore Hichborn, of the Construction Bureau, and Commodore Melville, of the Bureau of Steam Engineering, are yet to be approved by the Secretary of the Navy.

◆

THE COAST DEFENSE MONITOR "PURITAN," for the U. S. navy, is completed, and will go into commission about Nov. 1. This is the last of the five modernized touble-turreted ships of the Monitor type to be finished. The "Puritan" has two steel barbette turrets and is 289½ ft. long, 60 ft. beam, 18 ft. mean draft and has a displacement of 6,060 tons. Her engines are twin-screw horizontal compounds of 3,700 I-HP. Her speed is 12.4 knots and she carries 410 tons of coal. Her main battery includes four 12-in. breech-loading rifles and six 4-in. rapid-fire guns; in her secondary battery are six 6-pdr. rapid-fire guns, two 37 mm. Hotchkiss and four Gatling guns. Her side armor is 14, 10 and 6 ins., with 8 ins. on the turrets and 14 ins. on the barbettes; the protective deck is 3 ins. thick. She was built by John Roach, of Chester, Pa., under the act of Congress of Mar. 3, 1885, but was completed at the New York navy yard. Her sister ships, the "Amphitrite," "Miantonomoh," "Monadnock," and "Terror" carry four 10-in. breech-loading rifles; though the "New Monterey," of a similar type, is armed with two 12-in. and two 10-in. breech-loading rifles.

SINKING A LARGE SUPPLY WELL FOR THE WATER-WORKS OF CANTON, MASS.

The accompanying illustration shows the method of sheet-piling and timbering used to sink a large well at Canton, Mass. The finished well is 40 ft. in diameter and 23 ft. deep, the wall being of hard burned Taunton brick laid in cement, and having a thickness of 20 ins. for the first 12 ft., of 16 ins. for 11 ft., or to the surface of the ground, and of 12 ins. for 3 ft. above ground. The wall rests on a granite foundation 3 ft. wide, the depth not being stated.

The site is within about 50 ft. of some springs. Three "soundings" indicated that gravel would be reached at 16 ft. from the surface, and it was intended to carry the well down 18 or 20 ft. deep. The gravel had such an inclination that it was deemed best to go down 20 ft. for the bottom of the well.

The contractor for the well was Mr. Geo. W. Mantle, of Boston, to whom we are indebted for the photograph from which the accompanying view was made. Mr. Robt. Bird was Chairman of the Board of Water Commissioners when the well was sunk, and kindly furnished us with a copy of the annual report of that body, containing a description of the well.

WELL UNDER CONSTRUCTION AT CANTON, MASS.
Mr. Geo. W. Mantle, Boston, Contractor.

In constructing the work Mr. Mantle first removed the muck from a space about 75 ft. square. Within this space he put down heavy timbers, forming two squares, one 50 and the other 30 ft. wide, on each side. Sheet-piling was then driven around the outside of the outer and the inside of the inner timbers, the latter having each of the corners cut off by additional timbering to form an octagon. Bracing was then employed, as shown in the view. The excavated material was lifted out in steel hods by means of a Cram's quick-acting steam derrick. Two centrifugal pumps, with a capacity of 900 gallons a minute, were employed to keep down the water during construction. The earth was removed in horizontal layers 4 ft. deep. After the wall was completed the central core was excavated.

The well is covered with a roof. Water comes in at the bottom and through openings in the brick wall just above the granite foundations.

ELECTRIC MINING IN THE ROCKY MOUNTAIN REGION.*

By Irving Hale, M. Am. Inst. M. E.**

The superiority of electric power for mining purposes was recognized in a general way as soon as the electric motor became a practical success, but it has required time and experience to amplify and fully develop its advantages and to overcome the minor difficulties that arose.

Advantages of Electric Power.

These may be considered under three heads, based on the nature of the generating power:

I. Electricity Generated by Water-Power.
(a) Saving of coal, water for steam (an important item in many places), firemen, handling ashes, boiler repairs.
(b) Electric motors, as now made, require less attendance and repairs than steam or compressed-air engines.
(c) Underground wires are more convenient than pipes
(d) Avoidance of losses by steam condensation underground.
(e) Avoidance of bad effects of steam underground—heating mine, vitiating air, rotting timbers.
(f) Electric motors are more efficient than the small steam and compressed-air engines used on hoists, pumps, diamond-drills, etc.
(g) Rotary motion of electric motor is superior to reciprocating motion of engine for many purposes, especially blowers and diamond-drills.
(h) Electric locomotives are peculiarly adapted to underground haulage where steam is impracticable.

II. Electricity Generated by Steam at Some Distant Point Where Fuel and Water are Cheaper.
(a) Saving of difference in cost of fuel and water between places where power is generated and used.
(b), (c), (d), (e), (f), (g), (h), same as under I.
(i) Superior economy of large compound and, where practicable, condensing engines, over the small, inefficient engines used on most mining machinery, proper allowance being made for losses in transforming and transmitting electric power.

III. Electricity Generated by Steam at Place Where Power is Used.
(a) Disappears.
(b), (c), (d), (e), (f), (g), (h), (i), same as under I. and II.

Counter-Considerations.

Against the advantages enumerated in the preceding section must be charged interest, insurance, taxes and depreciation on the excess of cost of water-power and electric plant over a steam plant for doing the same work; also the greater cost of attendance, if any, due to the location of machinery at two places, although this will in many cases be more than offset by the saving in attendance on motors as compared with steam engines and boilers.

Conditions Affecting the Cost of Plant.

The cost of an electric-transmission plant depends chiefly on three conditions:

First. Nature of water power (assuming such power to be used) and cost of developing it.

Second. Distance of transmission.

Third. Electromotive force or voltage used.

For a given power and electromotive force (which fixes the current) the cost of copper, for a specified percentage of line-loss, varies as the square of the distance.

For a given power and distance the cost of copper, for a specified percentage of line-loss, varies as the square of the distance.

For a given power and distance the cost of copper for a specified percentage of line-loss varies inversely as the square of the voltage.

If the voltage is increased in proportion to the distance, the cost of wire for transmitting a given power with a specified line-loss remains constant.

Table I. shows the cost of copper, at 14 cts. per lb., per K-W. transmitted by the two-wire system for various distances at different voltages, with 10% waste of energy in line.

Considering the fact that the total cost of steam or water power, electric generators, switch-board and motors seldom exceeds $150 per K-W., it is evident that when a distance is reached that makes the cost of wire (and transformers, if used) exceed that amount, or the entire cost of the remainder of the plant, that distance may be considered to be near, if not beyond, the economical limit, unless the conditions are peculiarly favorable for electric power.

With 500 volts this condition is reached inside of three miles; with 1,000 volts, inside of six miles; with 3,000 volts, at about 17 miles, and with 10,000 volts, at about 50 miles (allowing for transformers). It is evident from the foregoing principles and figures that the key to long-distance transmission is high voltage.

Systems.

Direct Current.—Direct-current generators, suitable for power purposes cannot be made to operate successfully at a much higher electromotive force than 1,000 volts, on account of the arcing and short circuiting of the commutator and its connections required to rectify the current. The direct current cannot be transformed to a higher voltage, except in a machine similar in construction to a generator and open to the same objections.

Single-Phase Alternating Current.—The single-phase alternating-current generator can be wound without difficulty for 3,000 to 4,000 volts, and considerably higher if necessary, as the current is taken off from two continuous rings without rectifying it, thus avoiding the difficulties experienced with the commutators of the direct-current machine.

An alternating current of moderate voltage can be transformed into a current of smaller amperage and proportionally higher voltage, for transmission, and can be retransformed at the other end of the line to any voltage desired for lights or power, the amperage varying inversely as the voltage. The energy remains the same, excepting a small loss in the transformation, not exceeding 2% in large transformers. Many plants are in operation at 10,000 to 12,000 volts, and as high as 50,000 volts has been used experimentally with promising results.

The single-phase alternating current is widely used for lighting, but, being a simple alternating wave, is not suitable for power, as no satisfactory single-phase alternating motor of large size has yet been devised that is self-starting under load and capable of speed regulation.

Multiphase Alternating Current.—A multiphase generator has several windings, so placed as to generate several alternating currents differing in phase; that is, passing the zero and maximum points at different instants. Under the influence of these currents (which may be compared roughly to the cranks of a duplex or triplex engine—no dead-center), multiphase synchronous motors are self-starting under light load, while non-synchronous or induction motors will start under full load, and are capable of speed regulation. The latter possess the good qualities of direct-current motors, and the additional advantage of having no commutator and, unless speed regulation is required, neither collecting rings nor brushes, the wires being simply connected to terminals on the field of the machine. On the other hand, the multiphase alternating current, like the single phase, retains the indispensable quality, for long-distance transmission, of being transformable from low to high voltage for transmission, and from high to low for use at its destination.

In the large number of electric-mining plants installed in the Rocky Mountain district during the past eight years, the following systems have been tried:

Direct current, moderate voltage (500 volts or less).
Direct current, high voltage (900).
Direct current, using several generators and motors in series.
Single-phase alternating.
Two-phase alternating.
Three-phase alternating.

Table II. gives a list, which is believed to be complete and correct, of all electric-power plants for mining and ore-reducing purposes in this district, showing in detail the number, kind and capacity of the machines installed and the distance of transmission.

Electric Mining Machinery.

As will be seen from an examination of the appended list of plants, electricity is being applied to the operation of every kind of machinery used in mines.

TABLE I.—Cost of Copper (at 14 cts. per lb.) Required to Transmit 1 K-W. Various Distances with 10% Loss in Line.

	Miles.										
Volts.	1.	2.	3.	4.	5.	10.	15.	20.	30.	40.	50.
500	$20.00	$80.00	$180.00	$320.00	$500.00	$2,000.00	$4,500.00	$8,000.00	$18,000.00	$32,000.00	$50,000.00
1,000	5.00	20.00	45.00	80.00	125.00	500.00	1,125.00	2,000.00	4,500.00	8,000.00	12,500.00
2,000	1.25	5.00	11.25	20.00	31.25	125.00	281.25	500.00	1,125.00	2,000.00	3,125.00
3,000	.56	2.22	5.00	8.89	13.89	55.56	125.00	222.22	500.00	888.89	1,388.89
4,000	.31	1.25	2.81	5.00	7.88	31.25	70.31	125.00	281.00	500.00	781.25
5,000	.20	.80	1.80	3.20	5.00	20.00	45.00	80.00	180.00	320.00	500.00
10,000	.05	.20	.45	.80	1.25	5.00	11.25	20.00	45.00	80.00	125.00
15,000	.02	.09	.20	.35	.56	2.22	5.00	8.89	20.00	35.56	55.56
20,000	.01	.05	.11	.20	.31	1.25	2.81	5.00	11.25	20.00	31.25
30,000	...	.02	.05	.09	.16	.56	1.25	2.22	5.00	8.89	13.89
40,000	...	.01	.03	.05	.08	.31	.70	1.25	2.81	5.00	7.81
50,000	...	...	.02	.03	.05	.20	.45	80	1.80	3.20	5.00

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*Abstract of a paper read at the Colorado meeting of the American Institute of Mining Engineers, Sept., 1896.

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Hoists.—The first application of electric power, and one of the simplest, was to hoisting; the rotary motion of the electric motor being easily adapted to this work. Most of the earlier machines consisted of street-car motors, geared to flat-friction or V-friction hoists. This type is very satisfactory for small or medium-sized machines, as the friction-gear is an assistance to the motor-controller in smooth starting.

For large hoists a positive geared motor is more reliable; but it is desirable to interpose a friction-clutch or equivalent device at some point between armature and drum, as a safeguard in case of excessive strain on the gearing, caused by the inertia of the armature when the drum is stopped by a too sudden application of the brakes. Mr. D. W. Brunton, of Aspen, has designed a slipping-pinion, which is used on the electric hoists in mines under his management, and serves this purpose admirably.

The choice of the best kind of motor depends considerably on the size of the hoist, its location, and the nature of the work. For an unbalanced hoist of moderate size, especially if placed underground and exposed to dirt and water, the iron-clad series-wound street-car type is well adapted, as it is strong, well protected and designed to stand heavy work on intermittent service. In this motor, efficiency, low heating and absolute freedom from sparking are to some extent sacrificed for compactness and lightness. For large hoists, which are generally located in comparatively clean, dry places, and, if over-balanced, work almost continuously, hoisting and lowering, and in which high efficiency is more important than in small hoists, the stationary type of motor is usually preferable.

The speed-controller is one of the most important features of an electric hoist. On most hoists a variable resistance in armature-circuit is employed; and by making this resistance sufficiently high, a perfectly smooth start may be obtained, even with slack rope. The most satisfactory rheostatic controller, especially for heavy work, is one in which the resistance is cut in and out by a cylindrical switch with magnetic blow-out, which avoids the troublesome effect of arcing at contacts, when the current is broken. In some cases it is practicable to use a double-motor equipment, with series-parallel controller, such as is now employed almost exclusively in street-car work.

By overbalancing a hoist, making the counterweight equal to the dead load plus about half the live load, the work in hoisting and lowering can be made approximately equal, and the maximum current and size of motor can be reduced to considerably less than half of what would be required for doing the same work with an unbalanced hoist. This principle is used in the electric hoists at the Free Silver, Alta Argent and Della S. mines at Aspen, and the Silver Lake mines at Silverton, and will doubtless be employed more generally in the future than in the past.

The Alta Argent hoist, in addition to being overbalanced, is arranged in a novel manner. The hoist, with its motor, is placed on a substantial platform above the head of the incline, and is out of the way of the operator, who is located, with the controlling levers, just below the hoist and on the level where the cars are run off. This gives more room for handling the cars as they are raised, and enables the hoist-operator to do this work.

The largest electric hoist in the world is on the Free Silver shaft at Aspen, Colorado. It is an overbalanced double-reel, flat-rope hoist, equipped with a 100-K-W. 4-pole motor, capable of developing 120 HP. continuously and 150 to 175 HP. intermittently. An auxiliary 60-HP. motor, ordinarily doing other work, is arranged so that it can be geared to the hoist counter-shaft and assist the large motor if necessary. Each reel has 1,500 ft. of 4 × ⅜-in. flat rope, weighing 2¾ lbs. per ft. The cage weighs 1,375 lbs, bucket and ore (hung from cage in sinking) about 2,400 lbs., car and ore about 3,500 lbs., and bailer, containing 111 cu. ft. of water, about 9,000 lbs. Two counter-weights are used, the one for cage and bucket weighing 2,450 lbs., and the one for cage and car 2,675 lbs., the two being combined when bailing. Two armature-pinions are provided (the motor sliding on rails), one for ordinary hoisting giving a speed of 600 ft. per minute, and the other for bailing at 1,000 ft. per minute, which, with the maximum load of about 10,000 lbs. (bailing), would require over 300-HP. net, exclusive of friction in gearing and rope, were it not for the overbalanced arrangement. Actual tests have shown that the average current consumed in hoisting with the counterweight is only about one-third of the amount required when the hoist is unbalanced.

Pumps.—The electric pump presents a somewhat more difficult mechanical problem than the hoist, on account of the conversion of rotary into reciprocating motion, and the importance, in most cases, of compactness and protection of the motor against water. That the problem has been satisfactorily solved, however, is proved by the large number of electric pumps of various kinds and sizes in successful operation.

Duplex and triplex pumps, both vertical and horizontal, are suitable for operation by electric motors. For small pumps, where plenty of space is available, a belted motor affords the cheapest arrangement and gives satisfactory results. In the majority of cases a geared pump with motor on the same base is best. Both spur and worm-gears have been used successfully, various devices being employed with the latter to neutralize the thrust. In the Virginius 70-HP. pump, the armature-shaft carries two worms, one right and one left-hand, working into two gears which mesh into each other. In the 15-HP. pump in the same mine, the armature is placed vertically, and its weight approximately offsets the thrust. In most of the electric pumps made during the past few years, spur-gearing has been used, and with good results.

The sinking-pump is the most difficult to design, on account of the small space available for the motor, and the necessity of enclosing it in a practically water-tight case; but numerous successful pumps of this kind have been made and installed. The three-phase induction-motor is especially adapted to this work, and it has no brushes or moving contacts, and the wires can be carried through water-tight bushings in the case to the stationary terminals on the field.

Speed-control is an important question in electric pumping. Where waste of power is unobjectionable, a rheostat in armature-circuit is suitable. If high efficiency is imperative, and the required variation in speed is not great, it may be economically accomplished by varying the field-strength of the motor, either by commutating a sectional field or by the use of a rheostat. When the generator supplies nothing but the pump, an excellent method is to vary the generator-voltage by changing its speed or field-strength, or both. In some cases a water by-pass can be advantageously used. In others it is best to pump at full capacity intermittently. The most suitable method is a matter of judgment in each case.

Blowers.—The running of blowers and exhausters is another simple operation, the motor being either belted, geared or direct-connected to the blower-shaft. Small outfits of this kind, placed at various points throughout the mine, run continuously with very little attention, and afford the most economical and satisfactory ventilation—far superior to the vitiated air that has passed through air compressors and drills.

Percussion-Drills.—To obtain with electricity the rapid reciprocating motion with varying stroke and necessary elasticity required in a percussion-drill, and at the same time get a machine that will stand unlimited abuse, has been the hardest problem in the mining field that the electrician has had to solve.

Two general methods have been followed. One employs the ordinary rotary motor, connected to the drill by a flexible shaft and producing the oscillatory motion by cranks, cams, levers, springs and similar devices. The other uses the solenoid principle, the plunger being moved back and forth within two solenoids, placed end to end, by currents sent through the two alternately, these currents being shifted automatically at the drill or generator—generally and preferably at the latter.

The solenoid type of drill is the only one that has been used commercially and successfully in this country. These drills were tried in several mines in Colorado and elsewhere about four years ago, but were only partially satisfactory. The principal defects were lack of pulling-power, heating of solenoids, unsoldering of connections and breaking of drill-chucks, due to the crystallization of the bronze of which they were at that time made. These defects have been remedied by better electrical and mechanical design of solenoids and connections, and the adoption of an all-steel plunger and chuck. The improved drills have been used successfully for some time in quarrying and tunneling in the East; and a few plants, as shown in the table, have recently been installed in mines in this vicinity, the operation of which will throw much light on the exact value of the drill for mining use.

Diamond Prospecting Drills.—In contrast with the percussion drill, the rotary diamond-drill is more easily and satisfactorily operated by an electric motor than by any other power, not only because the rotary motion of the motor can be applied directly to the drill, while the reciprocating motion of a steam or air-engine must be converted, but also because the former is much steadier than the latter, and causes less wear and breakage of carbons. Moreover, the transmission of power into a mine by electricity is more economical than by steam or air, and the electric drill, with its wires, can be more conveniently

TABLE II.—LIST OF ELECTRIC-POWER PLANTS FOR MINES, MILLS AND SMELTERS IN THE ROCKY MOUNTAIN REGION.

Abbreviations: DC., direct-current; SP., single-phase alternating current; 2P., two-phase alternating current; 3P., three-phase alternating current; Dr., special alternating drill current.

Note.—Percussion drills are classed, for convenience, as motors and nominally rated at 5 HP. each.

Location.	Name.	System.	Distance transmission in miles.	Voltage of generators.	Voltage of line.	Generator capacity in K-W.	Total motors.	
							No.	HP.
Colorado.	Central Stations.							
Aspen	People's Light and Power Co.	DC.	..	500	500	400	..	..
	Roaring Fork Electric Light and Power Co.	DC.	3.5	500	500	545	..	..
	Mines and Mills.							
	Alta Argent Mine	DC.	..	500	500	...	2	25
	Aspen Mine	DC.	..	500	500	...	3	56
	Aspen Mining and Smelting Co.	DC.	1.5	500	500	80	7	69
	Bimetallic Mining Co.	DC.	0.5	500	500	15	2	5
	Bushwhacker Mine	DC.	..	500	500	...	2	11
	Della S. Mine	DC.	..	500	500	...	4	130
	Durant Mine	DC.	..	500	500	...	3	95
	Free Silver Shaft	DC.	..	500	500	...	3	183
	Lessees	DC.	..	500	500	...	2	6
	Mineral Farm Mine	DC.	..	500	500	...	3	11
	Smuggler Concentrator	DC.	..	500	500	...	1	110
	Taylor & Brunton Sampler	DC.	..	500	500	...	1	35
Central	Old Kentucky Mine	Dr.	0.1	220	220	45	1	5
Creede	New York and Chance Mining Co.	DC.	2	500	500	100	2	84
Denver	Omaha & Grant Smelting Co.	DC.	0.1	500	500	100	4	86
Florence	Metallic Extraction Co.	DC.	0.8	500	500	55	1	30
Gilman	Gilman Electric Light and Power Co.	DC.	0.5	500	500	45	..	..
	Belden Mine	....	..	...	...	...	1	20
Leadville	Ibex Mining Co.	DC.	0.3	110	110	40	1	3
Manitou	Wilson & Jackson, Colo. Springs W.-W. Tunnel.	3P.	8	3,600	3,600	150	1	75
Ouray	Caroline Mining Co.[2]	DC.	4	900	900	600	11	514
	American Gold Mining Co.	DC.	2	500	500	60	3	90
Rouse	Colorado Fuel and Iron Co.	DC.	0.5	500	500	100[3]	6	300
San Bernardo[1]	San Bernardo Silver Mining Co.	DC.	0.5	250	250	6	1	5
Silverton	Silver Lake Mines	3P.	3	2,500	2,500	300[3]	8	326
Telluride	Central Station—Telluride P'r Transmission Co.	2P.[4]	15	500	10.000	1,500	..	..
	Supplying following:							
	Columbia-Menona Gold Mines Co.	....	..	...	...	...	3	120
	San Miguel Concentrating and Mining Co, Bear Creek Mill (at present)	....	..	...	...	...	4	80
	Turkey Creek Mill	....	..	...	...	...	1	50
	Smuggler Union Mining Co.	....	..	...	...	...	5	190
	Tomboy Gold Mines Co.	....	..	...	...	...	5	190
Tin Cup	Brunswick Mining and Milling Co.	DC.	0.3	250	250	9	1	8
Tomichi	Magna Charta Silver Mining and Tunnel Co.	DC.	0.4	500	500	90	..	..
	Lewiston Mine	DC.	0.4	500	500	...	3	56
Victor	Columbine-Victor Deep Mining and Tunnel Co.	Dr.	0.2	135	135	35	3	15
	Cripple Creek Gold Tunnel Co.	Dr.	0.1	135	135	12	2	10
	Golconda Gold Mining and Milling Co.	Dr.	0.1	135	135	12	2	10
Ward	Chicago & Colorado Mining and Milling Co.	3P.	0.8	440	440	75	2	25
Idaho.								
Burke	Consolidated Tiger & Poorman Mining Co.	DC.	1.5	1,200	1,200	350	2	450
Wardner	Bunker Hill & Sullivan Min'g & Concent'g Co.	DC.	0.3	500	500	25	2	30
Montana.								
Anaconda	Anaconda Cop. Min. Co. (Electrolytic Cop. Rfnry)	DC.	..	75	...	1,970	..	..
				110	...	...	2	40
Bannock	Gold Dredging Co.	DC.	..	500	500	100	4	130
Butte	Virginius Mine (Power from central station)	DC.	..	500	500	...	1	50
Corbin	Helena & Livingston Smelting & Reduction Co.	DC.	2	500	500	485	4	555
Great Falls	Boston & Montana Cons. Cop. & Silver M. Co.	DC.	Data unobtainable.					
Utah.								
Castle Gate	Pleasant Valley Coal Co.	DC.	1.3	500	500	248	4	190
Scofield	Pleasant Valley Coal Co.	DC.	1	500	500	124	3	135
Green River	Bennett Amalgamator Mfg. Co.[5]	DC.	..	500	500	100	4	78
Park City	Ontario Silver Mining Co.	3P.	6.5	2,500	2,500	150	4	70
Wyoming.								
Rock Springs	Union Pacific Coal Co.	DC.	2	500	500	62	1	60
	Total	....	..	...	...	7,988	135	4.816

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[1] (Trout Lake.) [2] Virginius Mine and Revenue Tunnel and Mill. [3] To be duplicated. [4] Formerly single phase. [5] (For South Placer Mining Co.)

moved from place to place than the steam or air-drill and pipes. On account of these advantages the electric diamond-drill has become a favorite wherever current can be conveniently obtained.

Coal Cutters.—Electricity was successfully used for coal-cutting even when the direct-current motor was the only kind available. The application to the chain-cutter of the three-phase, induction motor, without commutator, collector or brushes, and avoiding all possibility of sparking, has produced an almost ideal machine for this work. Another valuable characteristic of the induction-motor for this kind of service is the fact that, when overloaded beyond a certain limit by striking a hard stratum or by sticking of the cutter, it stops, thus relieving both motor and machine from excessive strains. These coal-cutters are being rapidly introduced in the East, but have not yet been used in this part of the country.

Locomotives.—Electric haulage in mines, under ordinary conditions and where distance and tonnage are not too small, is without much question superior to any other system available. It is more flexible than rope-haulage and more economical than mules or compressed air.

Mine-haulage is similar in most respects to street-railway service; but the locomotives must generally be adapted to narrow gage, the motors should be better protected, the speed is slower and the weight on driving-wheels greater.

The series-parallel controller, now so widely used in street-car service, which throws the motors in series for starting and slow speeds, and in parallel for higher speeds, is not so suitable for a mining-locomotive, for the reason that the slipping of one pair of wheels (which is more liable to occur than on a street-car, the load being behind the locomotive and the rails being more slippery) increases the speed of the motor on that axle, raises the counter-electromotive force and cuts down the current through both motors, if in series, thus reducing the power of both. For this reason some form of rheostat-controller is generally used. The essential requirements in a mining-locomotive are compactness, strength, simplicity, convenience of handling and especially durability and freedom from repairs.

Placer-Mining Machines.—Electric power has been very satisfactorily applied to the operation of placer-mining machines, several motors being employed to run the different parts of the dredge and gravel-treating apparatus. One motor generally raises and lowers the dipper; one forces it into the bank: another works the turn-table for depositing the gravel in the hopper; and a fourth operates the cylinder, tailings-carrier, amalgamator, etc. All of these motors are supplied by a generator located at any convenient point. The peculiar adaptability of electric motors to such work is evident; in fact it would be difficult to operate such a machine in any other way.

The Bennett Amalgamator Manufacturing Co. is operating a plant of this kind for the South Park Mining Co. at Green River, Utah, and the Gold Dredging Co. has a similar installation at Bannock, Montana.

Electro-Metallurgy.

Copper-Refining.—The principal application of electricity to metallurgical operations in this part of the country is copper-refining, which is carried on extensively at Anaconda and Great Falls, Montana. The plant at Anaconda consists of eight electrolytic generators, aggregating 1,870 K-W., and its capacity is 125 tons of refined copper per day, the average output being about 100 tons per day. They also have a 100-K-W., 110-volt power generator, supplying two 25 HP. locomotives and three traveling cranes, for handling and transporting materials and product.

The commercial success of this process is too well established to require discussion. Its economy is principally a question of the cost of power and the scale on which operations can be conducted.

Gold and Silver Extraction.—Electricity has been applied as an auxiliary in various processes for the treatment of gold and silver ores by cyanide, chlorination and amalgamation. While some of these processes are based solely on the faith of the inventor that a current of electricity sent through his mixture will in some mysterious way produce results that he cannot otherwise obtain, others undoubtedly possess merit, as they are founded on well-established laws of electro-chemical action. These processes are usually conducted with considerable secrecy, and it is impossible to give any reliable data as to the actual results accomplished or the economy of the operations. There is reason to believe, however, that, with the proper combination of chemical, metallurgical and electrical knowledge brought to bear upon this subject, good results may be expected.

Future Development.

During the past eight years and principally in the last four years, 52 distinct companies in the Rocky Mountain district alone have installed electric-power machinery for mining and ore-reducing purposes, comprising 62 generators, aggregating 7,988 K-W., and 135 motors, aggregating 4,816 HP., operating every variety of mining and milling machinery.

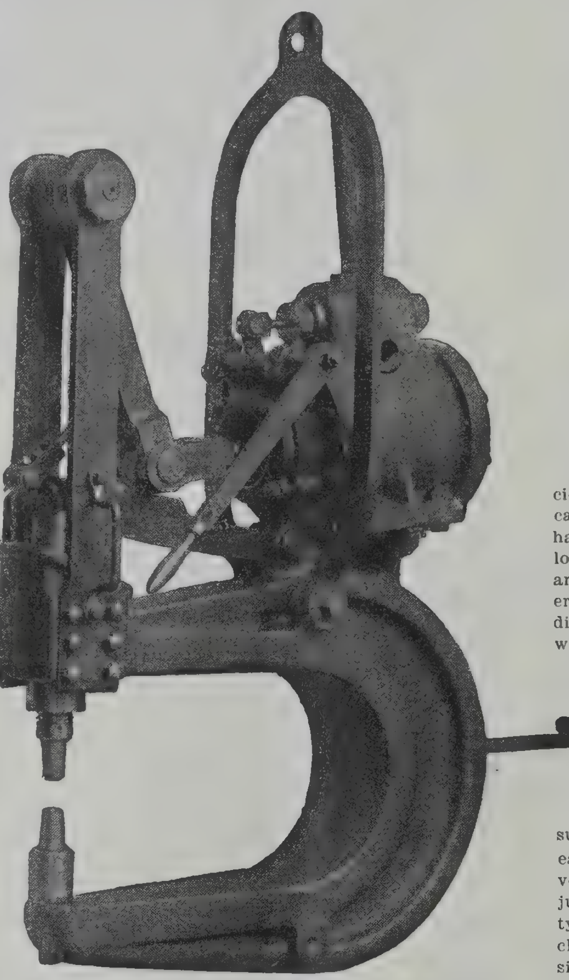
Electric apparatus, formerly regarded as delicate and peculiarly subject to break-downs, has been brought to such a degree of perfection that depreciation and repairs may be considered as less on this than on almost any other kind of machinery.

The multiphase high-voltage system has brought nearly every mining district within economical reach of water-power. The induction-motor, without commutator, collector or brushes, is the acme of simplicity and durability. Electro-metallurgical operations are increasing and give promise of success. Under these conditions it may be safely predicted that during the next five years much greater progress will be made, and the application of electricity will become one of the most attractive and important features of mining economy.

* * *

SOME NEW DESIGNS IN POWER RIVETING MACHINERY.

The half-tone cut herewith shows a new form of bridge riveter recently placed on the market by Mr. Chester B. Albree, of Allegheny, Pa. The peculiar feature of this riveter is the means by which the power is transmitted from the air cylinder to the ram. On top of the ram is a roller, on which rests the inclined arm or lever shown in the cut, which is pressed down by the roller at the end of the link to which is connected the pitman or connecting rod, driven by the trunk piston. A toggle joint motion is thus secured, which gives the greatest pressure at the extreme end of the stroke. The yoke of the riveter is of cast steel, of 60,000 lbs. tensile strength. The working parts are of hardened steel. The cylinder is provided with an automatic cushioning device and the valve is perfectly balanced. The machine will balance either horizontally or vertically by the trunnions. The yokes are made of different depths to suit different classes of work, 26-in., 36-in., 60-in. and 70-in. The cylinders are made either 10 ins. or 14 ins. diameter, as ordered. Mr. Albree has also patented an ingenious column riveter for work in contracted spaces where the ordinary power riveter cannot be used or is used only with difficulty. The accompanying cut shows its mechanism.



A NEW PORTABLE RIVETER FOR BRIDGE AND STRUCTURAL WORK.

Designed and Built by Chester B. Albree, Allegheny, Pa.

Either of the above machines are built to operate with compressed air; but can be built for steam or hydraulic pressure where desired. Stationary riveters for heavy work in boiler and tank shops are also built with operating mechanism, similar to that shown on the other machines. The durability of these machines has been tested by their use for some nine months in the structural iron works of Mr. Albree, where it has given the best of satisfaction.

* * *

STEAM BOILER PRACTICE IN EUROPE.

Circular No. 5 of the Steam Users' Association, Edward Atkinson, president, contains the report of Mr. R. S. Hale of his visit to Europe to study European boiler practice. The following table, prepared by Mr. Hiller, of the National Boiler Insurance Co. of Manchester, is given in the report:

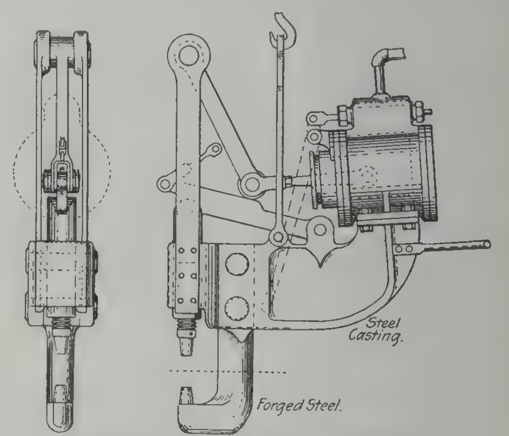
Per Cent. of Boilers of Various Types Used in Europe.

	United Kingdom.	France.	Germany.	Switzerland.	Austria.
Year	1895.	-1893-4.-			
Lancashire & similar types.	38.0	4.7	35.7	19.6	*
Cornish and similar types.	23.7	8.2	15.3	40.8	*
Extern'ly fired cylindrical[1]	6.8	57.3	14.8	15.5	41.0
" " multitubul'r	..	13.4	5.2	3.5	7.5
Locomotive	11.0	5.1	17.3	5.7	10.5
Small verticals	16.6	3.6	5.0	13.5	6.1
Water tubes	1.8	5.7	4.6	1.4	3.8
Other types	2.1	2.0	2.1	..	1.4
Total	100.0	100.0	100.0	100.0	100.0

*Lancashire, Cornish and similar types, 29.7. [1]Including elephant.

From Mr. Hale's comments on the several styles of boiler used we extract the following:

The standard type of boiler, with the exception of France and the Province of Elsass in Germany, was decidedly the internally fired flue boiler known as the Lancashire when it has two flues, and the Cornish when it has one. The Lancashire boiler is generally about 30 ft. long by 7 ft. 6 ins. in diameter. The two internal flues are about 3 ft. diameter, and the grates in them are generally 6 ft. long. Galloway, or cross tubes, about 6 ins. diameter are often placed in the tubes back of the bridge wall, five to each flue, but this is advised against by some of the best authorities. The gases after leaving the furnace tubes pass underneath the boiler to the front, then back along the sides to the underground flue. Such a boiler would have 36 sq. ft. of grate surface and about 1,000 sq. ft. of heating surface, giving a surface ratio of 28. When built for 160 lbs. steam pressure, it costs about $2,500 in England, and will deliver easily 6,000 lbs. steam per hour. At this rate it is not very economical, but if used at a lower rate or in conjunction with an economizer it is as economical as any type of boiler. It is a boiler that is very easy to keep clean since every portion of the surface inside and outside is of easy access.



Portable Riveter for Work on Columns.

The Cornish boiler is exactly like the Lancashire, except that it has only one furnace tube. This single tube is in England placed in the center, in Germany it is placed to one side with the idea of improving the circulation. It is nowadays rarely built except for small plants, so that the average Cornish boiler is probably considered older than the average Lancashire.

In France and in Elsass, Germany, the type of boiler known as the "elephant" is the standard. This is classed under the head of externally fired cylindrical in Mr. Hiller's table. It is not as regular in size or proportion as the Lancashire. The upper shell is generally from 20 to 30 ft. long and some 5 ft. in diameter. The two lower shells called "bouilleurs" are about 2 ft. diameter. They have one and sometimes two connections to the main shell. This boiler has the advantage of allowing a very large grate surface, an important consideration with the poor coals in use on the Continent.

In boiler construction I judged the English workmanship to be fully equal to our best. In England no punching is allowed; the plates are always planed on the edges and then drilled in place. Steel is being used almost exclusively in England; iron is still preferred in some places on the Continent.

The internal flues in the Lancashire boilers are generally welded along the longitudinal seam, and the cross or Galloway tubes are frequently welded in. I did not hear of any cases of welding the boiler-shell itself. The flues are occasionally made corrugated in various ways as the Fox, Purves, and other patents. My impression was that these were considered better, but that most frequently the improvement did not warrant the expense. The steam pressures, of course, varied from plant to plant. I should judge that if 140 to 150 lbs. was considered a standard for a new mill in America, the corresponding practice would be 200 lbs. in England, 180 in Elsass, and 140 to 150 in Belgium and Germany. In all countries I found occasionally higher pressures than the above, and, of course, the immense majority were lower.

Economizers.

The use of economizers is more general in Europe than in America, and the type known as the "Green," now made by several good firms, is the standard. Occasionally on the Continent one of the bouilleurs of the elephant boiler was used as an economizer. The most general practice was to put one economizer for each battery of boilers, making the economizer heating surface and the boiler heating surface the same. In Belgium, however, they were recommending one small economizer to each boiler. Scrapers are used to keep the fire surfaces clear of soot. The water surfaces are subject to scaling if the water be bad, and it is chiefly in the bad water districts that economizers are not used, though they are not much if any, worse in this respect than water tube boilers. But when the economizers are taken out the heating surface of the boilers must be more than doubled to get the same economy.

Heat Storage.

An advantage claimed for the Lancashire boilers and for the economizers was that the large amount of hot water in them afforded a reserve of heat for a sudden call. An interesting application of this principle were the feed torage and the steam storage systems of D. Halpin, Esq., London. The first is applicable to all plants and consists in providing tanks in which the feed is heated to the steam temperature by steam from the boiler during light demand, so that during the heavy demand the feed water is supplied hot (360° F.) instead of 100° or 200°. The steam storage consists in having very high pressure boilers, which pressure is reduced at the engine. Water is heated to boiler pressure during light load and stored in tanks, and during the heavy load expands into steam and relieves the demand of the engines on the boilers proper. The steam storage system did not impress the writer favorably. If you are going to go to the expense of high pressure boilers anyway, then it seems to him that you will be as apt to save coal by using high pressure steam at your engines as by reducing the pressure in order to equalize the load on the boilers. But the feed storage system, particularly where economizers are not used, seems a very practicable method of reducing the net first cost by a few per cent. (the boiler plant saved would cost more than the feed storage), and at the same time probably increasing the economy. Both the feed and steam storage systems are especially available with bad water.

Superheaters.

The use of superheated steam is very much in the air all over Europe, and in Elsass (Alsace) it is fairly general, about 500 superheaters being in use. There has never been any doubt that it saved from 10 to 20% of coal, but the difficulty has been in the lubrication of the engine cylinder and the keeping the large number of superheater joints tight. The Schwoerer superheater, which is much used in Elsass, consists of a small number of very heavy ribbed cast-iron pipes placed in a very hot portion of the flue, as, for instance, between the tubes and the drum of a Babcock & Wilcox boiler. The cast iron is made thick enough so that it may become red-hot without injury, and by being in the hot portion of the flue only a small superheater is required. The trouble with lubrication is overcome by using a high grade mineral oil. In England and on the Continent, several forms of superheaters using thin steel pipes were under test. I did not hear of their sale in any number as yet. The superheaters are also placed above a separately fired furnace in some plants.

Grates.

The grates in ordinary use did not noticeably differ from those in use in America. In Germany some of the under-fired boilers were provided with grates that inclined downwards to the rear as much as a foot or a foot and a half, which was thought to be easier for the firemen and to give better combustion. The ash-pits of these boilers were unusually deep. The coal is frequently very soft and bituminous, but in their internally fired boilers they had no trouble from having the furnace top only 18 ins. or less from the grates, in fact the Lancashire boiler enjoyed a better reputation for smokelessness than many others.

Mechanical Stokers.

In England several forms of mechanical stokers were in use, perhaps over one-quarter of the boilers being equipped. They may be divided into two general classes, the coking and the sprinkling stokers. The coking stokers feed the coal at the front where it cokes and is then carried to the rear by the reciprocating motion of the grate bars. The Vicars stoker is the best known of the class. It is represented in this country by the Roney, Wilkinson, Murphy, Brightman and other types; the chief difference being that on account of the internally fired boilers the Vicars grate bars are level The sprinkling stokers throw the coal over the grates by means of revolving or oscillating shovels; but they generally use as well a reciprocating motion of the grate bars to carry the ashes to the back end. The Bennis stoker is perhaps the most widely used of this class, but there are several good firms who make stokers of each class.

Opinion is, of course, widely divided on the merits of mechanical stokers. What seemed to the writer to be the general drift of opinion of those best fitted to judge, was as follows: No stoker absolutely prevented smoke, but both types very largely diminished it. In this respect the coking stoker had a decided advantage over the sprinkling. Neither stoker kept up the steam pressure on a sudden call as well as hand firing; in this respect the sprinkling stoker was considered to act more quickly than the coking.

The sprinkling stoker was being sold at about three-quarters the price of the coking. The cost of the Vicars stoker was about $500 for two stokers, each 2 ft. 9 ins. or 3 ft. wide and 4 or 5 ft. long.

The opinion as to whether the stokers saved coal was evenly divided. The most general reasons for their adoption were the diminution of smoke, the smoke laws being very strict in England, and the use of a cheaper fuel. The use of a cheaper fuel undoubtedly saved money, but when compared on the same grade of fuel the best opinion, so far as the writer could judge, was that they saved some coal, but not enough to show a net saving after paying the interest and repairs. The saving in labor was not generally considered and did not amount to very much in small plants, or in plants where no coal handling devices were adopted. The use of stokers and coal handling appliances together was thought to save about one-third of the boiler room labor in large plants.

Dust Firing.

In Germany grinding the coal to a powder and blowing this dust coal mixed with air into a hot combustion chamber was a method that was being experimented on in several plants and was meeting with considerable favor. The "Wegener" process is used in England; the "Camp," the "Schwartzkopf," and others in Germany. Fig. 10 shows one of these arrangements. The fine dust (almost as fine as flour) is, however, not only a very dirty stuff to handle but is also exceedingly liable to spontaneous combustion, and the problem of grinding and storing it had not yet been commercially solved so far as the observation of the writer went.

Boiler Fittings.

In boiler fittings several differences were noted. All fittings were noticeably heavier and stronger than with us. The use of spring-loaded safety valves is looked on as yet with a great deal of distrust, and those in most common use are the lever valve and also the dead-weight valve.

The use of try-cocks has been entirely given up in every plant that I visited and two gage-glasses are used instead, having been found not only neater but safer. On the Continent one glass and a mechanical lever indicator were sometimes used.

The dampers on the smoke flues are almost always of the sliding and not of the butterfly type. This may be because the flues are almost always underground. The dampers are always regulated by hand, damper regulators being practically unknown. Forced, induced, steam-jet, and other artificial drafts are no more and no less in use than with us; that is they are not infrequent in special cases where the ordinary draft is insufficient, but they are in no sense general.

The use of guards on the water-gages is very common to prevent pieces of broken glass from injuring the fireman. This is peculiarly necessary since in most of the foreign boilers the water glasses are on a level with the fireman's face.

Pipe Covering.

The average quality of the boiler and pipe coverings did not seem to the writer as good as those in general use in this country. Occasionally he saw wood and even rope covering on high pressure piping, some of which was already distinctly charred. Some plants, of course, had very good coverings, and there was a custom of covering the top of the boilers very thickly with some cheap covering with the result that nine times out of ten the space over the boilers was noticeably cooler than it is in America.

Chimneys.

In regard to chimneys the variety of sizes and of theories is just as great as it is here. The few of which the writer obtained both the dimensions and the amount of coal they were intended to burn were larger than those given in the tables in American books of reference for the same capacity. This may be because in England they lay a good deal of stress on a good draft as an aid in smoke prevention, and the English laws are very strict as to smoke. Brick is almost universal, iron stacks being used only in very exceptional cases.

Boiler Operation.

The admission of air above the fire either at the door or at the bridge was used occasionally. The opinion was very general that this diminished smoke. As to economy of coal, authorities were divided, but the general drift was, that this admission of air resulted in a slight loss.

Boiler surfaces seem to be kept cleaner than is the general practice here. In some places they run the boilers until the specific gravity of the water is 1.005, then they blow out and clean the boiler. In England they use soda, lime and potash in the boilers, according to the impurities, and on the Continent they are also beginning to know about the advantages of kerosene. Purifying plants to take the impurities out before the water enters the boiler are not infrequent but are hardly considered a complete commercial success as yet. A little water is generally blown out once or twice a day just as with us, and in mills the fires are banked at night. In electric stations the custom was very general to let the fires go out when they were not needed. Several plants gave us the result of experiments on the cost of banking fires. Reducing these to 24-hour days and to equal grate areas they run about 40 lbs. per 24 hours per square foot of grate.

The opinion as to the practice of letting the steam pressure off the pipes when the load was off was divided. On the whole it was in favor of the practice, although some plants said they had tried it and had found the cost of repairs to more than balance the saving in coal.

Boiler Testing.

Boiler testing is in some respects more advanced than it is with us, chiefly in that they attempt to tell where all the heat supplied goes to and thus to determine the reasons of good or bad performances.

The bomb calorimeter, in one or the other of its various forms, Mahler, Donkin, etc., is considered the only accurate means of determining the heat value of a coal, though the method of analyzing coal and using one of the numerous modifications of Dulong's formula is quite often employed. The Thompson and other calorimeters of that type are not considered in the least available for practical work. It was the custom to correct the results of the calorimeter for the latent heat of the H_2O formed from the hydrogen in the coal, or, if using the formula, to assume that the hydrogen was burned to steam and not to water. Coal tests are, of course, compared on the evaporation per pound of coal, boiler tests were generally compared on the evaporation per pound of coal "pure and dry," dry referring, of course, to the moisture correction, pure to a correction of the earthy matter contained in the coal, but not allowing any correction for the unburned coal in the ashes. Occasionally, however, pure and dry meant exactly the same as our "combustible." In determining moisture in steam they are as far behind us in their general practice, with the exception of a few of their best engineers, as they are ahead of us in the analysis of the gases. Fortunately at the high steam pressure now in vogue the priming is generally a negligible quantity so that their results have not been affected.

Boiler Economy.

In boiler economy I could not see that they were either ahead or behind us; they get from 60% to 80% of the heat in the coal, according to the air supply and evaporation per square foot of heating surface. None of their engineers had ever found any combustible gases in the chimney, except occasionally a little carbonic oxide. Most of their tests, however, left some zero to 15% of the heat unaccounted for, which may be radiation or error. Some said one, some said the other. No one had experimented as to why it is harder to supply the right amount of air to one kind of coal than to another, though they had all gone as far as to realize the immense importance of the air supply, as compared with any other factor in boiler economy, and also to realize and to experiment on the amount of air that leaks through the settings of some types of boilers to the injury of economy. Frequently more air has been found to leak through the settings than came through the fire. In some plants on the Continent they were painting the brick settings with a heavy tar paint to make them air tight, and occasionally even enclosing them in sheet-iron casings.

THE REVOLVING TOWER, proposed by M. Devic as the feature of the Paris Exposition of 1900, will be only about half as high as the Eiffel tower, or about 500 ft. But it is proposed to make this tower revolve at the rate of about 2½ miles per hour, for any point on its outer wall. The revolving part would be about 80 ft. in diameter and would be fitted up with restaurants, shops, etc., with a public ball-room at the top.

AN EXPERIMENT IN DREDGING WITH DYNAMITE.

Dredging by dynamite has been carried on at the outer bar at Brunswick, Ga., for several years, by Mr. C. P. Goodyear, a lawyer of Brunswick. He began work in the summer of 1891, and expended about $8,000, with, it is claimed, beneficial results. In 1892 he secured an appropriation in the River and Harbor bill providing for compensation in case he secured a certain depth by Jan. 1, 1893. Three surveys were made by the Government engineers, none of which showed the increased depth of water which the act specified. In the River and Harbor act of 1893 the time for securing the increased depths was extended to Nov. 1, 1893, and by the act of next year $30,000 was awarded him for the work done, as shown by the testimony of the masters of vessels passing over the bar, although the surveys of the corps of engineers still showed that the contract depths had not been secured. The same act also appropriated $30,000 additional to be paid Mr. Goodyear if he should secure a minimum depth of 23 ft. in a channel 100 ft. wide across the bar by Nov. 1, 1895. A board consisting of W. W. Duffield, Superintendent of the Coast and Geodetic Survey; Major W. S. Stanton and Capt. F. V. Abbott, Corps of Engineers, U. S. A., was constituted to make surveys to determine whether this depth was obtained. Three surveys were made by this board in 1895, none of which showed that the increased depth had been secured.

Mr. Goodyear again went to Congress, therefore, and by the last River and Harbor bill he is to receive $70,000 when he obtains a channel 100 ft. wide and 24 ft. in depth across the bar; $30,000 additional when he secures a channel 200 ft. in width, with a least minimum depth of 23 ft., and $40,000 additional when a 200 ft. channel with a least depth of 24 ft. is secured. The surveys to determine this increased depth are to be made by an officer of the Coast and Geodetic Survey to be detailed by the Secretary of War. The work must all be done by June, 1899.

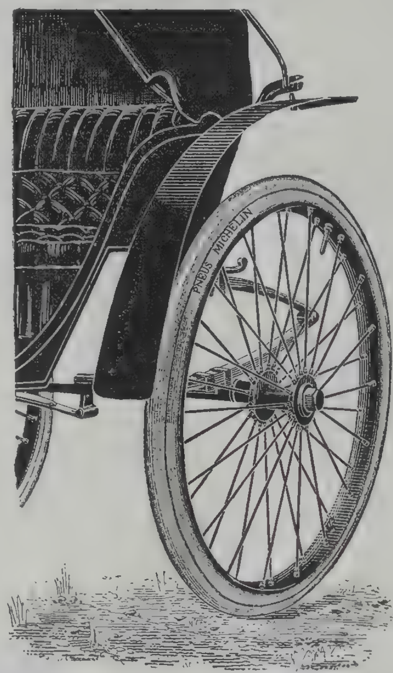
As we understand the matter, Congress, in this latest act, appears to have acted with considerable shrewdness. It refused to give the contractor anything for the 23 ft. channel 100 ft. wide, which was originally contracted for, as the soundings made by the board and by the engineer employed by Mr. Goodyear showed that the depth of the channel was already so close to 23 ft. that this depth might easily be brought about by the natural scour on the bar regardless of any work done, and whether it was secured or not was a matter on which engineers might easily disagree. To secure a depth of 24 ft., however, it seems probable that some real excavation will have to be done by the contractor; and if this depth is actually secured by his efforts, he will doubtless be entitled to compensation.

Respecting the actual merits of Mr. Goodyear's method of deepening channels by dynamite explosions, we are able to find nothing conclusive in its favor. He informs us in a personal letter that he has exploded over 200,000 lbs. of high-grade dynamite upon the bar, in charges from 25 lbs. to 200 lbs. The Board of Engineers in its report dated Jan. 11, 1896, stated that the best practicable channel 100 ft. wide across the bar was obstructed by about 9,000 cu. yds. less material in December, 1895, than in March, 1894, and about 21,000 cu. yds. had also been displaced from areas about 200 ft. wide at the side of this channel; but it says that there is no possible means of ascertaining how much of this was due to natural agencies and how much to Mr. Goodyear's dynamite explosions. On the other hand Mr. H. C. Ripley, an engineer employed by Mr. Goodyear, claims that the latter's operations had resulted in the removal of 785,000 cu. yds. of material in April last.

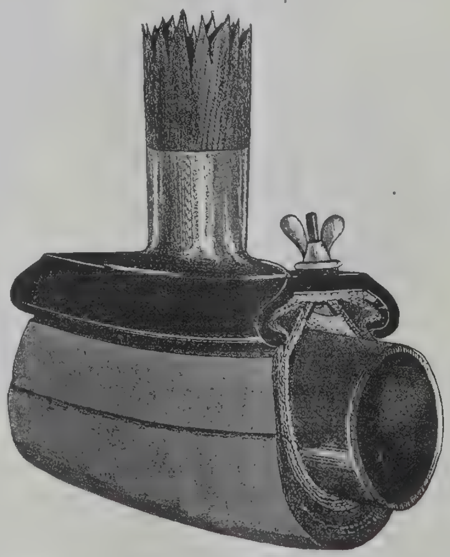
In view of the fact that prior to the wreck of a vessel upon the bar in 1879, there was an excellent channel across it nearly 23 ft. in depth and 900 ft. in width, it seems exceedingly probable that natural agencies are gradually restoring this former condition and that this has more to do with the improvement of the depth across the bar than Mr. Goodyear's dynamite explosions. He informs us that he has expended $133,500 upon this work to date. It appears to us that if he had expended this amount in work with modern dredging machinery, he would have removed a greater amount of material from the bar than even his own engineer claims and would have secured far more beneficial results.

PNEUMATIC VS. IRON TIRES FOR VEHICLES.

In "Le Genie Civil," for Aug. 15, 1896, Mr. Gerard Lavergne devotes considerable space to the application of pneumatic tires to the wheels of vehicles, a practice now quite common with the cabs of Paris. He says that an English engineer, Mr. R. W. Thomson, applied pneumatic tires to the wheels of carriages in 1846, and his device is fully described in "The Mechanics' Magazine" for August, 1846, and April and May, 1847. He at first employed an air chamber of rubber and an exterior envelope of leather; but he later used an air chamber made of canvas and rubber, reinforced by rubber on the rolling side, and very similar to the rubber tire of the present day. On March 17, 1847, Thomson made some experiments upon relative traction efforts, in Regent's Park, and reported as follows:



Pneumatic Tire for Paris Cabs; Bicycle Wheel.



Pneumatic Tire for Paris Cabs; Wooden Spoke Wheel.

	Ordinary wheels, lbs.	Pneumatic tires, lbs.
Over a good surface	45	28
Road covered with newly broken stone	120	38½

According to these figures the economy in traction, due to the pneumatic tire, was about 38% on a good road and 68% over freshly broken stone. It should be said, however, that his dynamometer was crude and the results were merely approximate, useful only for their relative values.

As giving more reliable data, the writer makes an abstract from a paper recently presented to the Society of Civil Engineers by Mr. Michelin, recording some more carefully made experiments of this character. Mr. Michelin used for his registering apparatus a dynametric spring, formed by two articulated plates at one end of the apparatus; one fixed to the vehicle and the other to the whiffletree. With this was used an automatic registering device of somewhat complicated and delicate design.

The first experiments were made with iron and pneumatic tires of the following diameters and weights:

Kind.	Diameter of wheels, Front, ft.	Diameter of wheels, Back, ft.	Weight of wheels, Front, lbs.	Weight of wheels, Back, lbs.	Weight of Empty vehicle, lbs.
Iron tires	3.02	3.67	127.6	158.4	1,269.4
Pneumatic tires	2.95	3.93	85.8	123.2	1,192.4

To the weight of the empty vehicle the weight of the driver must be added; and to make this feature comparable the same driver was used in both cases. These experiments were made over various soils, over different lengths of road, with varying loads and at different speeds. The results of the trials made in January, August and September of 1895 and January and February of 1896 are summed up in the following table:

	Tires, Iron, lbs.	Tires, Pneumatic, lbs.
Experiments in Snow.		
Carriage at a walk, empty	34.89	25.23
Carriage at a walk, load of 330 lbs.	39.22	27.96
Carriage at a trot, load of 330 lbs.	65.12	33.59
Carriage at a trot, load of 660 lbs.	68.57	39.51
Experiments in Mud.		
Carriage at a walk, empty	35.20	23.10
Carriage at a walk, load of 330 lbs.	38.06	27.34
Carriage at a trot, load of 330 lbs.	43.01	28.53
Carriage at a trot, load of 660 lbs.	50.73	31.15
Mean of Trials upon Macadam; dry, new, dusty and well-paved, with grades varying from 1.2 to 5.8%		
Carriage at a walk, empty	38.32	30.91
Carriage at a trot, empty	44.90	35.09
Carriage at a walk, load of 660 lbs.	45.65	35.51
Carriage at a trot, load of 660 lbs.	65.34	36.08

These figures show that under all the conditions given the use of the pneumatic tire diminishes the tractive effort; and this economy is greater upon a bad than upon a good road, as was to be expected, and it also increases with the speed and the load.

Some experiments were made to compare the relative effect of iron tires and pneumatic tires with varying air-pressure and with plain rubber. The results were as follows:

At a trot, load 660 lbs.......44.22 44.75 43.91 56.52

Vehicle.	Iron tire.	Pneumatic Air Pressure. 6.6lbs.	Pneumatic Air Pressure. 9.9lbs.	Plain rubber.
At a walk, empty	33.64	36.03	34.34	37.62
At a trot, empty	46.64	33.99	41.69	44.15
At a walk, load 660 lbs.	44.22	44.75	43.91	56.52
At a trot, load 660 lbs.	64.20	45.14	50.64	63.96
Average	47.17	39.97	42.65	50.31

From this table it would seem that the full rubber tire, while better than iron at a trot, is not so good at a walk. But Mr. Michelin adds that if the surface is muddy, or covered with snow, so as to remove all elements of elasticity, the full rubber tire gives better results than an iron tire. But the full rubber is always inferior in this respect to the pneumatic tire; and for the latter it would appear that the pressure of inflation should not exceed 6.6 lbs. The general mean of the experiments of Mr. Michelin in traction would give the following relative values:

Pneumatic tires	100.0
Full rubber tires	129.8
Iron tires	132.7

The author of the paper concludes with an illustrated description of some of the pneumatic tires used on vehicles in Paris, now generally fitted with metal rods, or spokes, though they can also be applied to wooden wheels. In the latter case the rim of the pneumatic is applied upon the wooden rim holding the spokes; but a better method is to fit upon the ends of the spokes a metal socket, which is riveted directly to the metal rim of the pneumatic.

The metal wheels are of the bicycle type, as shown in the cut, and need little description.

TRESTLE FOR CARRYING A FLUME AT SALTVILLE, VA.

By Emile Low, M. Am. Soc. C. E.

Occasion having arisen to convey away the liquid lime refuse of the Mathieson Alkali Works, with which the author has been connected as engineer, a plan was formulated, of which a flume trestle formed an integral part. Trestles for supporting flumes used in conveying water for irrigation purposes are common enough in the western states and territories, but in looking over the literature on hand on this subject, none was found which might serve as a precedent, and the author was compelled to evolve such a structure as would suit the exigency of the case in hand. As what might be termed in this particular, the rolling load, was comparatively a very light one, the main essential was to design a structure as light as possible, and at the same time possessing the requisite stiffness for stability, etc.

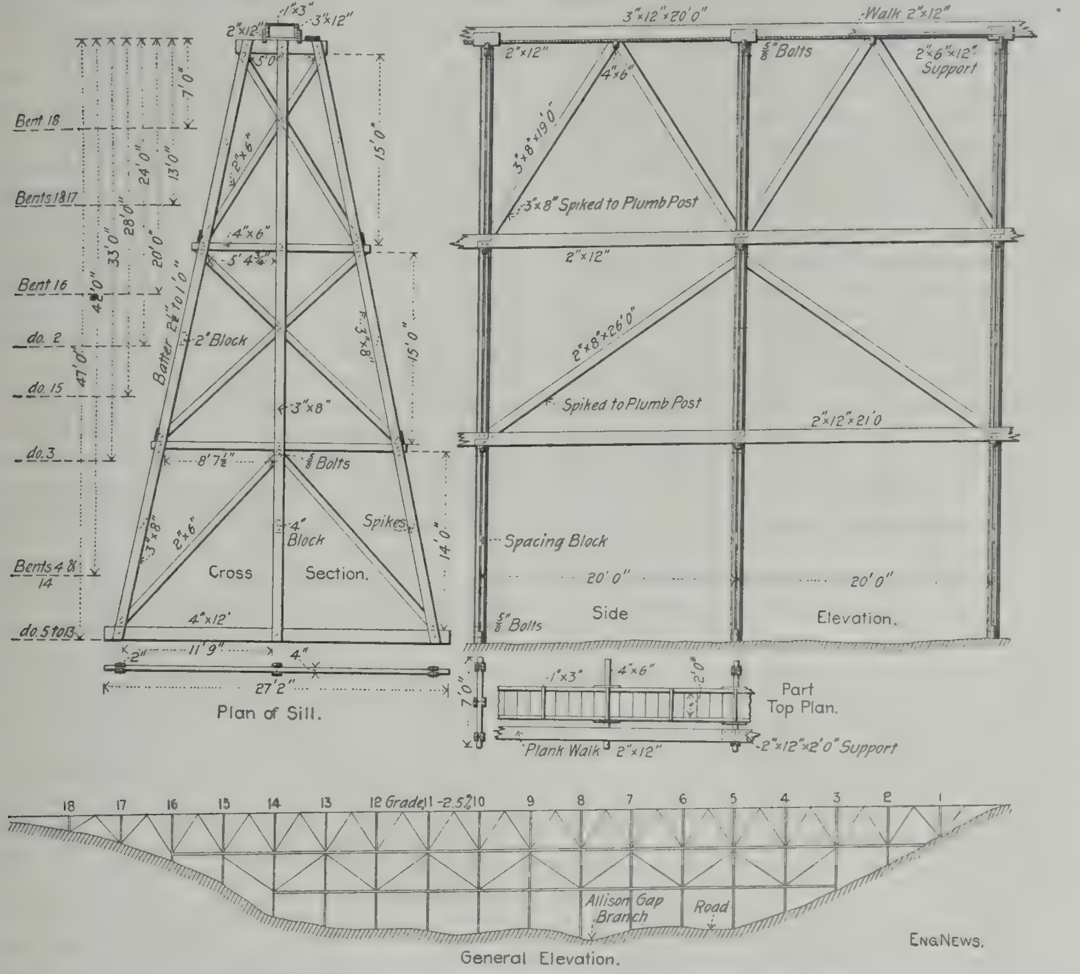


FIG. 1.—DETAILS OF TRESTLE AT MATHIESON ALKALI WORKS, SALTVILLE, VA.
Emile Low, Chief Engineer.

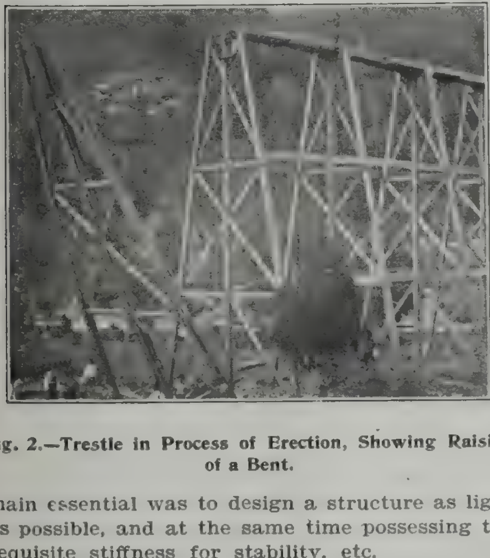


Fig. 2.—Trestle in Process of Erection, Showing Raising of a Bent.

After considering various designs, sizes of timber, length of spans, etc., the accompanying plan, Fig. 1, was finally selected.

The structure as built is 380 ft. long, the central portion being 47 ft. high, for 120 ft. in length. The grade employed is 2.5%. The spans are all 20 ft., measured center to center of bents. The foundations are mudsills, short timbers ranging from 6 to 12 ins. in thickness. Between the bents, where the creek flowed, the foundations were reinforced by rip-rap, to prevent washing and undermining. All the trestle legs were made of 3 × 8-in. stuff, arranged double, and separated by spacing blocks. It will be observed that the spacing blocks for the two batter legs are 2 ins. thick, while those of the vertical legs are 4 ins. thick, this so as to allow room for the double 2 × 6-in. braces, which cross each other at the vertical legs.

In ordering the timber it was in such lengths that bents Nos. 1 to 4, inclusive, and Nos 15 to 18, inclusive, were framed in one length. In bents Nos. 5 to 14, inclusive, the timber for each leg was ordered in two short and two long lengths, these pieces alternating on opposite sides, so that the splice always came near the middle of the long lengths, the joints abutting and being secured by three bolts, of which two passed through the braces, and one through the intermediate cap. This latter is 4 × 6 ins. in size and is dapped 1 in. on each side, at the ends, making the space between the parallel faces of the batter legs 2 ins., corresponding to the thickness of the braces and spacing blocks.

The sills and caps are made of 4 × 12-in. pieces, to secure vertical stiffness. The framing of these is similar to that of the intermediate caps, and is shown in detail on the drawing.

Bolts of ⅝-in. round iron were used in the various connections of the bents, only two lengths being required, 10½ ins. long for the batter legs and 12½ ins. long for the plumb or central leg. The sway or lateral bracing was made of 2 × 6-in. lumber, bolted at the ends and at the intersections. The longitudinal bracing consists of horizontal waling strips, 2 × 12 ins. in size, well spiked to the outside of batter legs. An additional system of inclined longitudinal bracing was used in the middle story, consisting of one piece of 2 × 8-in. lumber for each span. This was secured by spiking to the plumb legs.

The flume proper was planned to be 2 ft. wide and 1 ft. deep. This was modified before construction by making the same 30 ins. wide inside. The sides of the flume were made of 3-in. plank, the bottom being 2 ins. thick, composed of pieces 3 ft. long, and nailed at right angles to the sides. To support the flume at the center, three braces, 3 × 8 ins., were employed, the toes of which rested upon the intermediate caps and these were also well nailed to the center legs, with which they were in contact. The flumes were made in 20 ft. lengths and abutted. The ends of the flumes were secured by a plank 2 ft. long, spiked to the outside ends and dapped down over the caps. Several methods of erection were discussed, and it was finally decided to frame and put each bent together, arranging them in logical order on the ground, and in such a manner that when erected each bent would be in its proper position. It was found that owing to the lightness of the timber employed, the high bents would not possess sufficient stiffness against flexure, and to remedy this to some extent additional temporary timbers were lashed to the legs while in the course of erection. The accompanying photograph, Fig. 2, shows a portion of the trestle in place, and one bent being raised to a vertical position. Placing the flumes in position occupied considerable time, as each section had to be carried out whole on the completed structure, and then projected out over the end of the last finished bent. To facilitate this placing, the last erected bent was allowed to lean towards the working end of the trestle, and as soon as the forward end of the flume was securely attached to the leaning bent, this latter was drawn to a vertical position, drawing the flume with it.

The trestle was not erected without accident. After bent No. 13 had been erected and was being held in position by temporary guys, one of these, composed of two ropes, parted by the slipping of a knot, and the bent fell towards the finished work, carrying down in its fall bents Nos. 12, 11 and 10, which were as yet not stayed nor fully braced. By a singular fatalism, the bent that fell was No. 13. Luckily no persons were injured by the accident, and but little actual damage was done, although the resulting loss of time and expense of erection was considerable.

The total amount of lumber in the structure is about 23,000 ft. B. M., which cost, delivered on the ground, $12.50 per M. ft. B. M. The lumber was all oak. The cost of erection was about $500, which was large. Much of this can be attributed to the difficulty of erecting, as well as to the accident mentioned above.

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EXPORTS OF WIRE NAILS from this country have greatly increased during the past three years, and especially during the last year, as is shown by the following figures of the total exports of nails from the United States for four successive fiscal years:

Year ending June 30,	Cut Pounds.	Cut Value.	Wire and all other. Pounds.	Wire and all other. Value.
1896.......	20,730,260	$428,630	8,031,927	$321,055
1895.......	16,895,428	283,646	4,367,267	210,192
1894.......	16,736,643	330,118	3,233,776	180,607
1893.......	15,604,347	330,554	2,300,501	158,093

It is stated that at present American nail makers are beating the German firms in their competition for the trade of Japan, China and Australia, and this in spite of the fact that the Germans have much less freight to pay on the goods shipped to those countries than the Americans.

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THE ADVANTAGE OF TRADE STANDARDS in securing export orders is well illustrated by the success of American pipe makers in securing South African orders. The story is told by London "Engineering," as follows:

> The advantages of a set of standards generally recognized in the trade are well shown in the recent orders sent from Johannesburg to the States for iron piping. Formerly this was obtained entirely from the Clyde, but the different makers had all their own standard sizes for couplings, unions, etc., with the result that a batch of such goods received from one Scotch firm could not be used interchangeably with the goods supplied by another. American makers have agreed on a set of standards, to which all work, and for this reason only they are getting a large share of the South African trade. When complaints were made the Scotch firms defended themselves by the inane remark that their own fittings were interchangeable inter se, and they professed to be unable to understand why this was insufficient. Not so very long ago certain makers held similar ideas as to screw threads. In short, they rather thought they scored a point in having their own standards, as they fondly imagined that then all repairs must be returned to them for execution. Experience has, however, shown that a careful colonial importer avoids placing his orders with such firms, as the annoyance of having to send some thousands of miles to replace a broken bolt can only be balanced by a very substantial saving in the original cost of the goods.

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The proposed filtration of Philadelphia's water supply has been again brought to the front by the presentation of a report on the matter prepared by Mr. Allen Hazen, who was engaged for that purpose by the Woman's Health Protective Association. We have briefly summarized this report elsewhere in this issue. The need of a decent water supply for Philadelphia is well known; sooner or later the use of the foul and noxious Schuylkill water must be abandoned, and the sooner this is done the sooner will the annual sacrifice of human lives to the diseases spread by that contaminated water be ended. The question which for nearly a generation has been a mooted one in Philadelphia is what shall take its place? If the plan is adopted of going to some natural stream with abundant flow from a drainage area so far removed from populous towns as to ensure against serious pollution for many years to come, then the only available source of supply appears to be the upper Delaware, and this would mean the construction of a conduit of sufficient size to carry the city's entire supply and nearly 100 miles in length. It is no wonder that the city has hesitated to undertake so gigantic an enterprise.

But within the past few years engineers, and to some extent the general public also, have come to understand the practical possibilities in the purification of water by filtration; and it is quite possible that it may soon be accounted better practice to take water and filter it from a stream more or less polluted that flows past a city's doors, than to go long distances for a potable supply which often in a few years will become polluted. Philadelphia, for example, instead of going a hundred miles up the Delaware for a pure supply can take water from the same stream as it flows past the city, and by the process of filtration can make it as pure as the water of the mountain brooks that feed it. Mr. Hazen estimates the cost of a filtration plant at Philadelphia, capable of furnishing an average daily supply of 195,000,000 gallons, at $3,400,000. It will be seen that this is an insignificant sum compared with the cost of bringing the same amount of water from the Delaware Water Gap, and no one familiar with the actual results obtained in sand filter beds can doubt that it would actually be purer and safer water than that of the river as it flows at the Water Gap, provided, of course, that the filters were so designed and so operated as always to give the maximum degree of efficiency attainable by this process.

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We believe the fact is too often lost sight of in making comparisons between a filtered supply for a large city and a supply obtained from a distant watershed, that any stream large enough to supply a great city must at times carry more or less pollution. The watershed of any such stream must have on it more or less farms and villages, the drainage of which will often go directly into the streams unless great expense is incurred in the purchase and foresting of large areas, and their sanitary policing. In the case of such a great area as the Delaware watershed above Trenton, such a task would be practically impossible. Again all such streams are subject to sudden floods, during which great quantities of sediment, road washings, and the flushings of farm yards, pastures, house drains, etc., are carried into the stream and brought down. Should the question become an issue in Philadelphia between going to the Water Gap for a supply and installing a filtration plant, we suggest that those in favor of the latter take their opponents on an excursion to the Water Gap at a time when the river is in flood.

Whether Mr. Hazen's estimate of the amount of supply required and the cost of the filtration plant to furnish it are correct or not, it is at least fairly certain that the Philadelphia supply could be filtered for a small part of what it would cost to bring water from the Gap, or for that matter from any of the other sources which have been considered at various times.

The remarks Mr. Hazen makes with respect to the waste of water in Philadelphia are excellent. It is generally understood nowadays by all water-works engineers that the way to reduce waste of water is to install meters; but with the mud and grit and culm which Philadelphia water carries, any water meter is bound to wear more or less; and when a water meter becomes so worn as to lose its sensitiveness, so that it does not register the small flows due to leaky fixtures, a large part of its value as a means of preventing water-waste is lost. On the other hand, as soon as filtered water is distributed in Philadelphia, meters could be generally introduced, with a certainty that accurate registration and durability and freedom from repairs would be assured. By this means it is quite certain that the water consumption of the city could be reduced to a reasonable figure, and the saving made in this way would go far toward paying the cost of maintenance of the filter beds.

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We publish on another page an abstract of the report of Mr. R. S. Hale, Expert to the Steam Users' Association, on Steam Boiler Practice in Europe, which will be of interest to steam engineers. In the types of boilers used there appears to be a great diversity in the different countries. For instance, in England the Lancashire, Cornish and similar types form 61% of the whole number of boilers used, while in France only 12.9% of the boilers are of this type. The externally fired cylindrical, including the elephant boiler, is most common in France, 57.3% of all the boilers being of that type, while England has only 6.8%. England uses 16.6% of small verticals, while France uses only 3.6% and Germany 5.0%. Germany uses 17.3% of locomotive boilers, France only 5.1%. In the United States the plain externally fired multitubular boiler is the most common, but in England it does not appear to be used at all, while France uses 13.4% of that type. We regret that Mr. Hale did not procure statistics showing what kind of boilers had been purchased in the different countries say within the last ten years. We have no doubt that if such figures could be procured they would lead to different conclusions than those which may be obtained from the table given. The boilers now in use in Europe are to a great extent survivials from a past generation. Boilers often last 30 or 40 years, especially in England, where they are well taken care of. The Cornish and other single flue internally fired boiler, which forms 23.7% of the existing boilers in England, is certainly a survival, as is the elephant boiler in France, and the two-flue externally fired boiler in this country. Neither one of these types would now be adopted in a new plant designed with proper consideration of economy of space and of fuel.

A careful reading of Mr. Hale's report will show that Europe is by no means ahead of this country in steam practice in any particular, except in the use of superheated steam. Mechanical stokers are in more general use abroad than here, but they are rapidly being adopted here.

In boiler economy it appears that Europe is neither ahead of nor behind us. From 60 to 80% of the heating value of the coal is obtained in good practice both here and abroad, and the difference of 20% in the practice of different plants is not yet satisfactorily accounted for. In attempting to make a "heat balance" in boiler tests in England, as much as 15% of the heat has sometimes to be set down as "unaccounted for." In order to find the truth about the 5% to 15% of heat thus lost Mr. Hale is now conducting some experiments on a boiler in the vicinity of Boston. Mr. Edward Atkinson, president of the Steam Users' Association, in an introduction to Mr. Hale's report, states that with the completion of this work "the present undertaking may end, unless suggestions be made for the continuance of this service in some form after the present year."

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We regret that after all of Mr. Atkinson's attempts to improve the knowledge of steam engineering in this country his labors in this direction are apparently about to come to an untimely end, in fact just as the real work is about to begin, for the several circulars requesting information from subscribers which the Association has sent out, the compilation and publication of the returns, and Mr. Hale's trip to Europe have all been but preliminary to the work which may lead to an answer to the question "How may we improve our boiler economy?" In Engineering News of July 18, 1895, we gave an account of the work which Mr. Atkinson then proposed to do. He then thought that "the manufacture of steam as a separate art may be better comprehended in Great Britain than in this country" and he proposed to set two experts at work, one of them in Europe, to develop "rules for the manufacture of steam in the safest and best manner." The result of the investigation thus far has been to show that Mr. Atkinson was mistaken in his supposition that Europe was in advance of this country in the "manufacture of steam," and there does not seem to be any probability that the experiments on a boiler in the vicinity of Boston that are yet to be conducted will lead to any conclusions from which may be developed "rules for the manufacture of steam in the safest and best manner." It is too bad that "the present undertaking may end unless suggestions shall be made for its continuance." We, therefore, venture a suggestion. The work which Mr. Atkinson attempted to do is a most valuable one and it should be continued, although by different methods. There is an enormous waste of fuel in this country in the average (not in the best) steam boiler practice, and especially where bituminous coal is used. Mr. Atkinson is a great friend of Southern enterprise, and especially its great exhibitions. At the Tennessee Centennial exhibition next year there will be a fine opportunity to make competitive tests of steam appliances. Let Mr. Atkinson organize a bureau of tests of steam boilers, of smoke consumers, of boiler furnaces, mechanical stokers and the like, which shall test every appliance of that nature in the exhibition. We also make another suggestion. His experts have reported, and we believe correctly, that all types of boilers if properly designed and run give practically equal efficiency. It is not tests of different types of boiler that are now needed, but of different kinds of furnace under the same boiler, with different kinds of coal and different methods of firing. Let him try to solve this problem: "Given a 200-HP. water-tube boiler, and six different kinds of coal of widely different qualities, what kind of setting, what method of firing, what force of draught and what size and kind of grates are required to produce the best results with each of the different kinds of coal?" If Mr. Atkinson will now collect funds to pay for an investigation which will lead to the answer of this question he will advance the science of steam making to an extent far beyond anything that could be expected from the methods he has hitherto adopted.

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In connection with the coming use of motor-carriages the construction of the wheels is very important, and the notes upon the relative traction values of iron, pneumatic and full rubber tires, given in another column in this issue, are useful and interesting. The pneumatic, full rubber and the iron tire, so far as the effort of traction is concerned, have relative values, in round numbers, of 100, 130 and 133, showing a general economy for the pneumatic of about 30%. But besides this economy in power required there are other and important advantages in the use of the new wheel; and these are the reduction of the effect of sharp shocks and the marked decrease in noise and the wear and tear on the vehicle itself. As to this feature of noise, it may be remarked that the pneumatic tire on a low wheel of the bicycle type is now quite common among the cabs of Paris, and over the smooth wooden or asphalt roadways of that city these tires make so little noise that, for the safety of pedestrians, an ordinance has been passed requiring the owners of cabs to put bells upon their horses. In this way, while the rattle of carriage wheels is much reduced, the jingling of bells is substituted for it. But the person using the carriage gains decidedly in comfort, and the low wheels have advantages in getting into and leaving the vehicle. As shown in the cut reproduced, the wearing part of the rim is heavily armed with rubber and inquiry failed to find any cases of punctured cab tires. The fact that pneumatic tires were actually used fifty years ago, and that they practically differed very little in construction from those now placed upon carriages, will be new to many of our readers. But just as the bicycle, or velocipede, was introduced over seventy years ago, and then laid aside and forgotten, so the condition of our streets and highways, in 1846, was not favorable for the improved carriage tire of Mr. Thomson. The modern development of the bicycle, and now the motor-carriage, is a direct resultant of the improvement of our roads; and good roads and more of them will always be an important factor in the growth of all efforts towards cheaper and more rapid transit upon them.

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HOW CAN BETTER BUILDING INSPECTION BE SECURED?

The collapse of a building under construction in New York city on Saturday last calls attention again very forcibly to the fact that building operations in every city need to be very carefully watched in the interest of public safety to prevent careless and wilfully bad work being done. This is by no means the first time that such a disaster has occurred in New York city, and in some of these cases its Building Department has been held partially responsible on account of the careless or dishonest manner in which its duties were discharged under former administrations. In the recent disaster it is clear that serious defects and violations of the building law existed in the structure and were not discovered by the Department's inspectors; but on behalf of the Department it is said that the funds available do not permit the employment of a sufficient force of inspectors to prevent violations of law and bad work. Each inspector is said to have from 90 to 150 new buildings under his charge, and it is manifestly a physical impossibility for him to keep such close and continual watch on each of these as to certainly detect defects and unsafe work.

Another instance of defective construction was recently discovered by Philadelphia's Building Department. A row of 16 new houses was condemned by it, but the owners protested, and in response to their request the Director of Public Safety appointed a special committee to examine the houses and make a report thereon. The following is quoted from this report:

> Walls not plumb, and in some instances cracked; 9-in. party walls, where there should be 13-in. walls. Front walls not tied to party walls in either first or second stories; bricks laid without joints being flushed up, or cross joints put up, and in many places without any mortar whatever. Lintels not used properly, and in many cases there are no lintels at all over the frames. Flue linings not used properly. Inferior joist and roof rafters, in some cases being too short, and spliced out with 1-in. boards. Chimneys lathed and plastered over, also heat pipes. The heat pipes have been run without protection to woodwork or studding. The chimneys are not tied into the walls. The walls in some cases are composed largely of bats. These houses are, in our opinion, dangerous, and have no redeeming features, and we advise that they be torn down to the foundation walls and the foundation walls examined before rebuilding commences.

These two notable cases of defective construction, with others that are occurring from time to time in other cities, should call attention to the question what can be done to more certainly detect defects and unsafe construction.

For many years past more and more responsibility has been laid on the city building bureaus; the building laws have been made more and more complex and detailed, and reliance has been placed upon the official inspectors to see that the laws are carried out. We have no word to say against this tendency and consider it emphatically the duty of every city and town to see that the buildings within its limits are so constructed as to afford reasonable safety to their occupants and reasonable security against the spread of fire. But at the same time it appears to us that this inspection by public officials should not be allowed to take the place of a systematic inspection by the owner or his agents during construction.

Let us take the case of New York city. If we are correctly informed, the total amount expended in new buildings and alterations of existing structures is about $90,000,000 per annum, while the total appropriation for the annual expenses of the city's Building Department is $265,000. Probably at least a third of this sum is expended for the office employees, who examine plans filed with the Department, and in general office expenses, superintendence, etc. This leaves about $177,000 to pay for actual inspection of buildings, or roughly, about one-fifth of one per cent. of the total expenditure on construction. Any engineer or architect can easily see that this is far too small an allowance to ensure a thorough inspection. On the simplest class of civil engineering works, such as bridge pier or retaining wall construction, an allowance of ½ to 1% for inspection would not be excessive; and manifestly a much larger amount should be expended for inspection of ordinary building construction; if good work and strict compliance with specifications is to be ensured. On the other hand, of course, the city building inspector need only concern himself with matters of safety, which somewhat simplifies his task. We believe it will be generally agreed, however, that an expenditure of not less than a half of one per cent. of the annual outlay on buildings is necessary to enable a city to inspect properly the construction work going on within its limits.

It appears, therefore, that allowing every city building department to be honestly and efficiently managed and every one of its inspectors to be absolutely honest and faithful, it is still certain that with the limited appropriations which are generally allotted to city building departments, their inspection must be too hasty and incomplete to ensure discovery of every defective building, even though they may usually succeed in doing so. The time may come when this will be remedied—when ampler means will be furnished to building departments for their work; but it should be fully understood that under existing circumstances, the inspection made by the city should never take the place of or relax the vigilance of the inspection that should be carried on on behalf of the owner.

It is in this class of inspection that a great opportunity for improvement exists. The best architects, conducting a large and well-systematized business, have efficient corps of inspectors; but on the great bulk of building construction carried out under the direction of ordinary architects, or in many cases without the aid of any architect, inspection is too often a very cursory affair.

That this should not be, goes without saying. The owner of a building is responsible for its safety. If it falls because of bad construction and death or injury result to the inmates, he can be held for damages. Further, most insurance policies contain a clause making them null and void in case of the fall of the structure which they cover. The owner of a building who neglects to provide inspection to ensure its safe construction, therefore, runs a heavy risk. Besides this, an expenditure for inspection will mean in many cases a more durable structure, one which will involve less expense for repairs for many years. The owner, therefore, who, to save money, neglects to secure inspection of the structure he is building is saving at the spigot and wasting at the bunghole.

It has seemed to us in considering this question of building inspection that there is an opportunity here for the establishment of enterprises similar to the inspection bureaus which have made so pronounced a success in the examination of iron and steel, bridge work, etc., or those which cut so prominent a figure in marine architecture. Once let such a bureau acquire reputation for integrity and thoroughness and its services would be everywhere in demand. At present the purchaser of a building has no adequate assurance that the structure is soundly and securely built. Any such purchaser would pay somewhat more for a structure if with the deed he received a certificate of an inspecting bureau of wide reputation that the structure had been continuously inspected during its construction and had received approval. Moreover, when it became customary for purchasers to ask for such certificates, builders who erect houses to sell, as well as owners building for their own occupancy or for investment would find it to their advantage to employ such a testing bureau. Financial institutions, also, would demand such a certificate as precedent to granting a loan upon the structure.

It can easily be understood, moreover, that such a bureau could perform the work of inspection more efficiently and economically than the ordinary architect. It could, for example, have special men to inspect machinery, lighting apparatus and other special details of the work with which the average architect or his assistants are often not familiar. Thus many architects would prefer to place the inspection of their work in the bureau's hands rather than undertake it themselves.

We have outlined the above merely as a suggestion of what seems to us to be a hopeful plan for the improvement of the character of buildings; and we hope that some of the engineers and architects who have made a success of the inspection of metal construction may see their way clear to undertake work in this larger field.

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LETTERS TO THE EDITOR.

Civil Service Examinations.

Sir: I desire to inform you that there will be an examination for the position of Plumbing Inspector by this Board on Thursday, Oct. 8, beginning at 10 a. m., and will be greatly obliged if you will insert notice of such examination in your journal. Applications will be received only from residents of the State of New York.

Yours respectfully, S. William Briscoe,
Secretary New York City Civil Service Boards.
New Criminal Court Building, New York city,
Sept. 25, 1896.

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Water Development on the Mojave River, near Dagget, Cal.

Sir: I wish to call attention to an apparent error, referring to my article in Engineering News for Sept. 3, 1896, "Water Development on the Mojave River." The last sentence of the first column, page 159, reads: "In this case, where the sheet piling brings the water plane constantly above the flume grade, it would seem that the gathering flume might have been dispensed with."

I have no copy of my manuscript here in camp, so I cannot now compare, but I presume the sentence was originally written as follows: "In this case, where the sheet piling brings the water plane constantly above the flume grade, it would seem that the floor of the gathering flume might have been dispensed with."

Yours truly, J. B. Lippincott.
Strawberry, Cal., Sept. 16, 1896.

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Water Tigers and Water Supplies.

Sir: When cleaning out a distributing reservoir here last May there was considerable alarm manifested over the presence of numberless worms covering the entire sediment at the bottom of the reservoir. It was feared that they might be permanent inhabitants of the water and liable to continual distribution through the service pipes of the city.

Specimens submitted to an entomologist, however, were pronounced to be the larvae of the so-called water tiger belonging to the caleroptera. Among them were the hydrophilidae, gyrinidae, dytiscidae, etc. They are reported to have a remarkably rapid transition from this form to the next, which is that of the flying beetle. It is said that it deposits on the water the eggs from which these larvae are produced; also that it is not injurious to water for domestic use, and in fact is a scavenger in the water, tending to purify it rather than pollute it.

Their presence in the water is of such short duration that their discovery was accidental. A question arises as to how often our drinking water is similarly inhabited.

I would like to ask if this is a common experience, and if so what influence this insect really has on the quality of the water? If harmful, what is the usual treatment?

Respectfully, H. B. Patten, City Engineer.

Cheyenne, Wyo., Sept. 14, 1896.

(We do not recollect a similar instance, and should presume that the authority consulted was right in pronouncing the visitors entirely harmless.—Ed.)

Cost of Testing Steel Tapes.

Sir: In the Sept. 24 number of your valuable journal, under the caption of "Testing Steel Tapes," the statement appears that our charge for testing a steel tape of 100 ft. is $25, and we are at a loss to understand how such an erroneous impression originated.

The facts are as follows: We charge only 50 cts. for comparing with our standard the whole length of any tape of 100 ft. or less, and 10 cts. additional for each intermediate graduation actually tested. We compare many tapes from all parts of the country, and sometimes from other countries, and frequently the total length only is desired, the total charge in that case being only 50 cts. If both sides are graduated, one in feet and the other in metric measure, and both are tested, the charge of course would be doubled. It is seldom that a test of more than ten of the intermediate graduations is called for, and the additional charge in that case would only amount to $1. The amount of work expended on a tape, therefore, depends on the wishes of its owner.

It has always been the policy of this office to make the charges for such work merely nominal, and in view of the great importance of this matter to engineers, surveyors and others, we trust you will insert in your next number a correction of the statement above referred to.

Yours respectfully, W. W. Duffield,
Supt. U. S. Coast and Geodetic Survey.

Washington, D. C., Sept. 29, 1896.

(We are pleased to make the above correction and are sure that many engineers will be interested to learn that they can have their tapes verified at so trifling a cost. We were misled by a statement made before the Ohio Society of Civil Engineers and Surveyors in discussing the testing of tapes.—Ed.)

Sir: Following the inquiry by Mr. Erlandsen in reference to testing steel tapes, the writer wishes to call attention to an experience in this line showing a discrepancy between the United States standard tests at Washington and the method employed for testing by at least one prominent tape manufacturer.

The tape in question was received from the manufacturers as being 300 ft. long. It was at once sent to Washington, and by the Department of Standard Weights and Measures reported to be 0.52 in. long under a pull of 10 lbs. When the attention of the manufacturer was called to this, they at once claimed that 10 lbs. was more tension than the tape should have when supported throughout its length, and that their own tests were made under a pull of 2 lbs. This at once explained the difference in length.

The question then arises, why should a manufacturer assume a method for testing steel tapes which is known to differ from that employed by the Department of Standard Weights and Measures? Assuming that their standards for comparison are of the same length, the tapes manufactured and sent out by them must always exceed the U. S. standard length when tested by the Department at Washington.

It would be interesting to know if it is common practice for manufacturers of steel tapes to each make and test his work as his own individual ideas would suggest and to send these tapes out as being of correct length.

Yours truly,
Edwin D. Graves, Assoc. Am. Soc. C. E.

Hartford, Conn., Sept. 29, 1896.

A Stand-Pipe Failure at Garden City, Kan.

Sir: A brief note in regard to the failure of the Garden City stand-pipe, another addition to the already large number of failures of these structures, may be of interest to the readers of Engineering News.

This stand-pipe was built by Palmer & Son, of Kansas City, Mo. It was located about one-fourth mile from the Arkansas River, and a few feet above its bed. It was 10 ft. in diameter, 130 ft. high, and was supported on a masonry foundation on a level with the surface of the ground. It was held in place by six 1½-in. bolts through six cast-iron brackets, and by six 1-in. wire guys fastened to masses of masonry 65 ft. from the pipe and to an angle iron 90 ft. above the base. The plates of the top course were ¼, and of the bottom course ½-in. thick. The vertical joints were double riveted and the horizontal joints single riveted, with ⅞-in. rivets. The structure was stiffened by five 3 × 3 × ⅜-in. horizontal angles, to one of which, 90 ft. from the base, rings were welded to hold the guys. The bottom plates were ½-in. in thickness, and were connected to the first course by 4 × 4 × ⅝-in. angles. The brackets were cast iron, legs 2 ft. long, fastened to the structure by ten rivets, and to the masonry by 1½-in. bolts.

About four years after erection a crack appeared on the west side of the pipe, in the angle iron connecting the bottom to the first course. This was soldered but continued to leak and about 2½ years before the failure a new piece of angle, about 5 ft. long, was put in. Four of the six brackets had their legs broken about this time, and were repaired by bolting to them a strap of iron which passed down around the anchor bolt.

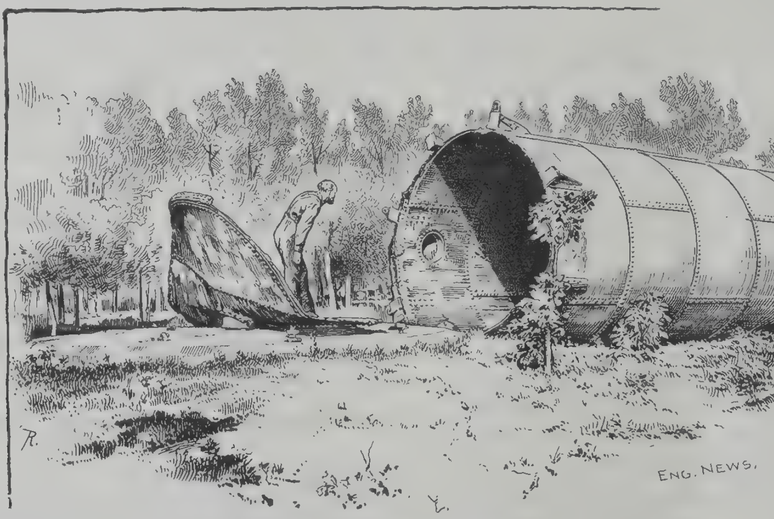
On April 30, 1896, during a very high wind from the northwest, estimated to have a velocity of 60 to 70 miles per hour, with occasional gusts of 90 miles, and which wrecked many of the windmills in this vicinity, a crack appeared on the north side of the bottom angle iron. This crack increased in size for 1¼ hours, until it was 5 ft. long, with the water rushing out rapidly. Suddenly the angle iron to which the north guy was fastened gave way and the pipe blew over in the southwest direction. The pipe was about one-fourth full at the time of failure, with both pumps delivering into it at nearly their full capacity.

The bottom angle iron broke at the angle all the way around, except where the new piece was put in, where the first course failed along the rivets. All the brackets were broken, and the bottom was broken somewhat at its center around the entrance pipe.

It seems quite clear that the failure was due to three causes: (1) The weakness in the angle iron connecting the bottom and first course; (2) to the brackets not being long and strong enough; and (3) to the fastening of the guys being weak.

E. C. Murphy,
Hydrographer U. S. Geological Survey.

Lawrence, Kan., Aug. 31, 1896.



AN OVERTURNED STAND-PIPE AT GARDEN CITY, KAN.

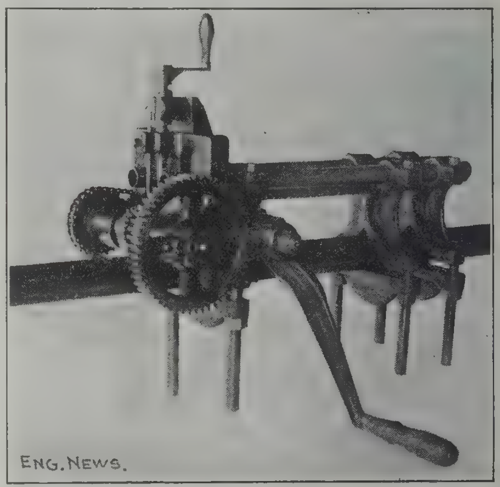
Notes and Queries.

T. W., Philadelphia, Pa., asks for a reference to some paper or publication on the construction of switch-back railways and of toboggan slides, as he has received a request on the subject from Japan and is anxious to supply the information desired.

The Paul Boynton Co., of New York, has patents on toboggan slides or chutes for boats to run down into a sheet of water, but we do not know the builders of any of the switch-back railways to be found at all pleasure resorts in this country.

A PORTABLE KEYSEATER.

The illustration herewith shows a portable keyseater, for cutting keyways in long shafts, manufactured by Messrs. John T. Burr & Son, Kent Ave. and South Sixth St., Brooklyn, N. Y. As shown in the cut the machine is clamped on the shaft and operated by hand. It will cut keyseats in shafting up to 5 ins. diameter, and will cut for 12 ins. in length without resetting. The cutting is done by milling cutters, and the machine is geared so that three revolutions of the crank produce one of the cutters. An automatic power-feed is provided, which can be instantly disengaged, and the machine fed by hand if desirable. A keyseat ¾ × ⅜ in. can be cut at one operation; for wider cuts the work is gone over more than once. A laborer can cut a keyseat ⅝ × 5-16 × 12 ins. easily in an hour. Larger size machines are also built to be operated by electric motor or by belt.



Portable Keyseater. Manufactured by John T. Burr & Son, Brooklyn, N. Y.

FILTRATION OF THE PHILADELPHIA WATER SUPPLY.

A vigorous crusade against the further use of Schuylkill River water, without filtration, is being led by the Woman's Health Protective Association of Philadelphia, and the subject is being actively discussed by the press of that city. All admit that the present supply is impure, and that the water from this river is blackened with coal dust or made yellow by mud at every high stage in the river, and that it is liable to contamination from six cities upon its banks above Philadelphia, whose aggregate population is 350,000. An entirely new supply, from a distant source of permanent purity, is undoubtedly the most attractive solution of the difficult problem presented, and for years past extensive surveys and investigations have been made with that end in view. But the enormous cost of such an undertaking, coupled with the lack of available means in the City Treasury and the disinclination to permit a private company to control the water supply of Philadelphia, have so far prevented any of the many projects of this sort which have been brought forward from being carried out.

Filtration has been often suggested, in Philadelphia. Several years ago certain parties backed by the city press, seriously recommended the location of filter-beds or filter-galleries in the River Schuylkill itself, an absurd scheme, which was dropped as soon as computations were made of the area required for the quantity of water to be filtered, the cost of construction, and the difficulties and risks of maintenance. But since the success of sand filtration as a means of purification of water has become generally understood, the intelligent citizens of Philadelphia have become strongly in favor of the construction of a system of filter-beds. Our readers will recall that an appropriation to build a single filter-bed was before the Philadelphia Councils some months ago, and was only defeated by a close vote.

Recently the agitation for filtration has been started anew by the publication of a report upon the project of filtering the city's water supply made to the Woman's Health Protective Association by Mr. Allen Hazen, of the firm of Hazen & Noyes, of Boston.

This report has now been submitted to the Mayor by the Association, and the recommendations are about as follows: Mr. Hazen figures upon a population of 1,300,000 in 1900 and a per capita supply of 100 gallons per day. He admits that the maximum consumption now reaches 150 gallons per head per day, at times, but he believes that this could be reduced to the amount stated by the increased use of meters and by closer supervision of the daily consumption. He thus assumes a total filtering capacity of 195,000,000 gallons daily as ample for all purposes, with a reasonable system for the sale of water. He also assumes upon present European practice that the average daily yield for each acre of effective filtering area, of the character proposed, would be 2,000,000 gallons, for all seasons of the year and including the time the beds are out of service for cleaning. He figures that at times of maximum consumption 50% more water will be used than the average of the year; and at such times the filters may be operated at the rate of 3,000,000 gallons per acre daily. If this is not sufficient for these emergencies, the deficiencies can be made up by drawing upon the reservoirs.

The filters proposed are the ordinary sand filters, similar to those used at London, Hamburg, Altona, Liverpool, Amsterdam, Rotterdam and other cities, and in this country at Lawrence, Poughkeepsie, Mt. Vernon, Nantucket and elsewhere. These consist of water-tight basins, with masonry sides; the water-tight pavement carrying upon it underdrains surrounded by gravel and supporting a layer of sand. The water will be brought over the sand and filter downward, and would be collected in the gravel and carried by the drains to the reservoirs or to the pumps; a suitable regulating apparatus being placed at the outlet of the drains for controlling the rate of filtration and loss of head. Mr. Hazen would build the walls of the filters of brick, or rubble-masonry lined with brick, and would probably use concrete for the pavement with a thin water-tight covering of asphalt. He does not consider that the climatic conditions would require covering the filters; nor does he consider settling basins an essential for Delaware River water, but he believes this preliminary treatment would be desirable for water taken from the Schuylkill River. His plans contemplate for each set of basins, a receiving basin into which the water would be pumped from the river and from which it would flow to the filters. These receiving basins would hold one-fourth of a day's supply and the sedimentation which would take place in them would probably be sufficient. The Schuylkill River, he says, is ordinarily comparatively clear, and could be filtered without previous sedimentation. And as the high water turbidity rarely occurs at the time of maximum consumption, the filters would usually operate upon this water at a rate below the maximum.

According to a map presented with the report, Mr. Hazen proposes to establish these filters as near as possible to the Belmont, Roxsborough, Spring Garden, Queen Lane and Frankford pumping stations, with filtering areas ranging from 5 to 30 acres at each point, and with an average filtering capacity of from 10,000,000 to 60,000,000 gallons daily. The approximate cost of supplying 195,000,000 gallons daily of filtered water is placed at $3,400,000, and the cost of operation is estimated at $3.50 per million gallons of water filtered; or $166,075 annually for the amount stated. Mr. Hazen also suggested that when larger quantities of water were required it would be possible to obtain this supply from the Delaware River by means of filtration, and to use it in connection with that furnished by the present pumping stations. In this way a practically unlimited supply could be secured, at least 1,000,000,000 gallons per day being available.

Mr. John C. Trautwine, Jr., Chief of the Water Bureau, in speaking of Mr. Hazen's plan, said that the city is now consuming about 225,000,000 gallons daily, and unless steps were taken to stop the present great waste of water Mr. Hazen's filtering capacity, and the cost of the plant, would have to be doubled.

The consideration of the merits of the two water sheds as gathering areas for a city water supply was a feature of Mr. Hazen's report. The Schuylkill River, above the water intakes, has a drainage area of 1,900 sq. miles and the population upon this water shed, above Philadelphia, is 350,000, or about 185 persons per square mile. The Delaware River, above the city intakes, has a drainage area of 8,100 square miles with a population, in 1890, of about 600,000, or an average of 74 per square mile. Yet 94% of the present Philadelphia water supply comes from the Schuylkill basin, and only 6% from the Delaware River. Mr. Hazen also pointed out that the existing eleven reservoirs in the Philadelphia supply have a nominal aggregate capacity of 1,400,000,000 gallons, equivalent to about seven days' supply at the present rate of consumption; but owing to the defects in some of these reservoirs the actual aggregate storage is about 1,000,000,000 gallons, or five days' supply.

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TEST OF A FIREPROOF FLOOR.

In our issue of Sept. 17 we described the tests which are being made by the Department of Buildings of the City of New York to determine the resistance to fire and water of various systems of fireproof floors. The third test of the series was made on Sept. 29 at the testing ground at 68th St. and Avenue A. The floor was built by the Central Fireproofing Co., of No. 874 Broadway, New York city, and was of the ordinary construction of 10-in. iron beams set 4 ft. apart, with the spaces filled in with 10-in. cellular blocks of porous terra cotta set endwise. The lower flange of the beam was protected by a 1-in. tile carried by projecting flanges of the adjacent blocks. The construction was identical with that used in the new building of the Corn Exchange Bank, the blocks being part of the lot made for that building. Two sections of the floor were loaded with brick to 150 lbs. per sq. ft. and a fire of cordwood was started at 9 a. m. in the brick room of which the floor formed the roof. In about an hour a temperature of over 2,200° F. was reached. The fire was maintained for six hours when a stream of water of 60 lbs. pressure from a fire engine was thrown into the room and against the underside of the floor. The result of the sudden cooling of the hot terra cotta blocks was to crack the lower portions of some of them, but at no point was there a hole broken through, and the floor continued to support the load of 150 lbs. per sq. ft.

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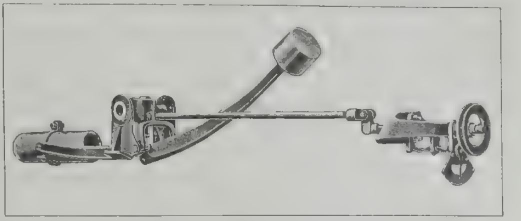
AN AUTOMATIC FEED WATER REGULATOR FOR STEAM BOILERS.

We illustrate herewith an automatic feed-water regulator for steam boilers, which has been placed on the market by Messrs. J. J. Thornycroft & Co., of London, builders of the well-known Thornycroft water tube marine boiler. This regulator entirely avoids the common objection to instruments of this class, viz.: that they have moving parts passing through stuffing-boxes, which are apt to give trouble by their friction whenever the packing is tightened. Its principle is similar to that of the ordinary ball cock used on house cisterns. A float formed of solid drawn steel causes a lever to rise and fall with the water level and so to shut or open a valve placed inside of the boiler, which controls the admission of feed water.

The important novelty in this regulator is the method adopted for enabling the float to be adjusted to stand at a definite height, although the amount of valve opening required to admit sufficient feed water varies with different rates of steaming. This is done by mounting the fulcrum of the float-lever on one arm of a bell crank, the position of which can be adjusted by a rod which passes through a stuffing-box in front of the boiler and which is provided with a screwed end. This rod can be moved to and fro by the screwed hub of a hand or chain wheel. An index to show the rate of working for which the position of fulcrum is adjusted completes the apparatus. Messrs. John Platt & Co., 97 to 103 Cedar St., New York, are agents for the United States.



Automatic Feed-Water Regulator. Manufactured by J. I. Thornycroft & Co., London.

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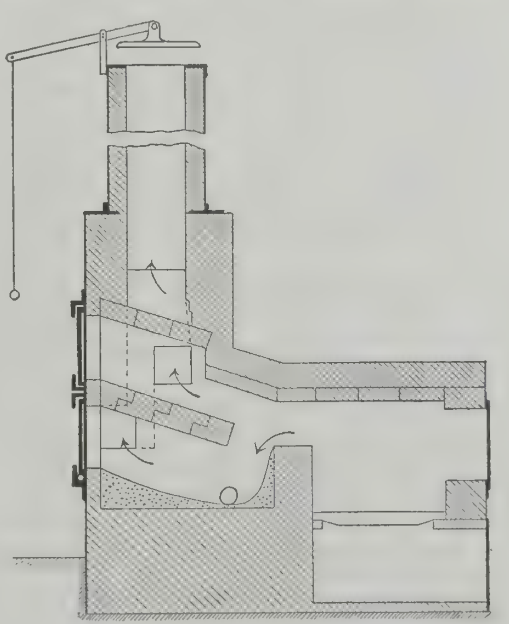
THE GARRETT BRASS-MELTING FURNACE.

We illustrate herewith a style of brass-melting furnace, known as the Garrett furnace, which is being introduced by Messrs. J. W. Bennett & Co., engineers and contractors, 714 Lewis Block, Pittsburgh, Pa. In it crucibles are dispensed with, and at the same time the furnace is quite different from the ordinary reverberatory furnace. The metal is charged in the upper chamber shown in the cut, which is separated from the lower, or bosh, by a sloping fire brick arch. When the metal is heated it is pushed forward on the arch, and when it melts it drops down into the lower chamber out of reach of the oxidizing influence of the melting flame. The bottom of the bosh is lined with ganister, and it slopes toward the tapping hole. The furnace may run continuously, and it is claimed that in continuous use the bottom will last from five to to seven weeks without repair. The upper and lower chambers are each connected with the flue by fire-brick dampers, by which the heat in either chamber may be regulated. If the melted metal in the bosh becomes too cold it may be heated by opening the damper leading from the bosh and causing the flame to traverse through it. A furnace of 600 to 800 lbs. bosh capacity, capable of melting 5,000 to 6,000 lbs. daily, occupies a space of 30 to 40 sq. ft. The loss by oxidation in this furnace is said to be no greater than it is in melting in crucibles.



Section of the Garrett Brass-Melting Furnace.

THE WATER POWER AND ELECTRIC TRANSMISSION PLANT OF THE BIG COTTONWOOD POWER CO.

By W. P. Hardesty, C. E.

(With inset.)

The water power and electrical plant of the Big Cottonwood Power Co. is situated on the creek of the same name in Salt Lake county, Utah. This stream has its source in the high mountains of the Wasatch Range in the eastern part of the county, heading next to the summit and divide between Salt Lake and Summit counties, and after flowing in a general westerly course for about 16 miles it emerges from the mountains onto the broad Salt Lake Valley. The creek is fed at its head by several fine lakes, of which Silver Lake is the largest and farthest down. From here, at an elevation of about 9,000 ft. above sea-level, the fall to the mouth of the canyon is about 4,000 ft. The creek gathers volume from its numerous small tributaries, and by the time it leaves the mountains has attained a size that, for eight months in the year, would justify calling it a river. The great fall of this stream, together with its large and reliable flow of water combine to render it peculiarly fitted for water power purposes.

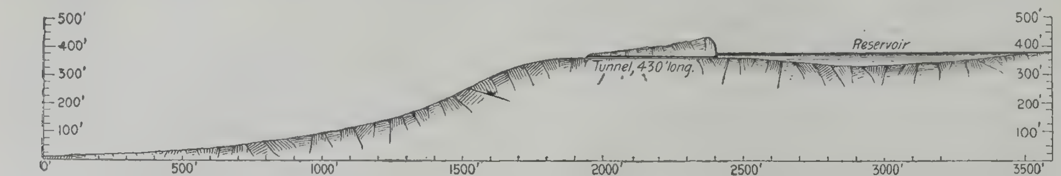


FIG. 7.—PROFILE OF PIPE LINE OF BIG COTTONWOOD POWER PLANT.

The map, shown in Fig. 1, of about nine miles of its lower part, including over one mile entirely out of the canyon, shows the course of the creek. Depending for its supplies for uniform and effective flow entirely on the melting snows or their results, never-failing springs, the stream is quite reliable for the production of water power. About three miles above the mouth of the canyon, begins a steep ascent producing what is known as "The Stairs." Here the rise is 200 ft. in one stretch of a little over ¼ mile, or the "Stairs" proper; nature has done much moreover in rendering this a peculiarly well fitted site for the production of power by having caused the creek to make a wide detour on account of a huge slide from the mountains having at some time pushed it across the canyon at this point, partly gorging it and raising the upper levels, and at the same time leaving a low neck or divide on the slide so as to permit water to be carried directly across it and save following the canyon in its horse-shoe curve.

The great advantages of this portion of the canyon for the production of water power, being only 14 miles from Salt Lake City, were first realized by Mr. R. M. Jones, the engineer and manager of the project about to be described.

In September, 1891, he located and appropriated the waters of this part of the creek for power purposes, and at once went to work on his project. Work was done on a small scale until November, 1893, when the Big Cottonwood Power Co. was organized, since which time the undertaking has been carried forward to completion. This development, called the "Stairs" Division or Plant of the company, consists essentially of a reservoir for storing water, a delivery pipe, so arranged that water can be taken either from the reservoir or the creek itself, leading down to the power house. The map, Fig. 1, shows the location of all parts.

Reservoir.

The minimum flow of the creek at the reservoir during the low water season is 3,400 cu. ft. per minute, and for eight months of the year is 5,000 cu. ft. The theoretical horse-power thus obtainable, with the static head of 380 ft. at the power house, is 2,450 and 3,600 respectively.

On account of the varying amount of power demanded at different hours of the day by the concerns it was intended to supply with power, it was decided to build a storage reservoir with a capacity for 12 to 24 hours supply, thus storing for maximum consumption, during the hours of the day when the consumption of water was the least.

At the location chosen for diverting the water the canyon widens out into a basin. Across the lower or southern portion of this an earth dam was thrown. This dam is 535 ft. long, 92 to 135 ft. wide at the base, 24 ft. at the top, and has a height of 19 to 31 ft. It is curved up the valley in plan to get it onto higher ground. The original creek-bed is near the eastern end. The slopes are 2 to 1 on the upper and 1½ to 1 on the lower side. As no suitable material for puddling could be procured at the site, it is homogeneous throughout. The material is a mixture of sand, clay and gravel, obtained from within the reservoir site. This was well compacted during building, having the advantage also of the rains during the year or more of construction.

The reservoir is oblong in shape, running east and west, and contains an area of 8¼ acres. The depth ranges from 10 to 35 ft.; with an available working depth of 12 ft. With this drawoff depth the reservoir furnishes a supply of 55 cu. ft. per second for 24 hours, independent of the flow of the stream.

At the east end of the dam is an overflow waste-way, 30 ft. wide and 5 ft. below the top of the dam, being cut through the end of a sharp rock ridge. Through this same ridge and just east of the waste-way is a drain tunnel for carrying off the surplus flow of the creek. This tunnel is 180 ft. long and is timbered and planked inside to a section 6½ ft. square. It is through slate and quartzite, and the openings at the ends between the timber and rock are well back-filled with cement concrete.

At the entrance to the tunnel is a penstock for regulating the level of the water in the reservoir. This is 6½ ft. wide in the clear by 26 ft. high and 24 ft. long. The sides are brought up to the same elevation as the waste-way before described, and the front or upper end is provided with two iron gates and with movable flash-boards above them. The sills, posts and caps of the penstock are all 10 × 12-in. timbers; the bottom and sides are of 3 × 16-in. plank, bolted to these. The two cast-iron gates are each 3 × 3 ft., and are moved by screw-stems extending to cross-beams at the top, where they are operated by worm gearing. The gates move in iron guides. The penstock is sunk 7 or 8 ft. into the ground, and is well weighted down by heavy rock piled over the ends of its sills and other special projecting timbers near the bottom. When the reservoir rises above high-water level, the water pours over the sides of the penstock, falling to the bottom to be carried away through the tunnel.

The dam and underground fissures passed considerable seepage water at first, which has been gradually and nearly all shut off by placing additional dirt on the upper side. The water slope has also been rip-rapped with a layer of loose rock.

As the county road up the canyon passed through the reservoir site, it had to be changed to pass around, on the east side and high up the ridge before mentioned. This required much heavy and expensive work. Of the 1,200 ft. of length, 1,040 ft. is hill-side work, called "dugway," and 160 ft. is in a through rock cut, 60 ft. deep in maximum cut and passing through the ridge. The creek is crossed in a new place near the upper end of the new location, by a strong timber bridge on a heavy grade.

Tunnel.

In order to utilize the reservoir site and to take advantage of the "cut-off" across the low divide, already spoken of, to the power house site, it was necessary to tunnel through this divide to draw water from the reservoir. This was accomplished by a tunnel 430 ft. long, driven through the slate and quartzite. This was done by hand-power and by rotary electric drills of Mr. Jones' invention.

The summit of the divide is but 65 ft. above the tunnel. The tunnel section is 7 ft. wide by 7½ ft. high, and timbering was needed for only a short distance at the west or lower end. The grade of the tunnel is 0.2%.

Wooden Stave Pipes.

As it was desired to draw water from the creek as well as the reservoir, a pipe was laid to take water from the creek above the east end of the reservoir and carry it to a common regulating receiver or intake near the lower end of the reservoir.

The receiver of the wood pipe is made from a turbine case built for two different sized wheels, taken from a paper mill. It is 6½ ft. wide by 9½ ft. long and 6 ft. deep, with cast-iron heads and riveted steel sides. The front side was cut away for a diversion of water, being replaced by a screen composed of bars ¼-in. by 1½ ins. deep, ¾-in. mesh, and 48 sq. ft. in size. The intake is set in concrete and cemented at all joints. A cast-iron flange inserted at the back serves for connection with the wood pipe, oakum being used at the junction of ironwork and wood pipe at both ends of the latter. The approach to the intake is paved with shale slabs, and it is set so low that no dam is needed to divert water from the creek into it.

The pipe is laid in the reservoir for most of its length, it being preferable to do this under the conditions than to go around. It is 1,420 ft. long, 50 ins. inside diameter, and is made of Oregon fir staves, banded with steel bands. A circular section consists of 31 staves, each milled from a 2 × 6-in. piece, the thickness reduced to 1 11-16 ins. These are banded every 10 ins. with 9-16-in. round steel bands, upset and threaded at each end instead of one end, as is customary. By this it is claimed that the tightening is made easier and more certain, the drawing up being in a more direct line and with less friction. Cast-iron lugs are used for joining the ends of the bands, being really double lugs. The pipe is anchored down to the bottom of reservoir by loops of the same kind of wire, the end on each side being fastened to a "dead man" buried and weighted with rocks. Part of the pipe is laid on loose rock and part on earth, 100 ft. or more being laid on trestles. The average depth of the water over the pipe is 14 ft.

Receiver and Reservoir Intake.

This structure, being what is called the "valve tower" in most reservoirs, is at the west end of the reservoir. It is 7 ft. 2 ins. diameter, 24 ft. high, of ½-in. steel plates, and was made by altering a digester, also taken from a paper mill. It is set on concrete and is 32 ft. from, and directly opposite, the head of the tunnel. It has three 50-in. openings with flanges for connections to the wood pipe, a steel pipe outlet and the reservoir intake fitting. Over each opening and on the inside of the receiver is placed a simple 50-in. flap valve, moving on hinges and raised and lowered by chains extending to a differential pulley block on top of the receiver. This is suspended from a three-legged angle iron stand surmounted by an iron umbrella for protection against weather. The top and bottom of the digester were of ¾-in. plate and curved, and to level it up on top a floor of cement was put on, encircled by a banded wooden cap.

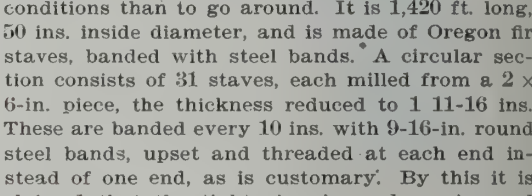


Fig. 8. Cross Section of Reservoir Dam, Big Cottonwood Power Plant.

The reservoir intake, for admitting water directly from the reservoir to the receiver, is enclosed by a heavy wire screen that is expanded to give a much larger area than the opening itself, to insure a full supply of water. The wooden pipe discharges into the receiver and the steel

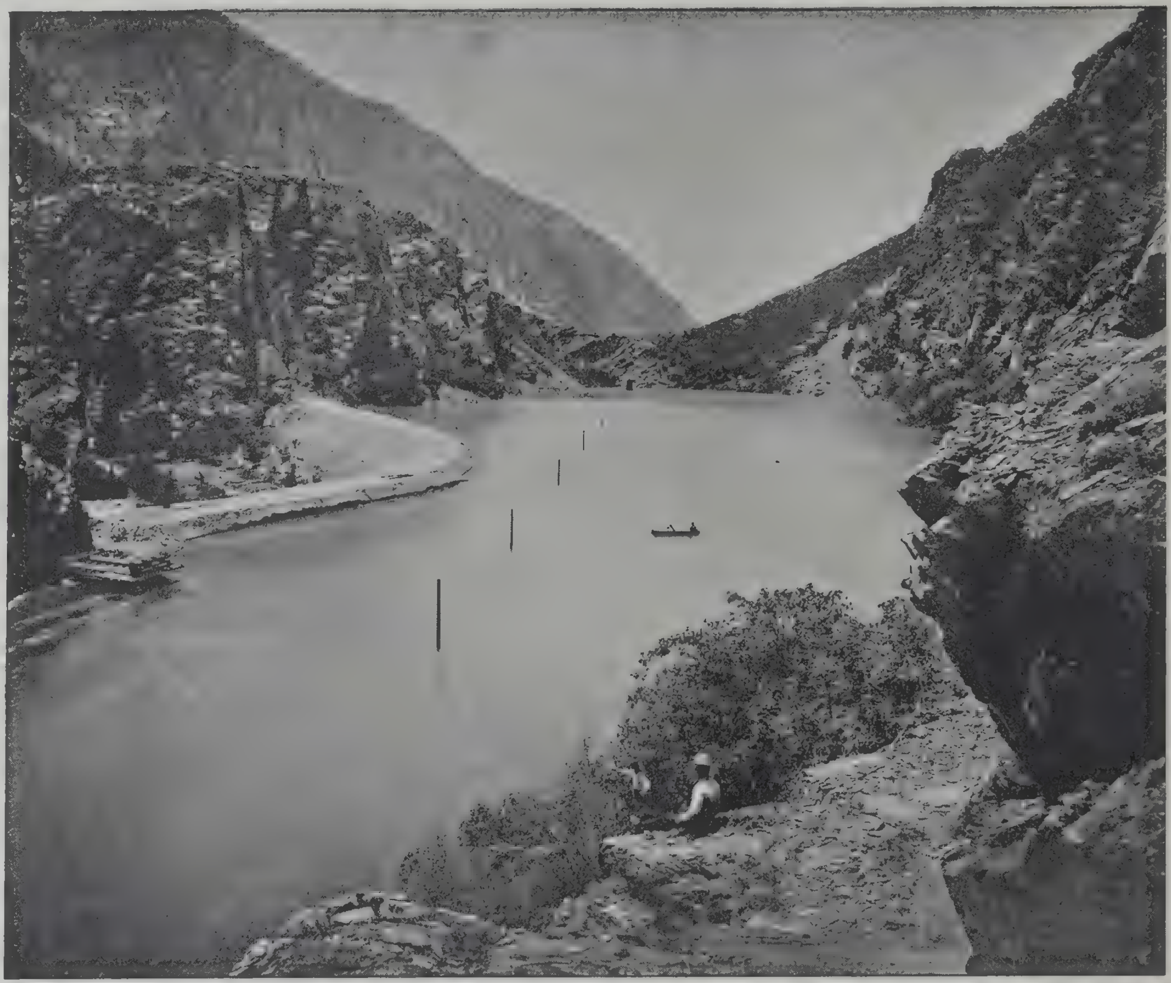


FIG. 2. RESERVOIR FROM NORTHEAST END,
DAM AND ENTRANCE TO DRAIN TUNNEL ON THE LEFT.

FIG. 3.
SHOWING

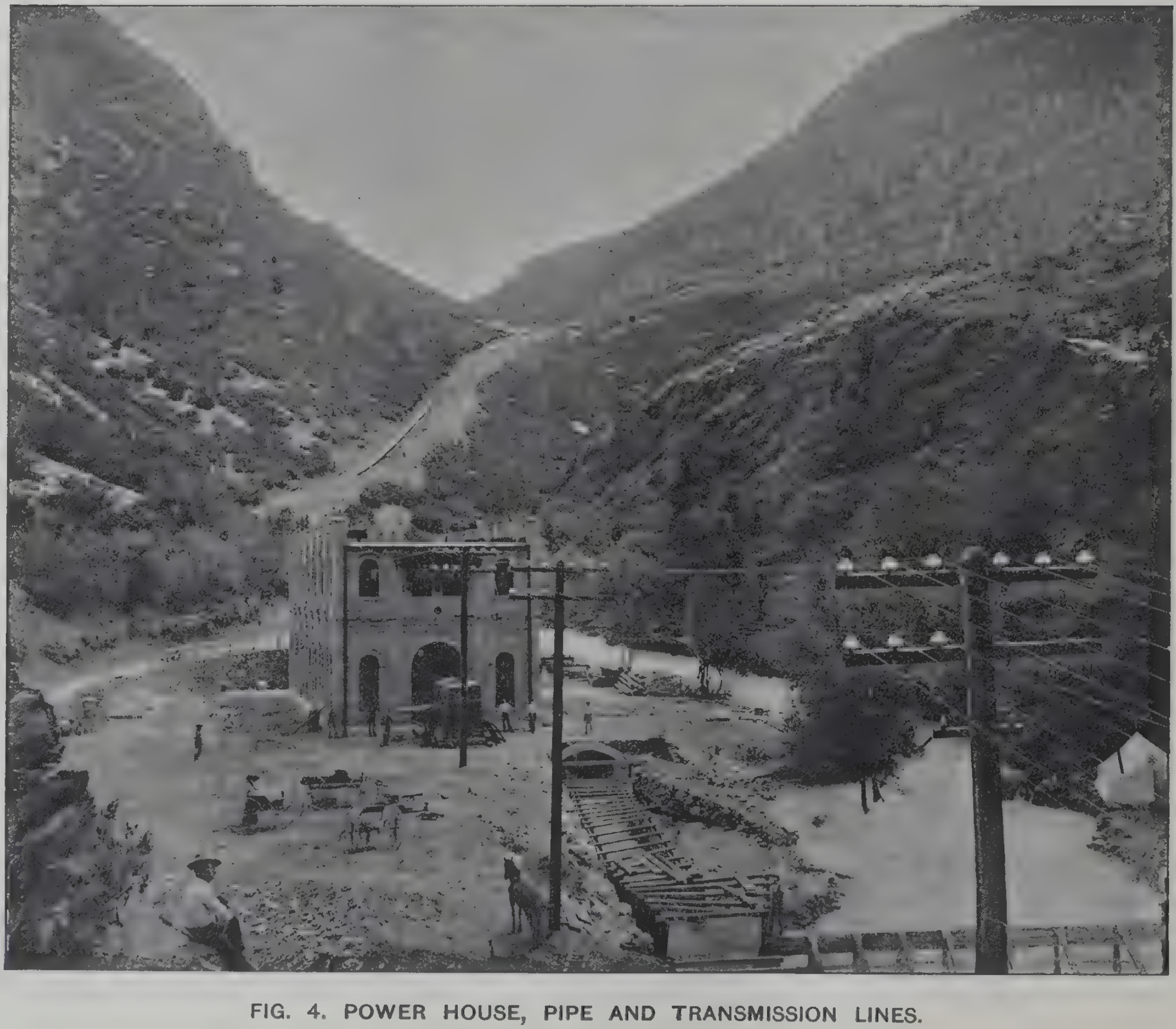
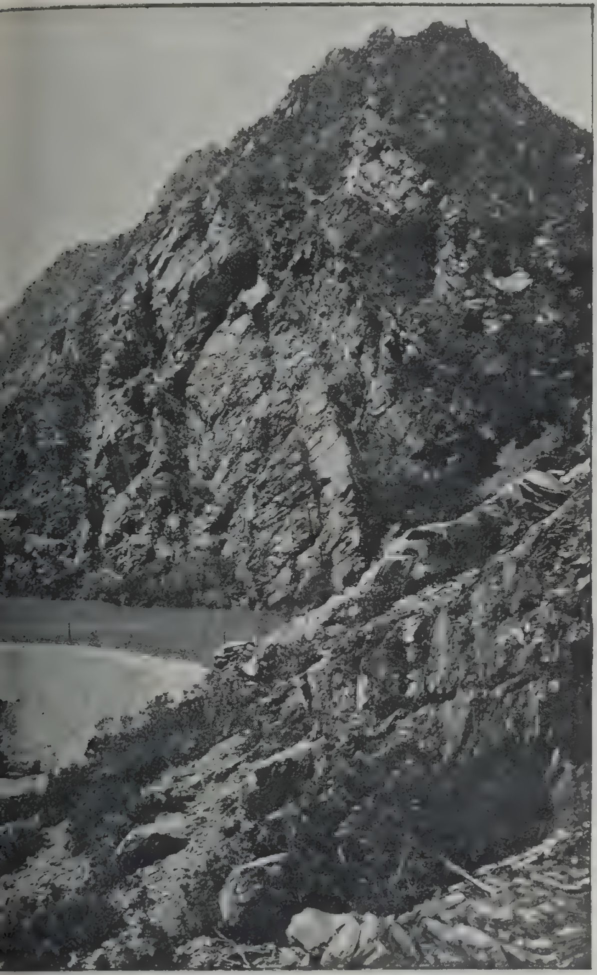
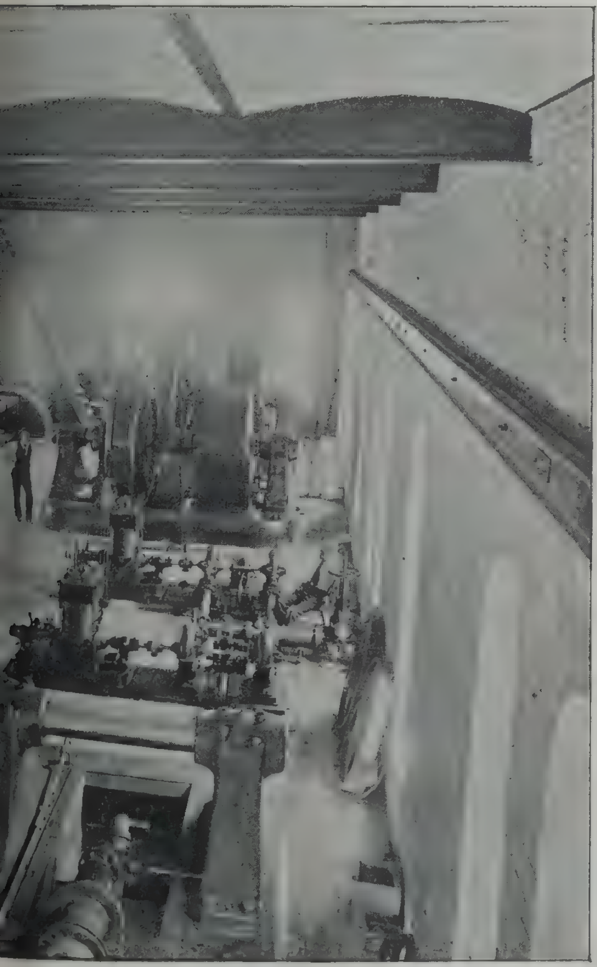


FIG. 4. POWER HOUSE, PIPE AND TRANSMISSION LINES.

FIG. 5. INT



FROM BELOW THE DAM,
VING FROM DRAIN TUNNEL.



WER HOUSE, FIRST FLOOR.

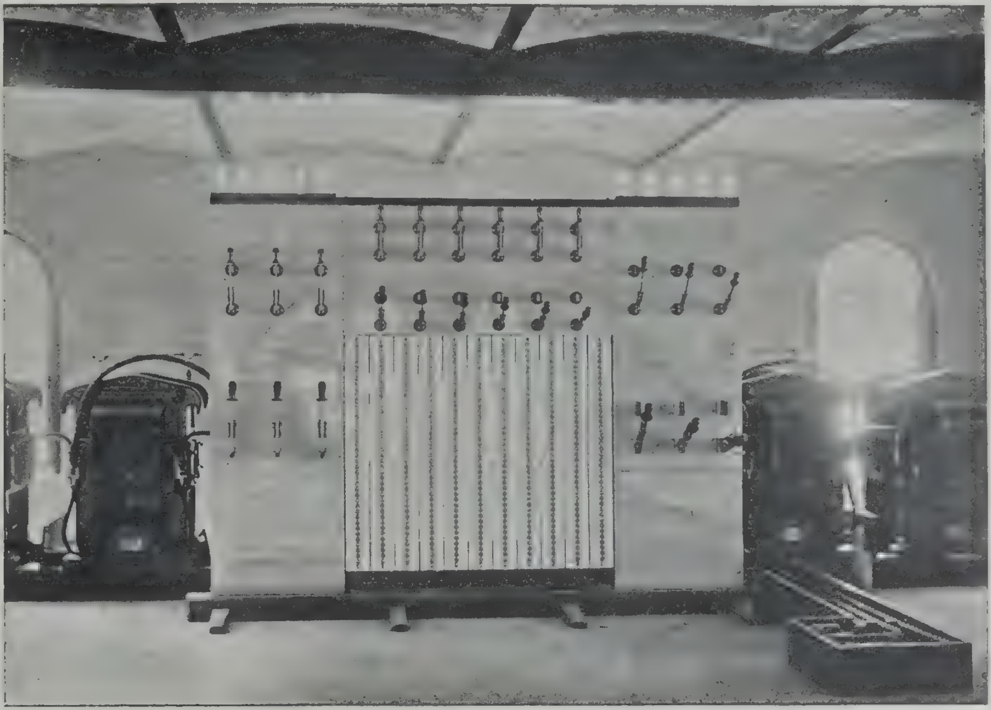


FIG. 6. SWITCHBOARD AND STEP-UP TRANSFORMERS ON SECOND FLOOR OF POWER HOUSE.

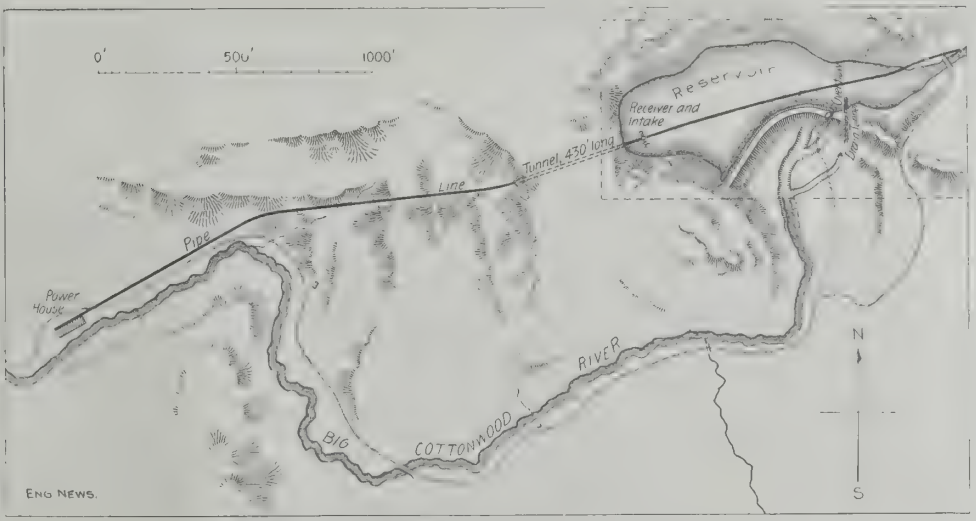


FIG. 1. MAP SHOWING LOCATION OF RESERVOIR, BIG COTTONWOOD CREEK, PIPE LINE AND POWER HOUSE.

WATER POWER AND
ELECTRIC PLANT OF THE
BIG COTTONWOOD POWER CO.,
SALT LAKE CITY, UTAH.

R. M. Jones, Engineer.

pipe draws from it and leads to the power house. The three openings are 12 ft. below high water.

Steel Pipe.

The steel pipe passes through the tunnel and thence down the west slope of the mountain and valley to the power house.

There are 2,300 ft. of the following description:

Length.	Diameter.	Thickness.	Head.
636 ft.	50 ins.	¼-in.	12 to 75 ft.
224 "	50 "	5-16-in.	75 " 150 "
224 "	49 "	⅜-in.	150 " 225 "
224 "	49 "	7-16-in.	225 " 300 "
992 "	49 "	½-in.	300 " 380 "

An ordinary section of pipe is 32 ft. long, being made up complete from four 8-ft. sections before shipment. The pipe is double-riveted, with flange connections and copper gaskets, each of the joints of the 71 sections being made up with 52 × 1¼-in. steel bolts. Each of these gaskets was made by taking No. 4 soft-drawn copper wire and wrapping it in a single layer of five complete turns in the joint between flanges. This was done by winding around a wood template placed on one flange, the wire being then soldered to the flange at intervals and the template removed. The flanges were then brought as closely together as possible with 4-ft. wrenches applied to the bolts, after which the joint was gone around with driving bar and set hammer and "flogged" to flatten the wire still more, this process alternating with tightening of the bolts two or three times till the wire was nearly flat and the joint perfectly water-tight. The gaskets thus made cost about 80 cts. each, while $2.50 to $3 would have been the cost of any of the ordinary gaskets on the market.

Thirty flange connections are on angles, with beveled joints, used on the curves, one horizontal and one vertical, each with a radius of 293 ft., and one compounded of a horizontal and vertical curve, giving a radius of 414 ft., and thereby also providing for expansion. The pipe is covered where deemed necessary, and on its steepest grades has inclined stay-braces of wood, abutting against the flanges and resting against timbers buried in the ground, to prevent its moving down hill. Thirty-two feet at the head of the pipe is submerged in the reservoir, thence the tunnel is entered, the pipe being passed through a concrete bulkhead, well cemented at the joints and placed about 15 ft. within the portals. A footwalk reaches from the cliff above the tunnel entrance to the intake receiver, being supported by four 2½-in. iron pipe columns set on flanges on the steel pipe below, and used both as columns for the bridge and for air valves for the pipe. Just outside the west end of the tunnel another air-pipe rises from the steel pipe. This is 4 ins. diameter, rises 18 ft. high or above high-water in the reservoir, and is open at the top like the others.

Power House.

The power house is located on the north side of the creek, some distance below the "Stairs" and the horse-shoe curve in the creek. The outside dimensions are 34 × 100 ft.; it has two stories, the first 21 ft. in height and the second 11 to 13 ft. in height.

The foundations are of concrete, with a 10 ft. bed under the machines and 2 ft. under the rest of the floor of the house, with cement coverings. The walls are of brick, the framework of steel, the second floor of brick arches and the roof of concrete, both built on I-beams. The structure is absolutely fireproof in every part, and is very substantial. The roof covering is of asphalt and gravel.

Upon the first floor are the water-wheels, the generating aparatus and the switchboards. The second floor has the step-up transformers with their regulating boards or panels, and also living rooms for the employees.

On the south side of the building is the tail-race, a pit built with very heavy concrete walls and bottom. It is 100 ft. long, 7½ ft. wide, 6 ft. deep at the upper end and 9 ft. deep at lower end.

The "header" or receiver is erected in this, being supported by cast-iron columns with large footings resting on the bottom of the pit. This receiver is 100 ft. long, 50 ins. in diameter, and is of ½-in. riveted steel plates, and cast-iron plates with radial braces at the ends. The discharge water passes along the pit, under the receiver, and thence can be discharged back into the creek.

Inside the building is a traveling crane with ten tons capacity, covering the entire area of the first floor of the house.

Water Power Machinery.

This consists of four special double-nozzle Pelton water-wheels, each is 61 ins. in diameter, and will develop 700 HP. with the effective head of 370 ft. obtained. Each wheel is keyed directly on the armature shaft of its generator. Water is supplied to each wheel through a 20-in. pipe tapping the receiver on one side and running horizontally through the wall, then making two 90° curves, one vertically to bring the water up above the floor, and one horizontally to turn the pipe into line with its wheel, lengthwise of the building. The curves have a 4½-ft. radius and are reduced to 16 ins. inside diameter.

Each wheel and its generator rest on one solid base-frame. Each nozzle is 3½ ins. diameter, the straight nozzles are each provided with a gate valve, and each lower nozzle is equipped with a hood regulator, to secure good regulation and economy in water consumption. The wheels run at 300 revolutions per minute, and each carries 20 buckets.

A cast-iron housing is placed over each wheel and the discharge water falls below and passes out through openings in the foundation wall to the tail race. As part of the hydraulic machinery, there is also a regulating equipment for each of the four generators. There are also all pipe connections, valves, gages and other appliances needed for regulation.

Electrical Generators and Equipment.

There are four three-phase generators with 24 poles, each having a capacity of 500 K-W. They generate a 500-volt current with a frequency of 60 cycles per second. Each has three armature bearings, having an extended shaft, and is on the same base-plate as its water-wheel.

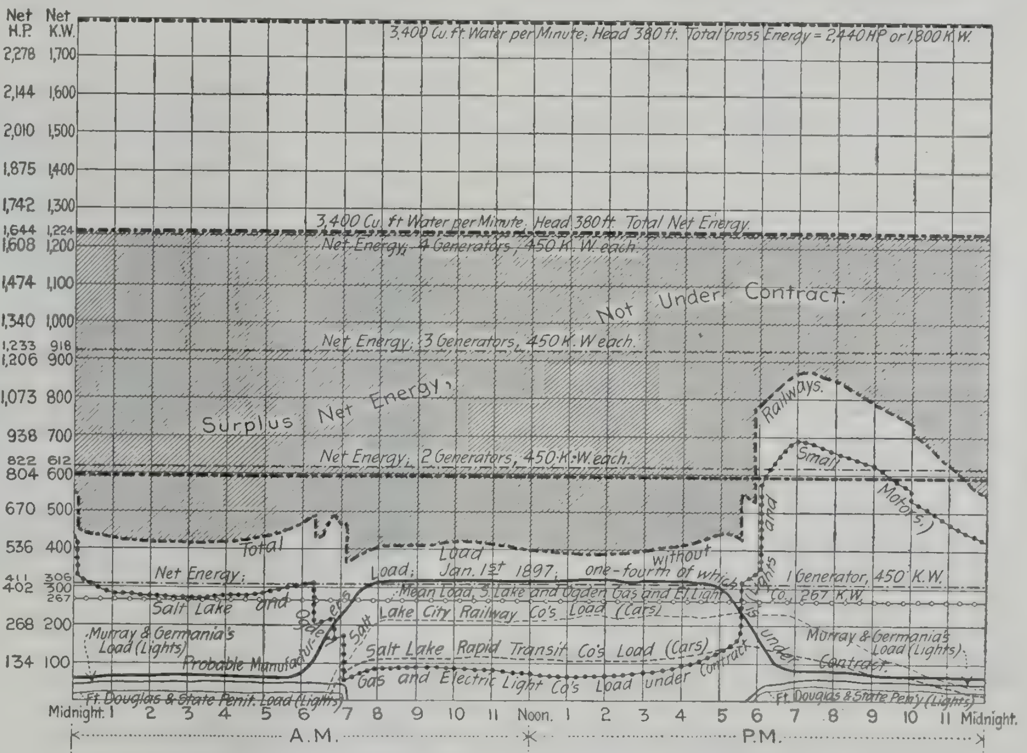


FIG. 9.—DIAGRAM SHOWING AVAILABLE ENERGY, AT "THE STAIRS," OF THE BIG COTTONWOOD POWER CO. AND THAT UNDER CONTRACT AND ESTIMATED FOR, JUNE 1, 1896.

There are two 25 K-W. independent exciting generators, of the Edison bi-polar type. Each generator has capacity sufficient to excite the fields of all the alternators, and is driven from two 13-in. Pelton wheels, direct connected with the armature, and run at a speed of 1,300 revs. Generators and motors are set upon one cast bed plate. On the north side of the machinery room is erected the five-panel station switchboard, with complete controlling and indicating apparatus. There is also a tachometer driven by a synchronous motor.

Up-stairs are six 265-K-W. air-blast transformers, raising the voltage from 550 to 10,500. There is a Sturtevant exhaust fan for cooling the transformers, driven by a 5-HP. induction motor. Over 4,000 lbs. of soft rolled polished copper bars were used in the wiring of the station.

Transmission Line.

As this development of power was made with the primary object of transmitting electrical energy to Salt Lake City, the transmission line is made as direct as the country will allow, it being intended to run branch lines to such places as may demand it.

After leaving the canyon the line runs in a general north by northwest direction, and the total length to the distributing station, on South 3d and State Sts., in the city, is 14 miles.

The poles are of Idaho cedar, and are 40 ft. long and 9 ins. in diameter at the top. Some special ones are 50 and 60 ft. long and 10 ins. in diameter at the top. The poles are placed at an average distance of 120 ft. apart. Each has two cross-arms of spruce, each 4 × 6 ins. by 9 ft. These are fastened with lag bolts and braced on each side. There are six special pattern, double-petticoat, porcelain insulators to each brace, each tested to 40,000 volts. The line conductors consist of 12 wires, four circuits of three wires each. All of the circuits are of No. 2 B. & S. gage soft-drawn, bare copper wire and the total length of the wires amounts to 168 miles.

A telephone line is strung below the transmission wires, mounted on a short cross-arm to each pole. The telephone circuit consists of two No. 12 hard-drawn copper wires transposed between each two consecutive poles for its entire length. A total of 224,000 lbs. of wire was purchased by the company for its various uses.

The chief user of the electrical current furnished at the present time is the Salt Lake & Ogden Gas & Electric Light Co., which is the older and larger light company in Salt Lake City. By a contract to run ten years, from Jan. 1, 1896, the electric light company is supplied with all the current it can use and dispose of for light and power, its right to supply other parties, however, being limited to units of 10 HP. and under, for any one motor, except for elevators, where there is no limit. By the contract the current is bought at 2,200 volts at the sub-station at a stipulated price per K-W. hour, and 2,000,000 units annually is stipulated to be the minimum limit of consumption.

About 3,000,000 units per annum has been the production of the light company by use of coal. The distributing station or sub-station is owned by the light company, which rents it to the power company at a nominal figure. In it are nine 160

K-W. air-blast step-down transformers, reducing the voltage from 10,500 to 2,200, at which it is measured to the light company. There is also a three-panel switchboard, with regulating and other apparatus. A 24-panel Ball lightning arrester is also placed here. The following efficiencies of the different parts of the entire system are claimed by the builders of the machinery:

Water-wheels	80%
Generators	94%
Step-up transformers	97½%
Line transmission	95%
Step-down transformers	97½%

This indicates that a net energy of 68% of the theoretical horse-power at the power house will be delivered at Salt Lake City as electric current.

The load has not yet reached a limit which enables an accurate measurement, but it is thought that all the machines will fulfill the claims of the manufacturers; some tests have shown the efficiency of the Pelton wheels to be 85%. The plant has been in operation since June 2, 1896.

The power company also has the contract, to begin one year from June 15, 1896, for street lighting in Salt Lake City, furnishing 276 arc lights at $102 per light, moon-light schedule. It reserves the right, in its contract with the light company, to supply power to motors in units of over 10 HP., and also has the right to reach such users of large power by wires erected on the light company's poles anywhere within the city limits.

It has already closed contracts with two or three other small users of power. The prospective users with whom no contracts have yet been made, consume at present over 2,000 HP. by use of steam. These include various factories, smelters, etc., in the city and at Sandy and Murray, south of it. For those in constant operation day and night, the power costs at present $90 to $145 per HP. per year. Most of the rest are manufactories, running 8 to 10 hours daily, except Sunday, at a cost of $35 to $75 per HP. per year.

It is stated that by the sale of 2,000 or more HP. to these parties the present income of the power company will be increased to $150,000 or more per annum. It is also figured that the earning capacity of the plant will be $200,000 if the current can be marketed so as to allow the maximum load that can be carried to be used.

A branch line is now nearly completed, called the Murray line. This leaves the main line about midway of its length and extends west on 16th South St. (outside the Salt Lake City limits) to State St., a distance of 3½ miles. Here is located a sub-station, a small brick building containing three 160 K-W. air-blast transformers, wound at a ratio of 10 to 1, and giving a secondary production of 2,200 volts.

From here a line is to be extended north two miles to the "Husler Mill," a 150-bbl. flouring mill. Power will be supplied here through a 30-HP. 220-volt induction motor. From the sub-station is being run a heavy secondary or 2,200-volt line to the village of Murray, one mile to the south. This town will be lighted by the electric current.

Several large smelters and similar works are located here and expect to use the current for lighting, and also for power when the necessary changes can be made. The sub-station at Murray has a capacity for handling 500 K-W. The smelters are run day and night the year around.

The Murray line has one circuit of three wires, the poles being of the same size as for the main line.

Cost, Income, Etc.

The construction cost of the completed system has been $325,100, distributed as follows:

Dam, reservoir and all appurtenances and head works, and 430-ft. tunnel	$56,350
Wooden stave pipe, constructed	8,540
Wooden stave pipe intake	400
Reservoir intake	1,760
Steel pipe and connections	41,250
Power house, foundations and tail-race	14,800
Travelling crane	1,400
Water wheels, pipe connections and regulators	13,175
Electrical machinery and equipment	96,200
Transmission line to Salt Lake City	58,100
Engineering superintendence, office expense, etc.	35,125
Total	$325,100

The annual operating expenses of the system when working at full capacity, including expenses of office, management and taxes, is put at $18,000, which, from the detailed figures it is based on, seems a liberal allowance.

The company has a 25-year franchise for the transmission and distribution of electrical energy from Big Cottonwood canyon to all places in Salt Lake county, and one for the same time for distributing light and power through all the streets and public places of Salt Lake City.

The following figures show the cost of the installation per HP. on different assumptions:

1. Actual cost of construction $325,100
   Actual minimum water power, 2,400 HP., or $135.50 per HP.
2. Construction cost as before 325,100
   Actual station capacity and usual power, 3,000 HP., or $108.25 per HP.
3. Net value the "Stairs" division 400,100
   Usual available power, 3,000 HP., or $133.60 per HP.

The net value is obtained by adding $75,000 to the construction cost, being $25 per HP. for water-right.

All work on the construction of this plant was by day labor, and no expense was spared to make all parts the most secure and substantial possible.

The steel pipe was furnished by Fraser & Chalmers, of Chicago; the wood pipe was built by the power company itself; the water wheels were furnished by the Pelton Water-Wheel Co., of New York and San Francisco; the wire by the John A. Roebling Sons Co., of Trenton, N. J.; the electrical generators and all equipments by the General Electric Co., and the regulating apparatus and local machine and foundry work by Silver Bros., of Salt Lake City. All parts of the system have worked very smoothly. It was stated that a few days after starting up, the greatest flood in 35 years poured through the canyon, with no damage whatever to any of the works.

Besides the completed "Stairs" division, the company has two other water power rights on the same creek, which it proposes to develop as follows:

I. Granite Mills Division.—This division begins nearly one mile within the canyon and extends to the mouth. It is principally based on the water rights and property once belonging to the Granite Paper Mills Co. This company had a paper mill at the mouth of the canyon, with water power machinery. The power development consisted of an open ditch with 8-ft. bottom and 5-ft. depth, leading water from the creek for 3,300 ft. along the hill-side or north side of the canyon. Here the supply to the mill consisted of a flume 8 × 4½ × 130 ft., leading out from the hill to a penstock 8 × 8 × 24 ft., from the bottom of which a single-riveted steel pipe of 48 to 38 ins. diameter and 460 ft. long led down to a Leffel 26½-in. horizontal turbine in the mill, giving a working head of 132 ft.

The mill burned down in 1892, leaving the walls standing, and the entire property has since come into possession of the water power company. Five brick dwelling houses and 200 acres of patented land, with irrigation water rights, are also included, the improvements all being situated thereon. A side-hill grade for wood pipe had been started, tapping the creek 1,200 ft. higher up. By carrying water to the contemplated station site, 1,000 ft. below the old mill, a static head of 357 ft. will be obtained, giving, with minimum supply from the creek of 3,400 cu. ft. per min., 2,300 HP.

II. Mill "B" and Mineral Forks Division.—This division begins at the head of the "Stairs" division and extends up the creek for a distance of over 2½ miles, with a fall of nearly 900 ft. The improvements consist of an old saw-mill and its intervening water rights and some 2,800 lin. ft. of side-hill grade for new construction.

The "Stairs" development and installation of water power, according to modern methods, was the pioneer of such projects in Utah, and the example set thereby has largely stimulated interest and called attention to other possibilities. The many streams draining the west slope of the Wasatch Range afford some ideal advantages for the production of water power, which have been fully realized and grasped by other projectors.

The officers of the Big Cottonwood Power Co. are: Col. J. W. Donnellan, President; W. H. Rowe, Vice-President; Geo. M. Cannon, Secretary; R. M. Jones, Engineer and Manager; J. W. Sumnerhayes, Member Executive Committee, all of whom have worked in unison to carry the construction to successful completion. The engineering work in all departments was done by Mr. R. M. Jones.

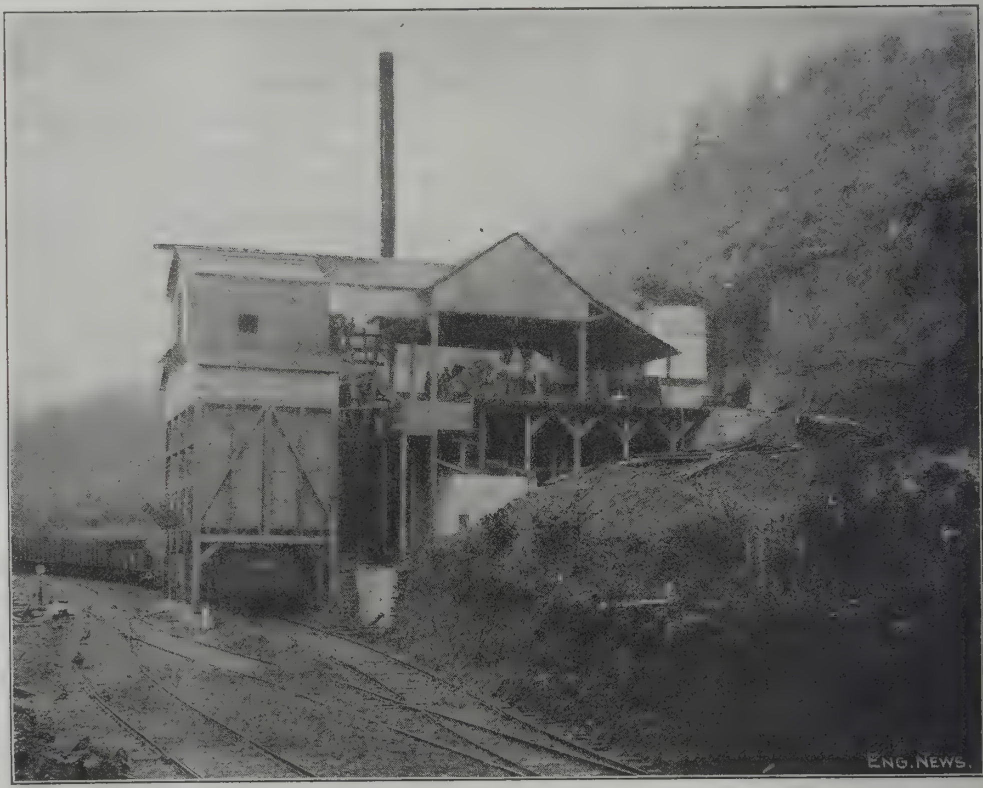


FIG. 1.—ROCK CRUSHING PLANT OF THE NEW ENGLAND TRAP ROCK CO., WESTFIELD, MASS.

A MODERN STONE-CRUSHING PLANT.

A very large stone crushing plant has recently been erected by the New England Trap Rock Co., at its quarries near Westfield, Mass., on the line of the New York, New Haven & Hartford R. R. The plant (Fig. 1) is situated on a level with the quarry, which is not more than 100 ft. distant. running along the side of the mountain. The rock is excavated by means of drills and dynamite and is broken up and loaded into end dump cars. These deliver it to the crushers, of which there are three, all of them of the "Farrel" (Blake pattern), 36 × 18 ins., set on substantial concrete foundations (Fig. 2). The total weight of each crusher is about 50,000 lbs. The capacity of each varies from 300 to 800 tons in ten hours, according to the size to which the pieces are broken, The driving pulleys are run at about 275 revs. per minute and about 40 HP. is required to operate each crusher. The crushed rock as it leaves the machine slides down a chute directly into steel elevator buckets which carry it up and discharge it into two 48-in. steel sizing screens. Each of these screens is about 18 ft. long and is composed of three sections, each with different perforations, which sort the broken stone into three separate bins. The screens are inclined ¾-in. to the foot. Pieces which are too large to pass any section of the screen are returned by a conveyor to the crushers. Doors similar to those used in coaling chutes permit the crushed stone to be drawn off either from the side or from the bottom of the bins. The crushers and all other machinery are driven by a 20 × 24-in. horizontal engine, especially designed for this work. The engine is coupled direct to a jack shaft to which the crushers are connected by leather belts. Steam is supplied by horizontal tubular boilers, which also supply steam to the drills in the quarry. The entire work has been done in the very best manner throughout, with the intention of making it a first-class plant in every respect. The plant has a capacity of 1,000 tons per day and cost complete about $25,000.

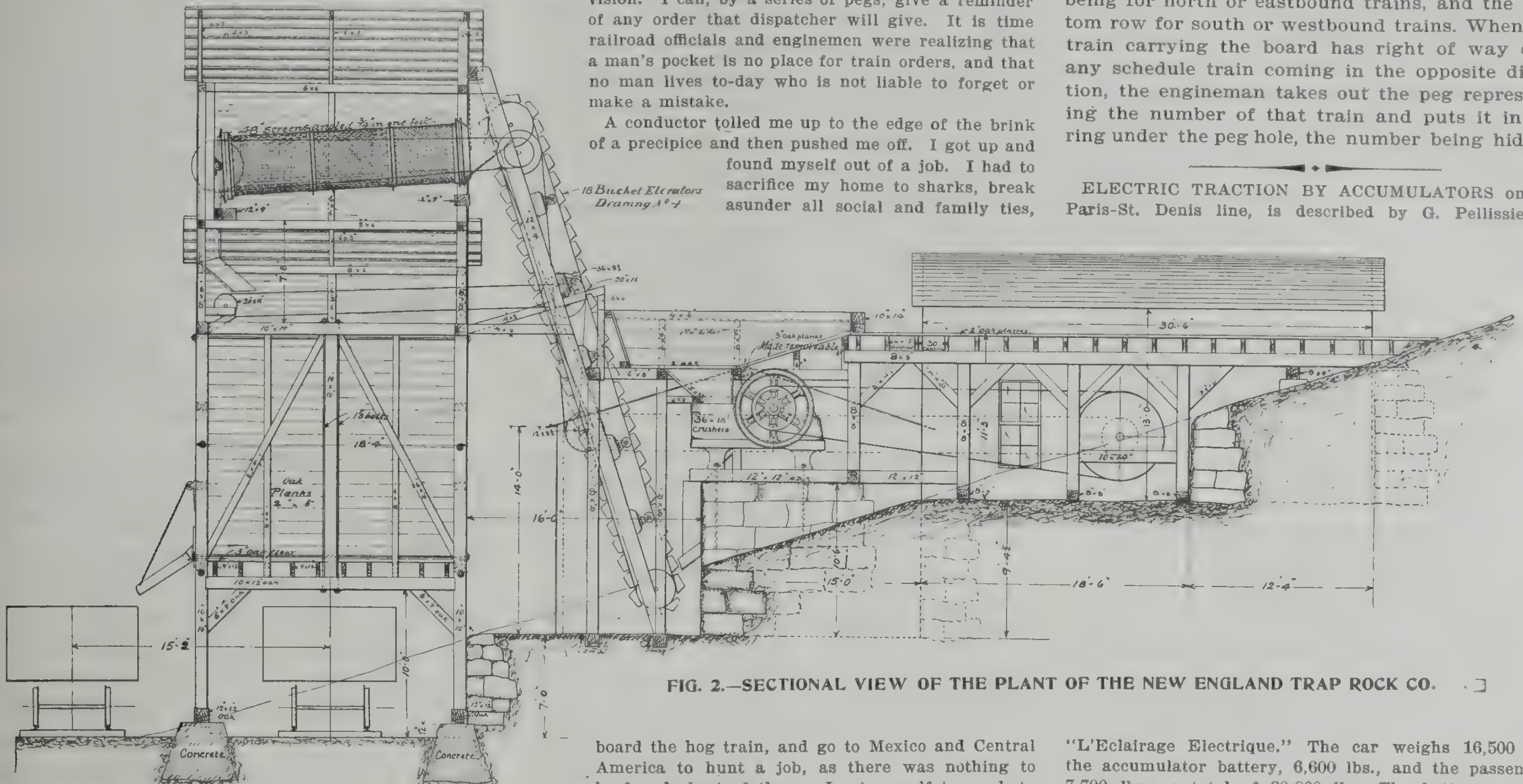


FIG. 2.—SECTIONAL VIEW OF THE PLANT OF THE NEW ENGLAND TRAP ROCK CO.

The officers of the New England Trap Rock Co. are: President, N. A. Harwood, Chester, Mass.; Treasurer, E. A. Carter, Springfield, Mass.; Manager, J. A. Talmadge, Westfield, Mass.

The entire plant, including the engine, crushers, bins, etc., was designed and erected for the New England Trap Rock Co. by Mr. Earle C. Bacon, M. Am. Soc. M. E., Havemeyer Building, New York city. We are indebted to Mr. Bacon for the matter from which this article and our illustrations are prepared.

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TRAIN ORDER BOARD FOR LOCOMOTIVE CABS.

The forgetting of train orders by the engineman has always been a fruitful source of railway collisions, and though steps have been taken to check this by impressing the order upon the man's mind by directing him to read it aloud to his fireman, forgetfulness is still a too frequent cause of accidents. On some roads the train order is placed in a frame in the cab, where the men can see it, but a still better plan is a graphic reminder in the shape of a train order board, with pegs marking the meeting points or stations. This device is shown in the accompanying cut, reproduced from a photograph sent us by the inventor, Mr. A. W. Jennings, of McComb, Miss., who describes it as follows in a letter to "Locomotive Engineering:"

> I send you photographs of a device which I have been granted a patent on. One is an order file for the use of locomotive engineers; the other a board containing the names, in cast aluminum letters, of all stations on the division. I can, by a series of pegs, give a reminder of any order that dispatcher will give. It is time railroad officials and enginemen were realizing that a man's pocket is no place for train orders, and that no man lives to-day who is not liable to forget or make a mistake.
>
> A conductor tolled me up to the edge of the brink of a precipice and then pushed me off. I got up and found myself out of a job. I had to sacrifice my home to sharks, break asunder all social and family ties, board the hog train, and go to Mexico and Central America to hunt a job, as there was nothing to be found short of there. I set myself to work to remedy the evil before I started, and give those I left behind with a job some protection against losing it.
>
> On the board I use red peg to denote meeting point between two extras—the numbers of regular trains opposite the station where they are to meet. A white peg for the terminus of an extra. A peg with red cross on black background for wait order. The two rows of numbers at bottom of board are schedule trains. The numbers of trains having right of track over train carrying board only will be left in sight.

A Train Order Board for Locomotive Cabs.

In a letter to us respecting this device, Mr. Jennings says that his file is 8 × 12 ins., and his order board is 6 × 18 ins., and costs about $3. The train carrying the board shown has orders to meet train No. 55 at Beauregard, therefore the peg is stuck opposite the name of this station or meeting point. The two bottom rows of pegs represent the schedule trains on the division, the top row being for north or eastbound trains, and the bottom row for south or westbound trains. When the train carrying the board has right of way over any schedule train coming in the opposite direction, the engineman takes out the peg representing the number of that train and puts it in the ring under the peg hole, the number being hidden.

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ELECTRIC TRACTION BY ACCUMULATORS on the Paris-St. Denis line, is described by G. Pellissier in "L'Eclairage Electrique." The car weighs 16,500 lbs.; the accumulator battery, 6,600 lbs., and the passengers, 7,700 lbs.; a total of 30,800 lbs. The battery contains 108 cells of 11 plates each, arranged in 12 wooden boxes, 6 on each side of the car. These boxes can be withdrawn and replaced by charged boxes in 6 minutes. When fully charged the car can run 37 miles on the Broca type of rail, and twice that distance on a T-rail. The cost per car-mile of operating the car is set down at 14.48 cts., as compared with 9.24 cts. per car-mile for overhead electric traction in Paris. This cost is divided as follows: Handling accumulators, 1.84 cts.; maintenance of same, 3.08 cts.; maintenance of motors and trucks, 1.56 cts.; motive power, 5.54 cts.; wages and superintendence, 2.46 cts. With a new accumulator system lately tried the cost is stated to be only 10.46 cts. per car-mile.

◆

A GAS EXPOSITION, the first of the kind in this country, is to be held in Madison Square Garden, New York, beginning Jan. 25, 1897, under the auspices of the Gas Industries Company. The full program has not yet been published but the list of officers and directors of the managing company include many well-known men whose names should be a guarantee of success. Among these men are Hon. Calvin S. Brice, New York; Gen. Asa A. Bushnell, of Ohio; Thomas Dolan, of Philadelphia; Gen. James H. Jourdan, of Brooklyn; Dr. Henry Morton, of the Stevens Institute; Prof. T. C. Mendenhall, late Superintendent U. S. Coast Survey; Thomas F. Rowland, Brooklyn; Frank Tilford, New York; and Walter Wood, of Philadelphia. Space is to be allotted to intending exhibitors on Oct. 15.

◆

THE PHILADELPHIA & READING R. R. was sold at auction at Philadelphia, Pa., Sept. 23, and was bid in by Mr. C. H. Coster, representing J. P. Morgan & Co., for $4,500,000, this including the property of the railway company and the coal and iron company. Notice was given on behalf of the city of Philadelphia that the contract entered into between the city and the railway for the construction of a subway would have to be carried out under the new order of things, and that the city of Philadelphia, as trustee under the will of Stephen Girard, would not consent to the immediate transfer of the coal lands which have been leased to the railway company. Under the reorganization the annual charges will be lessened $717,900. The present fixed charges of the railway and coal and iron companies aggregate $10,035,073, and under the reorganization they will be $9,317,173.

◆

THROUGH TRAINS TO TREMONT over the New York elevated railways have now been put in service, the trains running from the Battery to 177th St. Formerly the trains only ran to the Harlem River and passengers had to change cars, while now the trains run through and only a single fare of 5 cts. is charged for the run of 12½ miles.

WHITEHEAD TORPEDOES are being made by the E. W. Bliss Co., of Brooklyn, and the first five will be ready for testing on Nov. 1. In all 100 18-in. twin-screw torpedoes were contracted for, the price being $315,000. These torpedoes are 18 ft. long and carry 250 lbs. of dynamite. The motive power is compressed air stored within the shell and the extreme range is one mile. The Bliss Company has already made 250 torpedoes for the government.

A 12-IN. BROWN SEGMENTAL WIRE-WOUND GUN is recommended by the Ordnance and Fortification Board and an appropriation of $33,000 is made from the experimental fund for this purpose. A gun of this type was tested two years ago and 200 rounds were fired from it at remarkably high pressures without developing any weak points. The Board believes that this test warrants further experiments with a larger caliber and make their recommendations with the approval of Secretary of War Lamont. This gun was fully described in our issue of Nov. 24, 1892.

A HUGE CAST-STEEL PROPELLER, said to be the largest ever made in this country, was recently cast at Chester, Pa., for the new iron steamship "John Englis." It measures 16 ft. diameter from tip to tip of blade, and the hub is 26 ins. diameter. The thickness of the metal at the hub is 6 ins. The casting weighed 15,000 lbs. The steamship "John Englis" is 312 ft. long, 46 ft. beam, with a gross tonnage of 4,000 tons, and is intended to run between New York and Portland, Me. The engines are triple-expansion, of 4,000 HP. and they will drive the propeller at 90 revolutions per minute.

THE FIRST HEAT OF BESSEMER STEEL in the new works of the Troy Steel Co., on Breaker Island, near Troy, N. Y., was made on Sept. 15.

A TOREDO-PROOF PAINT, invented by Thos. J. Childerson, of Pensacola, Fla., has been tested by a naval commission. In March last four pieces of solid heart pine wood were sunk at the navy yard there. One piece was unpainted and the others had one, two and three coats of the paint respectively. The pieces were raised and examined lately. The unpainted piece was honeycombed by the toredo and fell to pieces. The other three were not touched by the insects and were perfectly dry in the interior. The commission reported the paint as a success. We take the above from Washington press dispatches. It is certainly important if true.

THE BOSTON PNEUMATIC TRANSIT CO. has received permission from the aldermen of that city to lay and operate a series of underground conduits for the transmission of mail matter, messages, packages and other articles. A similar order of the board was vetoed last year by Mayor Curtis, and a bill was later passed by the legislature removing the legal obstructions to its passage by the board of aldermen. The mayor now has ten days in which to consider whether he shall approve or veto the franchise.

RESOLUTIONS GRANTING ELECTRIC LIGHT, telephone and subway franchises have been vetoed by Mayor McGuire, of Syracuse, N. Y. The grantees are said to be practically identical in each case. The principal ground for the veto was that the franchises provide for no compensation to the city.

A STONE CRUSHER DRIVEN BY AN ELECTRIC motor is in successful operation at Peterboro, Canada, the current being furnished from the station of the Peterboro Light & Power Co., a mile distant. The motor is of 65 HP. capacity, and it runs the crusher readily when the latter is jammed full of the hardest stones obtainable.

THE WATER-POWER PLANT AT OGDEN, UTAH, of the Pioneer Electric Power Co. was described in detail in our issue of Nov. 8, 1894, by our special contributor, Mr. W. P. Hardesty, C. E. This extensive enterprise involves the development of about 10,000 HP. and the transmission by electricity of a considerable portion at a potential of 15,000 volts to Salt Lake City, a distance of 36 miles. The work has now proceeded so far that the company has awarded the contract to the General Electric Co. for the electrical machinery. The reservoir, dam and pipe line were described in our former article. In the power-house will be placed five Knight water-wheels made by the Risdon Iron & Locomotive Works, of San Francisco, running at 300 revolutions per minute and controlled by Knight automatic governors. Upon each water-wheel shaft will be mounted a 24-pole, three-phase generator wound for 2,300 volts and with a periodicity of 60 cycles per second. Two independent 100 K-W. exciter dynamos, each driven by its own water-wheel, will be placed, and the current from either will be sufficient to charge the fields of all the large machines in the station.

The current from the generators will be carried by lead-covered cables laid in ducts between the generator foundations and the wall of the building to the generator switchboards at one end of the power-house. The boards will have blue Vermont marble panels, and will be completely equipped with all the necessary controlling and regulating instruments and apparatus. Tachometers on the switchboard, operated by synchronous motors electrically connected to the generators, will indicate the speed of the machines.

The step-up transformers and the 2,000 and 15,000 volt feeder panels will be placed in a gallery erected over the generator switchboard. The transformers, nine in number, each of 250 K-W. capacity, will raise the generator potential from 2,300 volts to 15,000 volts, at which pressure 2,000 HP. will be transmitted to Salt Lake City. The local distribution of the balance at Ogden will be made at 2,300 volts.

The transmitted current will pass over six No. 1 wires strung on insulators of a special porcelain, developed by the General Electric Co. to withstand high potentials, to nine 250 K-W. step-down transformers at Salt Lake City, which will deliver it at 2,300 volts for distribution.

The transmission line and transformers will be arranged to allow of the use of a potential of 25,000 volts. This will permit of the efficient transmission of current to the mining regions of Mercur and other camps 30 to 35 miles beyond Salt Lake City. All lines will be protected by the latest types of General Electric lightning arresters.

To construct the iron and wooden pipes bringing the water to the wheels, motors aggregating 100 HP. are set up in the shops of Rhodes Bros., in Ogden, to supply the extra power required for the work.

Salt Lake City, with the completion of the Pioneer plant, will receive power from two of the most important electrical transmission installations ever undertaken. That transmitting the power from the Big Cottonwood Canyon has only recently been completed, that of the Pioneer Co. will probably be inaugurated about Nov. 1 of this year.

POTASSIUM CHLORATE is now being made at Niagara Falls by the Chemical Construction Co. The process is that patented by Henry Blumenberg, Jr., and is based upon the use of an electrical current in connection with a solution of potassium chloride. Power is obtained from the Niagara Falls Power Co., and the product claimed is one ton per day of chlorate of potash, without waste and at very low cost. There are two other electrical processes for this manufacture in use; that of Gall & Monthauer, of France, and Franchot & Gibbs, of Buckingham, Canada; but this one is said to be the first installed in the United States.

THE ELECTRIC RAILWAY proposed to be built along a boulevard between Baltimore and Washington may be abandoned, the construction company (Baltimore & Catonville Construction Co.) having been put in the hands of receivers. It has been stated by the Columbia & Maryland Ry. Co., however, that the work of building the road will be resumed in about two weeks. It is the intention to complete the Baltimore division to Ellicott City as soon as practicable. Most of the work on this division is finished. Construction on the Washington division will also be started. It is said that funds for carrying on the work will probably be obtained by an issue of receivers' certificates.

CIVIL SERVICE EXAMINATIONS will be held in Brooklyn, N. Y., on Oct. 5, for various positions, including sanitary inspectors, chainman, superintendent of sewer and water pumping station, and also inspectors of plumbing, elevators, buildings, gas and electric work, docks, grading and paving, sewer connections, etc. Mr. E. B. Lent is secretary of the Civil Service Commission, with office in the City Hall.

BOOK REVIEWS.

POOR'S MANUAL of the Railroads of the United States, with an Appendix containing a full analysis of the debts of the United States, the several States, Municipalities, etc. Also statements of Street Railway and Traction Companies, Industrial Corporations, etc. H. V. & H. W. Poor. Twenty-ninth annual number, 1896. New York, 44 Broad St. 8vo.; cloth; pp. 1,670. $7.50.

In our issue of Sept. 3 we gave a brief review of the railway situation in the United States for 1895, as obtained from the advance sheets of the Manual. The work now published for issue contains 258 pages more of matter than the edition of 1895, and embraces statements from 4,399 corporations, aggregating a capitalization of $16,475,000,000. Included in this list are 2,040 railway corporations, 1,208 street railway companies, 143 industrial corporations, and a list of the debts of 1,008 states, counties, cities, towns, etc. This simple statement of the volume of contents, coupled with the care and labor bestowed upon the collection and compilation of this information, is sufficient in itself to indicate the value of the publication.

THE MINERAL INDUSTRY, its statistics, technology and trade in the United States and other countries to the end of 1895, Vol. IV. Edited by Richard P. Rothwell, Editor of the "Engineering and Mining Journal," Past-president American Institute of Mining Engineers, Member American Society of Civil Engineers, Fellow Royal Statistical Society, etc. Statistical Supplement to the "Engineering and Mining Journal." New York and London. Scientific Publishing Company. 8vo.; 849 pp. $5.00.

This fourth issue of what is undoubtedly the most thorough and exhaustive publication of this character anywhere exceeds in value even its predecessors. It is impossible to enter here into a review of the contents of these hundreds of pages, and the general scope can only be indicated. The editor, in addition to giving the statistics of quantity and value of product for seventy-odd separate items, treats of each separately, and in almost every case this supplemental material forms a technical treatise upon the methods of treatment, according to the latest discoveries, the mining, tests, prices and general status of the industry discussed. In the preparation of this matter the editor has been assisted by many of the ablest investigators in the development of mineral industries in Europe and America, and some of these articles are in themselves very exhaustive and especially valuable for the figures and information given as to processes and general progress. The subject matter is arranged alphabetically by item and by country, and an excellent index enables the user to readily find what he wants.

PRACTICAL TUNNELLING.—By Fred'k Walter Simms, F. G. S., M. Inst. C. E. Fourth edition, revised and greatly extended, with additional chapters illustrating recent practice by D. Kinnear Clark, M. Inst. C. E., M. Inst. Mech. E., author of "Railway Machinery," "The Steam Engine," "The Mechanical Engineer's Pocket-Book," etc. New York: D. Van Nostrand Co. 1896. Large 8vo.; pp. 548, with 36 plates and other illustrations. $12.

It is almost to be regretted that Mr. Clark issued this work as a revised and extended edition of Simm's Tunnelling, last published 18 years ago; for the 188 pages devoted to the work of Mr. Simm's are now only valuable as a matter of history. In the "Additional Chapters," however, Mr. Clark deals with the more recent and modern practice of tunnelling, as exemplified in the Mt. Cenis, St. Gothard and Totley tunnels, in the tunnels for the Glasgow and Liverpool water-works, the proposed Simplon, and the tunnels at Niagara Falls and under the St. Clair River, Hudson River and the River Thames. In each of these cases the descriptive matter is full and the sections, processes and the drilling machinery are well illustrated. The ventilation of tunnels, especially long tunnels, is an engineering problem so complicated by controlling local conditions that no general rules can be laid down for this purpose. Mr. Clark, however, devotes considerable space to this important subject, and gives examples of various attempts made to get rid of foul air and details the results of such experiments for a number of prominent tunnels. Tunnel practice in America is scarcely touched upon; the exception being the tunnels under the Hudson and the St. Clair rivers, and the Niagara Falls power tunnel. Mr. Clark's work is valuable, however, in bringing together in one volume much scattered information relating to European tunnel work; and while this descriptive matter is made as concise and brief as possible, and useful details are thus omitted, the work as a whole is to be commended.

WATER SUPPLY.—(Considered Principally from a Sanitary Standpoint). By William P. Mason, Professor of Chemistry, Rensselaer Polytechnic Institute. New York: John Wiley & Sons. London: Chapman & Hall. 8vo.; cloth; pp. 504; illustrations and tables; $5.

This book occupies, to a considerable extent, a middle ground between Fanning's "Water Supply Engineering" and Hazen's "Filtration of Public Water Supplies," without infringing upon the territory of either. It resembles in its general plan Nichols' "Water Supply, Considered Mainly from a Chemical and Sanitary Standpoint," but supersedes it, owing to the advances made in the subject since Professor Nichols' work appeared.

The volume opens, practically, with a long and valuable chapter on "Drinking Water and Disease," a subject to which the author has given much attention. A portion of this chapter was printed in Engineering News of June 4, 1896, under the title, "Does Pure Water Pay?" Next comes a chapter on "Artificial Purification of Water," which is principally devoted to a general description of slow sand filtration, and rapid sand, or mechanical, filtration. Natural purification of water is then discussed, the principal sub-heads here being: "Direct Oxidation," "Sedimentation," "The Purifying Action of Sunlight," "Self-purification of Streams," and "Seasonal Variation in Purity of Streams."

After having discussed these subjects, the various sources, or classes of sources, of water supply are taken up in four chapters, these chapters being preceded by one on "Rain, Ice and Snow."

The principles underlying the chemical and bacterial examination of water, together with the methods employed, are treated in two chapters, and another chapter is devoted to consumption of water per inhabitant, a subject having a very important bearing on the sanitary phases of water-supply.

The concluding chapter reviews in an able manner the present understanding of the action of water on metals, and includes some remarks on pipe preservatives. A number of appendices present, among other things, some tables of analyses of city water supplies, statistics of typhoid death rates in American and foreign cities.

Altogether the book promises to be a useful one, while its general make-up is pleasing.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

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THE CHICAGO MAIN DRAINAGE CANAL is discussed as follows by President Eckhart in his annual report: Of the work of excavation, 90% is now completed; but the recent pollution of the lake water by sewage demands that immediate steps be taken to secure the full benefit of the sanitary district in the near future. This means the diversion of sewage from the lake, by the united action of the city authorities and the trustees of the sanitary district. Nearly nine-tenths of the present sewage outflow is already discharged into the Chicago River and its branches; and the construction of intercepting sewers by the city will bring the remaining sewage to this channel. The completion of the main channel and the admission of water from the lake, says Mr. Eckhart, will remove the present source of pollution from the lake and restore sanitary conditions in Chicago. The engineering department reports upon the main drainage canal, as follows:

Total amount of contracts	$19,261,619.62
Total amount earned	17,119,942.38
Total amount to be earned	$2,141,677.24
Total reserved percentage and unpaid vouchers	2,231,652.32
Total required to complete existing contracts	$4,373,329.56

Amount earned, 89.03 per cent.

A special committee of the trustees has been appointed to confer with the city authorities concerning the speedy utilization of the drainage canal.

◆

THE WATER POWER AND ELECTRIC TRANSMISSION plant at Fresno, Cal., described in our issue of July 2, is of special interest on account of the great head of the water and the distance which the power is transmitted. The water is carried to the reservoir by 7 miles of canal and flume, and from the reservoir extends the pipe line, 4,020 ft. long, with a total head of 1,400 ft. The pipe is of steel, coated with asphalt, and is laid partly with the Converse screw sleeve joints and partly with flange joints. The cast-iron flanges are shrunk on and beaded to the pipe, reinforced by ¾-in. rivets through flange and pipe between each bolt hole. One flange is recessed and the other has a corresponding annular projection, a 3-16-in. rubber gasket being placed between the faces. The flanges are drawn together by 16 bolts 1 in. diameter, 10¼ ins. long. The pipe was supplied by Dunham, Kerrigan & Hayden, of San Francisco, and the pipe line was made up as follows:

960 ft. of 24-in, riveted No. 12 steel.
860 ft. of 24-in. riveted ¼-in. steel.
400 ft. of 20-in. lap-welded 5-16-in. steel (Converse joints).
800 ft. of 20-in. lap-welded 5-16-in. steel (cast-iron flange joints).
1,000 ft. of 20-in. lap-welded ⅜-in. steel (cast-iron flange joints).

The 5-16-in. pipe was tested to 600 lbs. pressure, and the ⅜-in. pipe to 1,000 lbs. pressure. Air inlet valves of ample area are provided to prevent a repetition of the collapse due to a sudden emptying of the pipe. The pipe ends in a jet driving the Pelton water wheels. The current is carried over a transmission line wire for a distance of 35 miles, and 75% of its power is delivered at the switchboard.

◆

BIDS FOR THE REMOVAL AND DISPOSAL OF THE garbage of Brooklyn were received Oct. 5 from five different parties, as given in detail in our Construction News Supplement. The lowest bid was from the Brooklyn Sanitary Co., which proposes to use the Arnold system of utilization, now employed to treat a large part of the garbage of Philadelphia and soon to be put in use for the treatment of all the garbage of New York. This company made two offers, one for a plant located within the city and another for a plant on Barren Island, where the plant for New York is now being built. The next lowest bid was from E. J. McKeever & Co., for the Brownlee system of garbage cremation. The three offers named were as follows:

	Brooklyn Sanitary Co., for plant.		E. J. McKeever & Bro.
Year.	In City.	On Barren Island.	
First	$90,000	$113,000	$144,000
Second	91,000	117,000	144,000
Third	92,000	120,000	144,000
Fourth	93,000	125,000	144,000
Fifth	94,000	130,000	144,000

◆

WATER POLLUTION FROM SEWAGE has been worse in Chicago this year than ever before, according to reports from the Health Commissioner of that city, and corresponding with this pollution the death rate from zymotic diseases has increased so much as to presage a repetition of the typhoid fever epidemic of 1890-92. For the first nine months of 1896, the number of fatalities from typhoid fever has been 559, an increase of 71% over that for the same period of 1895, and nearly the rate per 10,000 population attained in 1889, just preceding the epidemic noted. The deaths from typhoid thus far in 1896 are 3.17% of the total deaths from all causes. In 1889 the corresponding figures were 2.67%. As noted in the last issue of Engineering News, these conditions have aroused the city officials to exert themselves to find some remedy, and at a recent meeting the special committee on water supply of the city council authorized the mayor to appoint a commission of three engineers to suggest plans for a complete system of intercepting sewers designed to receive the sewage now flowing directly into Lake Michigan and turn it into the Chicago River, whence the drainage canal can receive it. At present, 29 sewers, taking the sewage of some 400,000 people, discharge directly into the lake, 17 on the north side of the Chicago River and the remainder on the south side. Fully 90% of the sewage of the city now enters the lake through the Chicago River, and all this will be diverted through the drainage canal when that channel is completed. The only thing that will prevent the canal taking all the sewage is the flow of the 29 sewers mentioned above directly into the lake, and this the intercepting sewers, if built, will remedy. About 90% of the work on the drainage canal from Bridgeport to Lockport, 28 miles, is now completed, and an official statement from the trustees of the sanitary district asserts that the remaining work necessary to furnish the flow of 300,000 cu. ft. per minute will be finished in 1897 or early in 1898.

◆

ELECTRICITY ON THE MANHATTAN ELEVATED in New York city was given a practical trial, Oct. 5, the experiment being made on the 34th St. branch, between the Long Island Ferry and 3d Ave. A third rail laid on the outside of and 10 ins. higher than the regular rails carries the current. Contact is made by means of two sliding steel shoes. The motor car carries, when fully equipped, a storage battery of 256 cells which may be used in case of blockade or failure of current in the third rail, and which serves to keep the load on the line and on the station fairly uniform. The battery alone, it is said, will operate a train for 19 miles at a speed of 35 miles per hour. The motor car is 18 ft. long and slopes from a height of 8 ft. in the center to 3 ft. at the ends. The electric current is also used to light the cars, which is a new departure on the New York elevated lines. The locomotive has two General Electric motors of 125 HP., and weighs 10 tons.

◆

CAR PAINTING BY COMPRESSED AIR is being tried on the Pittsburg & Lake Erie R. R. The yard is well supplied with air pipes, and the barrel of specially prepared paint is mounted on a hand truck so that it can be moved to any part of the yard. The air line consists of 100 ft. of 1-in. heavy hose; the paint suction hose of 50 ft. of ½-in. heavy hose. The barrel is equipped with a float of pine wood with 4-in. hole in the center. Over the hole is a small hose-bearing tower, used as a support and hose regulator, insuring a uniform feed of paint. This device is light in weight, and can be readily carried to top of a box car for spraying the roof. The time for carefully spraying a box car is 30 minutes. To employ a man to follow with a long-handled 8-in. whitewash brush, 30 minutes additional, making labor cost one hour per box car, each coat. To coat a coal car of 60,000 lbs. capacity takes 20 minutes for each coat, including the time of two men. This road is also using a device for spraying on paint for the lettering, which, for covering uniformly, is considered a decided improvement over the stencil brushes, and will lead to a great saving in the wear and tear of stencil plates.

◆

A FOLDING CAR STEP, set below the bottom fixed step, is being tried on some cars of the Gulf, Colorado & Santa Fe Ry. Its purpose is to facilitate entrance to and exit from the car, and it is expected to be more convenient than the stools or boxes carried by the car porters. A lower fixed step cannot be used, as it would be liable to be struck by platforms, etc. This folding step was designed by Mr. F. W. Farrell, Master Car Builder, at Galveston, Tex.

◆

THE ELECTRIC MOTOR CARS for the Brooklyn Bridge cable railway are now being delivered. They are 45-ft. cars, weighing 28 tons, or 36 tons with the four 100-HP. electric motors and equipment, and closely resemble the present cars. There will be one motor car to each train and it will be used to switch the train from the incoming to the outgoing track, thus dispensing with the present shuttle movement of the steam locomotive which pushes the trains out from the station to the point where the cable is picked up. The motor car will also haul the train at night, when the cable plant is shut down for inspection. A shoe on each motor truck will take the current from a rail conductor laid outside of the track rails. The cars were built by the Pullman Palace Car Co., of Pullman, Ill., and the electrical equipment was fitted by the General Electric Co., at Schenectady, N. Y.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision of freight trains, Oct. 1, at Philson, Pa., on the Baltimore & Ohio R. R. An eastbound train descending the steep grade of the Allegheny mountains got beyond control and could not be stopped at the siding where it should have waited for the westbound train. The train went down the grade at high speed and struck the westbound train, which had two engines. The three engines and 34 cars were wrecked. The bodies of 18 men, all tramps, were found in the wreck, and several of the trainmen were injured. The accident occurred on a grade of about 2.3%, 17 miles long, from Sand Patch tunnel to Hyndman. It is said that 16 cars (or about half the train) had air brakes, and that the brakes were tested satisfactorily at Sand Patch, but that the tramps (large numbers of whom ride on these trains) meddled with the brakes, cutting them out of service.——A double collision of freight trains occurred Sept 30 at Niagara Junction, N. Y., on the Lehigh Valley R. R. A freight train had stopped to cool a hot box and was run into by a following double-header freight train, derailing one engine and the caboose, and throwing them across the other track in front of a westbound freight train. The two engines went down the bank and a number of cars were wrecked, four or five of the cars being destroyed by fire. One man was killed and another fatally injured. It is said that a signal which should have been set to protect the rear of the standing train, was not set at danger until the second train was seen approaching.

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A TUGBOAT BOILER exploded Sept. 29 in the East River, New York, near Hell Gate. The tug was the "Robert Lockhart," of the Lehigh Valley R. R., and was towing three heavy coal barges against the tide. The boat caught fire and very nearly drifted on the rocks, but was hauled out of danger by the "Edna B. King."

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A BOILER EXPLODED at No. 2 Colliery, Harwood, Pa., on Sept. 28, killing one man and seriously wounding two others.

◆

THE BURSTING OF THE DAM of the lake at the Fair Grounds, Staunton, Va., Sept. 30, caused a flood in Lewis Creek which caused considerable damage to property and the loss of several lives. The accident was due to the high water in the lake, caused by heavy rains.

◆

THE HEAVY GALE AND STORM of Sept. 29 caused widespread damage along the south Atlantic coast. The town of Cedar Keys, Fla., was almost entirely wrecked, and great destitution will result, while a number of persons were killed and injured. A number of the boats of the sponge fishing fleet were lost, with all hands. At Savannah, Ga., the loss by damage to buildings, etc., will probably amount to $1,000,000. Several ships were blown ashore on the coast and in the rivers, plantations were flooded, electric light and power plants shut down. Extensive damage was also done at Baltimore and Washington.

◆

TWO RIVALS FOR THE STEAM ENGINE in its usual form are now receiving much attention, the steam turbine and the gas engine. Which one is eventually to displace the reciprocating steam engine for the direct driving of dynamos is a matter of doubt, but the Westinghouse Machine Co., which builds the well-known Westinghouse steam engine, is preparing itself for either event by embarking in the manufacture of both steam turbines and gas engines. It has recently placed both upon the market. The turbine is of the Parsons type, which has for some years been on the market in England. The gas engine is a new design, the result of some years of experiment by Mr. George Westinghouse. It is a two-cylinder engine, using the Otto cycle, but with a governor which controls the admission of both air and gas in such a way that an explosion occurs at every stroke. The result is a very good regulation, such that dynamos driven directly on the shaft of the engine furnish an entirely satisfactory light, free from flickering. Two of the gas engines are now running in the Pittsburg Exposition.

◆

THE LARGEST INSTALLATION OF WATER TUBE boilers on any steam vessel is that of the Belleville boilers on the new British battle-ship "Powerful." A detailed description of the plant is given in Engineering News of Sept. 25. There are 48 boilers in all, designed to work at 260 lbs. per sq. in., which pressure is reduced to 210 lbs. by Belleville valves. The total heating surface is 69,453 sq. ft., equal to 2.77 sq. ft. per designed horse-power (22,500 I. HP.), and the total fire-grate area is 2,192 sq. ft.

THE PARK ROW BUILDING, 30 STORIES HIGH; NEW YORK CITY.

(With inset.)

The rage for phenomenally high office-buildings still continues unchecked in New York city, and there seems to be at present some rivalry here as to who shall build the highest structure. The design and construction of these very lofty buildings calls for some very interesting engineering work.

The first part of the work of designing such a building is the preparation of general elevations and floor plans, by the architect, but the structural or constructional design is largely an engineering rather than an architectural work, since with the steel skeleton style of construction necessary for these great buildings, the exterior masonry and treatment which are visible in the finished work are merely the clothing and ornament of the steel framework. Nevertheless the general plan and appearance of the structure are the first considerations, and it is, therefore, the architect who is first engaged to prepare the plans, and who may either prepare the structural design for himself or entrust the work to an engineer, subject, of course, to his approval as being responsible for the entire work. In all buildings of this character the architectural design and arrangement considerably complicates the arrangement and detailing of the structural ironwork.

The highest building thus far designed in New York city is the Park Row Building, which is to occupy the site of the old International Hotel on Park Row, opposite the Post Office, and work is already in progress on the foundations. This will be an office building, with stores on the street floor, and a restaurant at the top. The main part of the building will have 26 stories, while at the two front corners will be four-story towers, the total height from the curb to the tops of the cupolas being 386 ft. Below the curb level will be a basement and a cellar. The St. Paul Building, close by, has 25 stories, and is 313 ft. high from the curb (Eng. News, May 7, 1896); while the American Tract Society Building has 20 stories in the main part, three more in the tower, and is 291 ft. high to the top of the roof of the tower (Eng. News, Dec. 27, 1894).

The general appearance of the new building is shown in Fig. 1, which is reproduced from one of the water-color drawings prepared in the architect's office.

The plan of the building is very irregular, as shown in Figs. 3, 12 and 13, owing to the impossibility of securing some of the property at any reasonable price (until the owners of this property found that the new building could be built without it, when their demands at once fell considerably but it was then too late). The building will have a frontage of 103 ft. 11 ins. on Park Row, 20 ft. on Ann St., and 47 ft. 10½ ins. on Theater Alley, while the depth from Park Row to the alley will be 153 ft. 7¾ ins. The area covered will be 15,000 sq. ft., and this is entirely on a deep sand foundation. The foundation will be carried on piles driven into the sand to a depth of about 20 ft., this system having been satisfactorily employed for the American Tract Society Building, where no settlement has occurred. There will be about 3,500 foundation piles of good sound American spruce, free from knots and ring strokes, and having the bark left on. They are 10 to 14 ins. diameter at the head, perfectly straight and 20 to 25 ft. long; and have the heads cut off below the level of ground water, or at 34 ft. 4 ins. below the level of the curb on Park Row. For the Tract Society Building (which was also built by Mr. Robertson) it was specified that the piles should be driven to a greater depth than 20 ft., but it was found difficult to get them down more than 20 ft. without breaking or brooming them, while where they were very close together the piles would sometimes refuse to go more than 10 ft. into the closely compacted sand. For this reason a depth of 20 ft. or to a hard bearing has been specified for the piles for the Park Row building. The piles will be driven about 16 to 18 ins. c. to c., beginning at the center of each pier or group, and working outward, while the rows of piles will be about 24 ins. c. to c. No pile is to be loaded with more than 16 tons, and the allowed pressures are 15 tons per sq. ft. on brickwork, and 40 tons per sq. ft. on granite. The site of the building will be excavated to a depth of 34 ft. below the curb line. An additional 12 to 16 ins. in depth will be excavated between and around the heads of the piles for a clear space of 12 ins. from the piles, and this space will be filled in with a concrete composed of 1 part Portland cement, 2 parts sand and 5 parts broken stone not over 2½ ins. in size. This concrete will be tamped to a hard consistent mass, and leveled off flush with the heads of the piles. The Portland cement used is specified to be of the Stettin or Ooland brands, all of which must be of recent manufacture, and no retempering of the cement will be allowed. The sand must be coarse, sharp and clean. Upon the concrete capping will be laid large granite blocks for bases for the piers, which will be of brick, with granite capstones to carry the grillage beams. The bottoms of these grillage beams are to be 29 ft. 1½ ins. below the finished level of the first floor on Park Row.

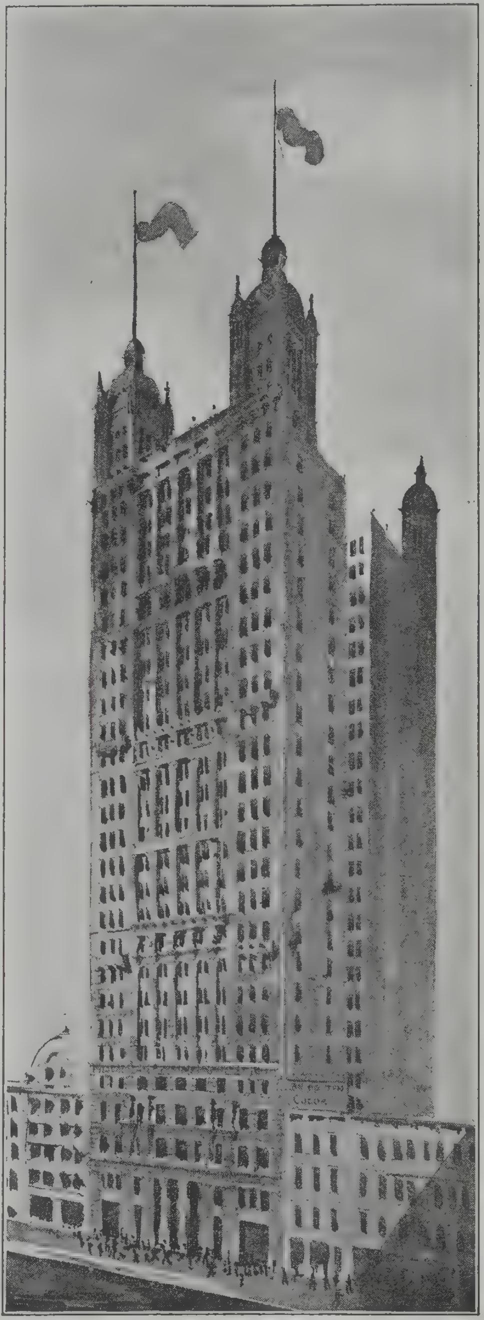

FIG. 1. GENERAL VIEW OF THE PARK ROW BUILDING; NEW YORK CITY.
Architect. R. H. Robertson.
Consulting Engineer, Nathaniel Roberts, M. Am. Soc. C. E.

It will be seen from the foundation plan, Fig. 3, that most of the columns rest on distributing girders, which in turn rest on a grillage of I-beams on two or more of the masonry foundation piers, while some of the interior columns rest directly upon grillages upon isolated piers. Each foundation had to be especially designed for the column loads to be sustained by it, the size of girders and the size and weight of grillage beams varying according to location. The long girder on the Theater Alley front is carried by 61 I-beams, 12 ins. deep, 32 lbs. per ft., 4 ft. long. The girder for columns G7, G8, has 13 15-in. I-beams, 67 lbs., 8 ft. 8 ins. long, and 11 15-in. I-beams, 41 lbs., 3 ft. 4 ins. long. The girders for columns A2, B2, etc., have 20 15-in. beams, 67 lbs., 8 ft. 8 ins. long, and 4 15-in. I-beams, 41 lbs., 3 ft. 6 ins. long. The grillages for isolated column foundations have a lower row of 15-in. I-beams, 45 lbs., and an upper row of 24-in. I-beams of 68 or 80 lbs. per ft. The grillage beams are I-beams of length, depth and number suitable to each individual foundation, and these are laid upon the granite caps of the brick piers, being set in a bed of cement, ½-in. thick, on top of the caps, any difference of thickness of over ½-in. being made up with layers and cross layers of flat steel bars, grouted in cement. Each span of grillage beams up to 5 ft. in length has four cast-iron separators, while where the beams are over 5 ft. long, six separators are used. The separators are box-shaped, with milled surfaces to bear evenly and truly on the top and bottom flanges of the beams.

The distributing girders are of plate construction, having two to four webs, their length ranging from 8 ft. to 47 ft., and their depths from 44 to 96 ins. The typical construction is shown in Fig. 5, and the details of one of the heavy girders are given in Fig. 11, which shows the girder at the Theater Alley front. The weight of this is about 105,380 lbs. for a length of 47 ft. 2½ ins In all cases the web stiffeners are required to have a bearing at top and bottom, Fig. 14 shows the location of some of the girders in relation to the columns. The make-up of some of these distributing girders is given below:

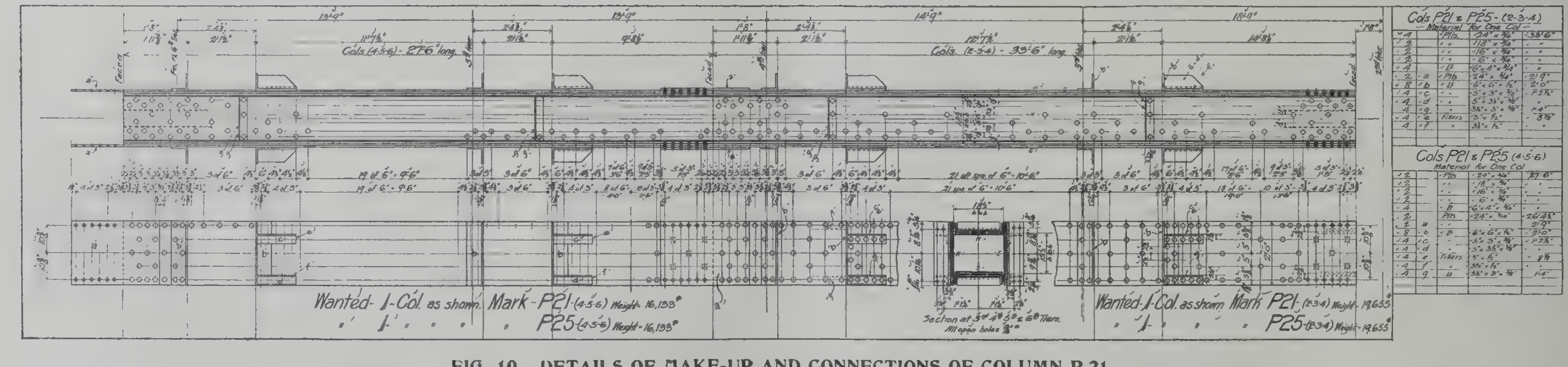
Cols (4-5-6) - 27'6" long
Cols. (2-3-4) - 33'6" long
Cols P21 & P25 - (2-3-4)
Material for One Col.
Cols P21 & P25 (4-5-6)
Material for One Col.
Fillers
Wanted- 1-Col. as shown. Mark - P21-(4-5-6) Weight 16,133
" 1 " " " " P25-(4-5-6) Weight - 16,133
Section at 3d 4th 5th & 6th Tiers.
All open holes
Wanted 1-Col. as shown Mark P21-(2-3-4) Weight 19,655
" 1 " " " " P25-(2-3-4) Weight 19,655

FIG. 10.—DETAILS OF MAKE-UP AND CONNECTIONS OF COLUMN P 21.

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OF THE
UNIVERSITY OF ILLINOIS

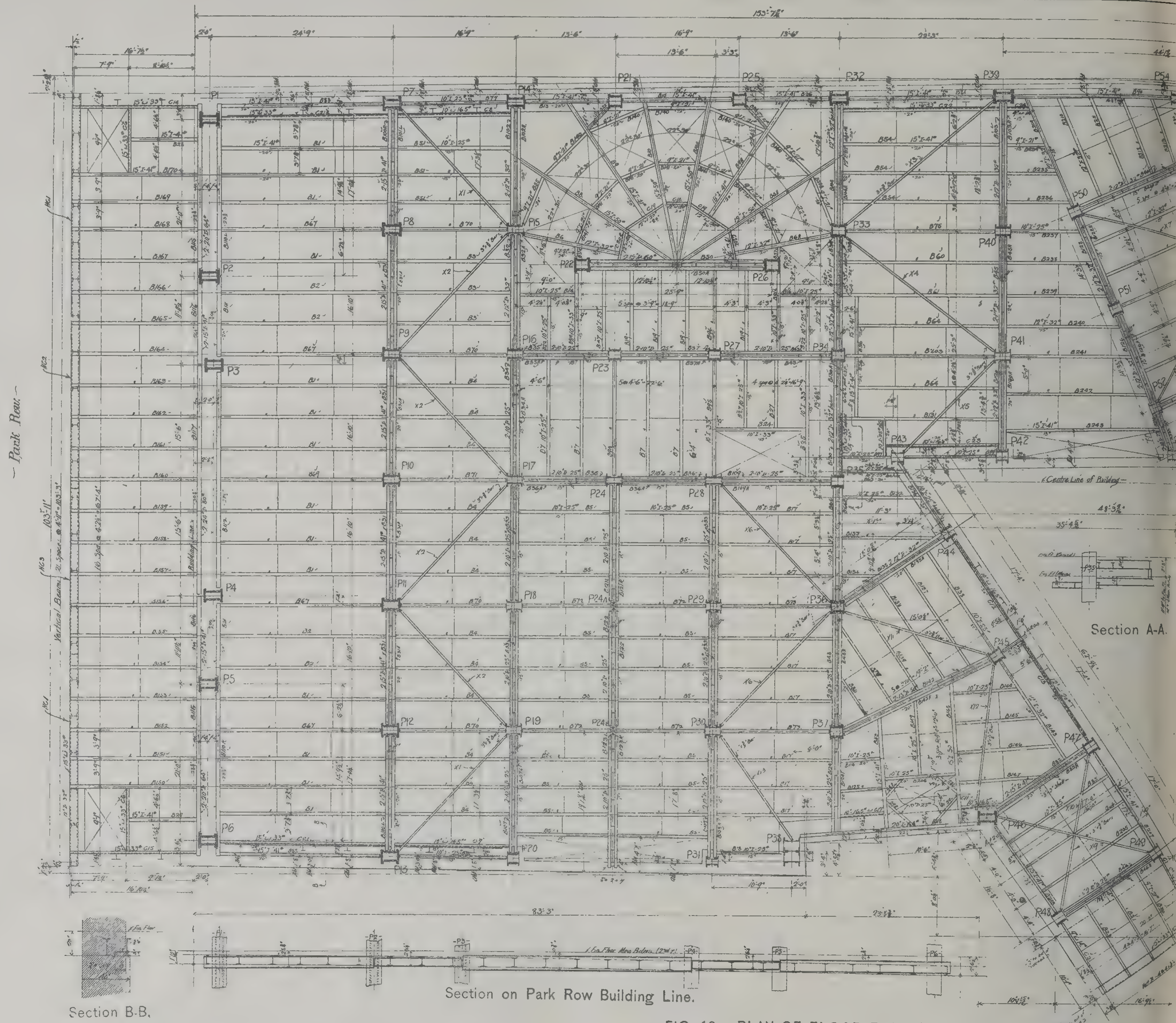


FIG. 12. PLAN OF FLOOR FRAMING.

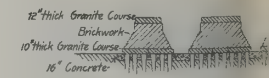


FIG. 4. TYPICAL SECTI

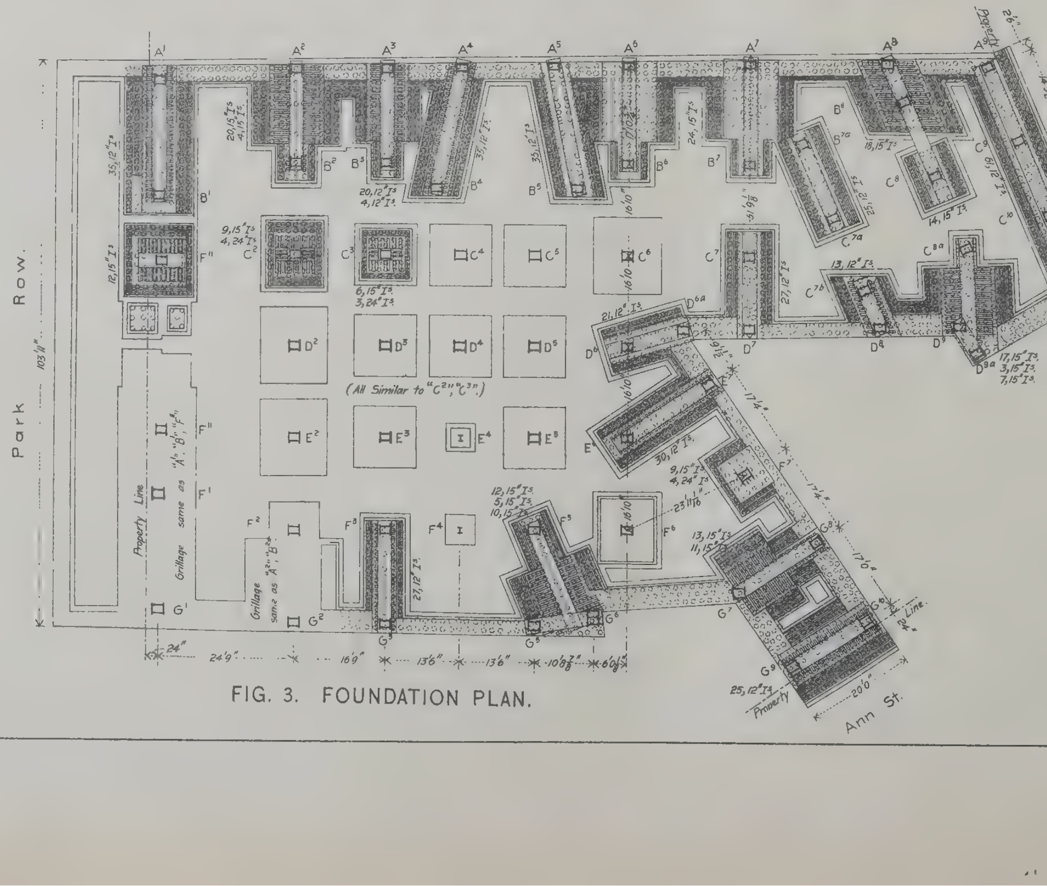


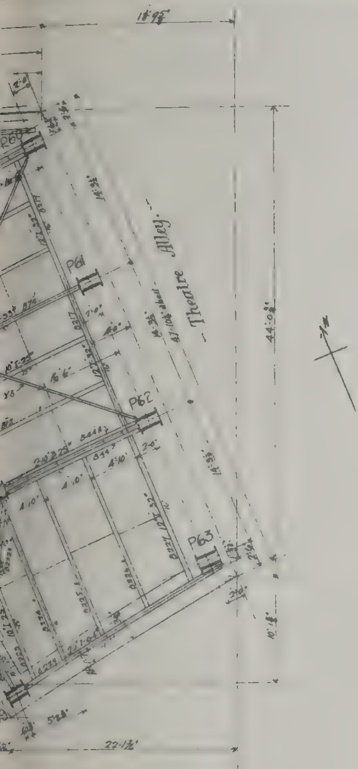
FIG. 3. FOUNDATION PLAN.

PARK R

NEW

R. H. Ro

Nathaniel Roberts, M. A



—Schedule of Cols—

Mark of Col	Section
P43,52,53,58	4 L 6"×4"×[illegible] 2 Pls 18"×[illegible] 2 · 24"×[illegible]
P42,55	4 L 6"×4"×[illegible] 2 Pls 18"×[illegible] 2 · 24"×[illegible] 2 · [illegible]
P20,23,27,35,44,48 P49,50,51,56,57	4 L 6"×4"×[illegible] 2 Pls 18"×[illegible] 2 · 24"×[illegible] 2 · 6"×[illegible] 2 · 16"×[illegible]
P21,25,33,34,36,37, P45,47	4 L 6"×4"×[illegible] 2 Pls 18"×[illegible] 4 · 24"×[illegible] 2 · 6"×[illegible] 2 · 16"×[illegible]
P22-26	4 L 6"×4"×[illegible] 2 Pls 18"×[illegible] 6 · 24"×[illegible] 2 · 6"×[illegible] 2 · 16"×[illegible]
P15,17,28,41	4 L 6"×6"×[illegible] 4 Pls 24"×[illegible] 2 · 12"×[illegible]
P16,54,59 to 63 incl P40	4 L 6"×6"×[illegible] 4 Pls 24"×[illegible] 2 · 12"×[illegible] 2 · 22"×[illegible]
P10,14.	4 L 6"×6"×[illegible] 6 Pls 24"×[illegible] 2 · 12"×[illegible] 2 · 22"×[illegible]
P1 to P9 and P11 to P13. P32, P46	4 L 6"×6"×[illegible] 8 Pls 24"×[illegible] 2 · 12"×[illegible] 2 · 22"×[illegible]
P39	4 L 6"×6"×[illegible] 8 Pls 24"×[illegible] 2 · 24"×[illegible] 2 · 12"×[illegible] 2 · 22"×[illegible]
P38	2 · 24"×[illegible] 3 · 24"×[illegible] 8 L 6×6×[illegible]
P31	4 Pls 18"×[illegible] 4 L 6"×4"×[illegible]
P24A, P24B	1 Pl 12"×[illegible] 4 L 4"×3"×[illegible]
P19,18,24,29,30	4 Pls 24"×[illegible] 4 L 6"×6"×[illegible]

—General Notes—

All Framing Details, Separators, etc. have been based upon Carnegie Sections as standard. If beams used vary from these Contractor must make allowance accordingly.—

All Tie rods ¾" ⌀. 3" from bot of beams

Finished Floor of space bet. Theatre Alley & Cols P32,33,34,35 is 2'8" above Fin. Floor of rest of building.—

All Cols from Theatre Alley up to and including P32, 33, 34, 35 & 43 splice 1'8" above Fin. Floor raised portion. All other Cols splice 1'8" above Fin. Floor, Main Portion.—

Figures in red give distance of Bot of I's below Fin. Floor.

DATIONS.

DING,

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E., Consulting Engineer.

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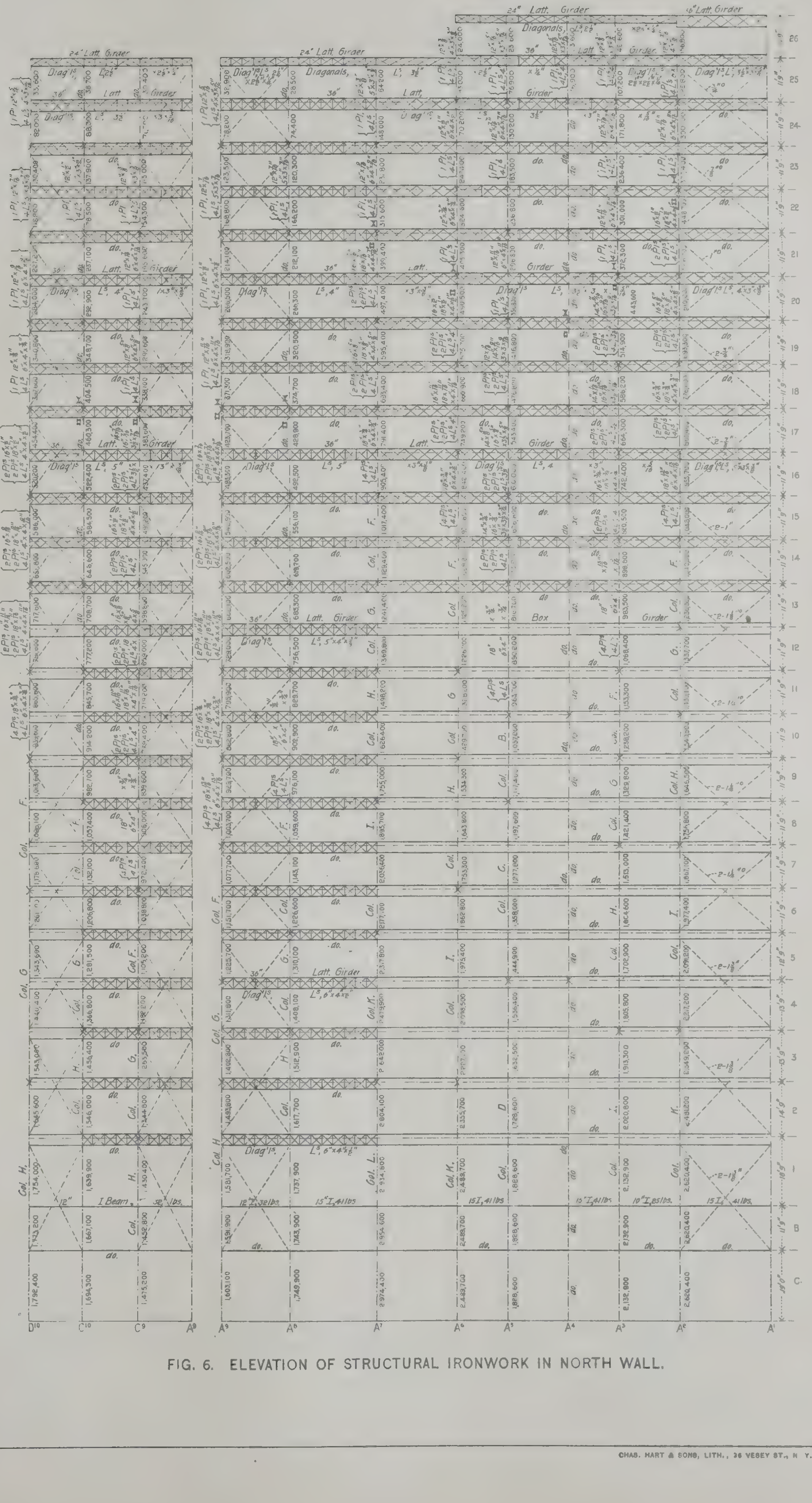


FIG. 6. ELEVATION OF STRUCTURAL IRONWORK IN NORTH WALL.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

Girders A1, B1, and F1, G1; 4-web plates $\frac{7}{8} \times 96$ ins., 8 angles $\frac{7}{8} \times 6 \times 6$ ins., 6 plates $\frac{3}{4} \times 32$ ins.

Girders A2, B2 ; F2, G2, and A6, B6 are similar but with 6 plates $\frac{7}{8} \times 32$ ins.

Girder A9, D10; 4 plates, $\frac{3}{4} \times 72$ ins., 8 angles $\frac{3}{4} \times 6 \times 6$ ins., 10 plates $13\text{-}16 \times 32$ ins.

Girder F3, G3; 2-web plates $\frac{1}{2} \times 96$ ins., 1-web plate $\frac{3}{4} \times 96$ ins., 8 angles $\frac{3}{4} \times 6 \times 6$ ins., 2 plates $\frac{5}{8} \times 32$ ins.

Girder F''; 4-web plates $\frac{3}{4} \times 44$ ins., 2 cover plates $\frac{1}{2} \times 32$ ins., 8 angles $\frac{3}{4} \times 6 \times 4$ ins.

All columns which do not rest on distributing girders, but have isolated foundations, are supported on short girders on a set of I-beams resting on the grillage beams, so as to distribute the weight evenly over the caps of the piers. The general arrangement of the foundation construction is shown in Figs. 2, 3, 4, and 5. The cellar floor will be level with the base of the granite cap, so that the steel girders will be accessible for inspection and repainting.

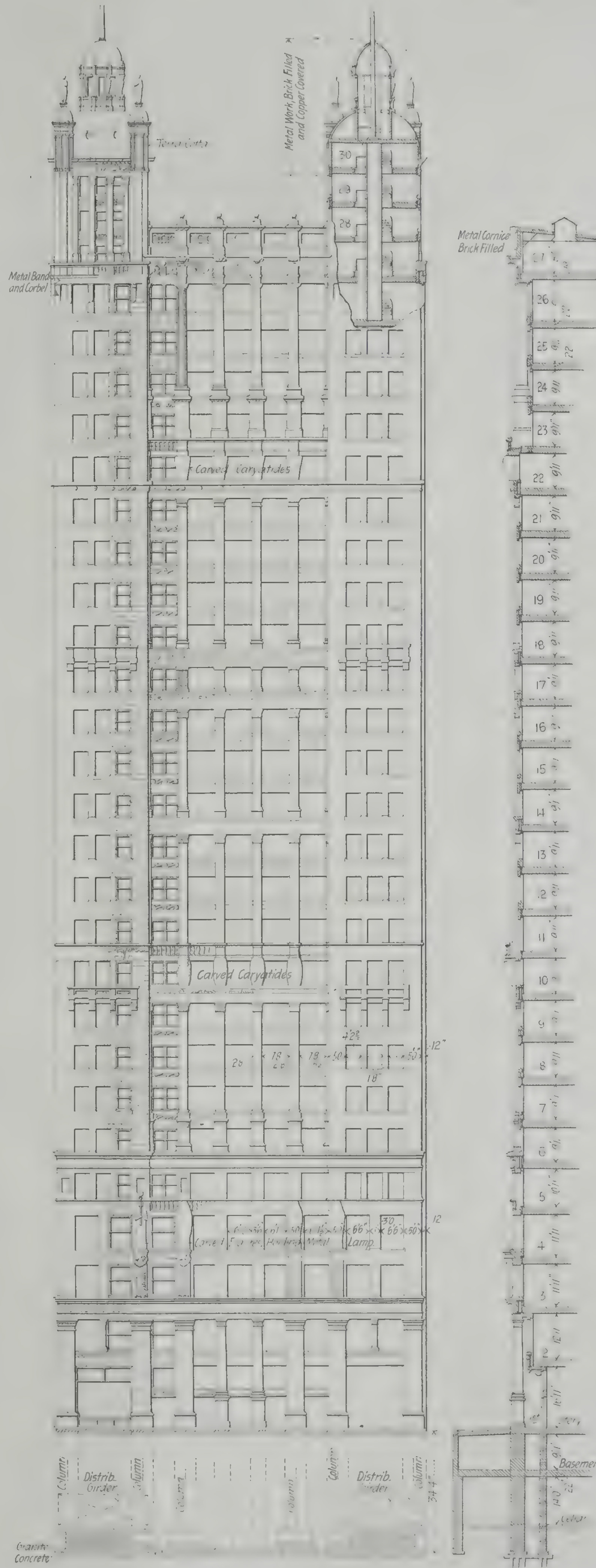
There are practically no two columns of identical section in the entire building, the irregular arrangement preventing any uniform loading, so that each column has had to be designed and built up for the particular load. The loads range as high as 2,900,000 lbs. All the columns are of box section (Figs. 7, 8, 9, 10), some being square and others of rectangular section, while in one case a double-box section is used, Fig. 8. They are flanged at every story, near the floor beams, to support the surrounding masonry. The bed plates are planed to a smooth surface to avoid shimming, and all the columns in the walls are to be carried up 3 ft. above the roof beams, and there connected with a line of 8-in. channels under the balustrade coping. The weight of columns P22 and P26 is about 58,080 lbs. per section of length.

The floor beams are generally composed of two I-beams, with cast-iron separators 5 ft. apart, these separators being the full height of the beams and bolted with ¾-in. bolts. There are three or four separators to each span, so made that the flanges of the beams will be not less than 1½ ins. apart. All floor beam tie-rods are to be ¾-in. diameter, set 3 ins. above the bottoms of the beams. The floor beams of each tier are framed so that the bottom will present two different levels, one 5 ins. above the other. In the area where 15-in. beams are used, the beams and girders will be framed flush (or coped together). Where 10 and 12-in. beams are used they are framed flush and level at the bottom, which is to be 5 ins. above the bottom of section where 15-in. beams are used. The plan of the framing of the first floor, Fig. 12, is reproduced direct from one of the drawings, and shows the general character of the drawings as sent out from the office of the consulting engineer, the illustration being about one-third the size of the original. It will be seen that the irregular plan of the building results in a somewhat complicated arrangement of the floor framing. The horizontal diagonal members are for wind bracing, while the semicircular arrangement at the back is for a group of elevators.

Box and lattice girders connect the columns at the walls. The lattice girders in the light courts are 48 ins. deep over chords, and those in the solid side walls are 36 ins. deep. Those in the light courts have the bottom set 1 in. lower than the 15-in. floor beams, and all have their chord angles ⅜-in. apart to allow of the easy connection or attachment of cast-iron lintels and sills. The outer ends of the light courts are spanned at every other floor by plate girders having curved bottom chords. The elevation of the ironwork of the north wall is shown in Fig. 6.

The main roof over the 25th story will be formed flat, like a floor, and will be sufficiently strong to carry a water tank of 10,000 gallons capacity. The roof over the 27th story (in the middle of the front) will be formed by angle-iron trusses 6 ft. apart, with T-iron purlins 12½ ins. c. to c., to carry safely a load of 100 lbs. per sq. ft. The walls and roof of this portion will be of vertical I-beams, with terra cotta block filling. The roofs of the turrets and lanterns will be of tees and angles, and the turrets will have a metal roof covering. Over the Ann St. front will be a dome, square in plan.

The amount of steel work in the building will aggregate about 9,000 tons. All beams, connections,



Front Elevation on Park Row.

Section through Center Portion of Front.

FIG. 2.—GENERAL ELEVATION AND PART CROSS SECTION.

rods, girders, angles, tees and channels; all built-up sections, and all cantilevers and columns, are to be of medium steel having an ultimate strength of not less than 60,000 lbs., nor more than 68,000 lbs. per sq. in.; elastic limit, half the ultimate strength; minimum elongation, 20% in 8 ins.; minimum reduction of area at fracture, 40%. The metal must bend cold 180° to a diameter equal to the thickness of the test piece, without a crack or flaw on the outside of the bent portion. The smoke flue and all its connections and appurtenances will be of mild steel. No variation of more than 2½% in weight or cross-sectional area will be allowed.

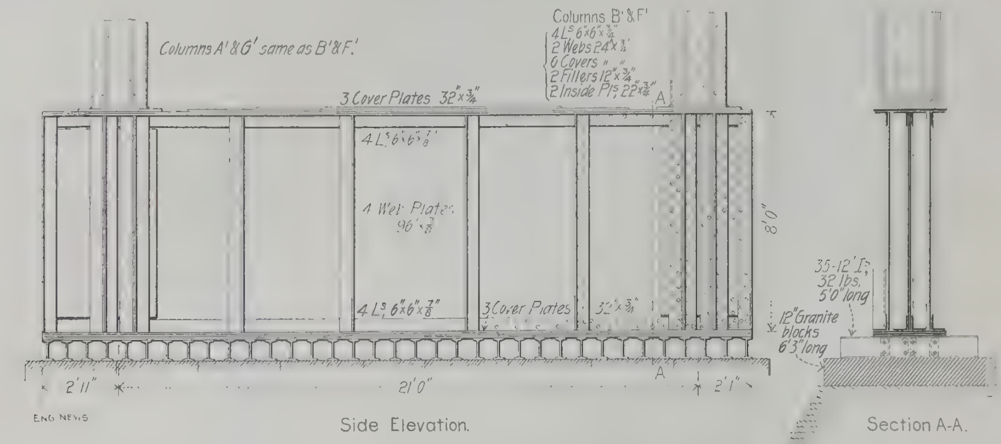


FIG. 5.—TYPICAL DETAIL OF GRILLAGE AND DISTRIBUTING GIRDER.

The specifications provide that all abutting surfaces of compression members, such as columns, shoes, etc., must be planed to even bearings, and all finished surfaces must be protected by white lead and tallow. All surfaces that will be inaccessible after assembling, must be cleaned and well painted (before assembling) with three coats of best red lead paint and oil, or asphaltic or graphite paint. The entire structural work of cast iron, wrought iron, and steel must be cleaned, dried and painted with two coats of paint (as above), and three coats on all portions which will be surrounded by masonry.

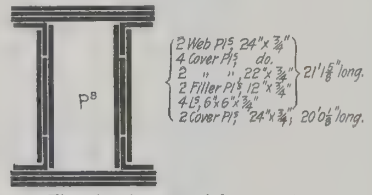


Fig. 7.—Section of Column P 8.

Rivets will be usually ¾-in. and ⅞-in. diameter, the pitch not exceeding 6 ins., nor 16 times the thickness of the thinnest outside plate, nor less than three times the diameter of the rivet. The distance between the edge of the piece and the center of rivet holes must not be less than 1¼ ins., except for bars less than 2½ ins. wide, and when practicable it must be at least twice the diameter of the rivet. The rivet heads must be concentric, with a height of at least 0.6 the diameter of the shank. Rivets will be machine driven wherever practicable. In punching, the diameter of the punch must not exceed the diameter of the rivets by more than 1-16-in., and all holes must be clean cut. The use of drift pins is allowed only to bring together the several parts of one member, and the pins must not be driven with such force as to disturb the metal about the holes. The rivet holes for splice plates of abutting members must be accurately spaced, so that the holes will be truly opposite when the members are brought together and before the rivets are driven.

The wind bracing consists of horizontal diagonal bracing in the floor systems, while the column connections with the box and lattice girders also give great lateral stiffness. There is also a vertical diagonal bracing in the panels between the following columns: G5 and G6, G7 and G9, G8 and G10, A3 and B3, A6 and B6, D6 and D7, and D8 and D9. This is composed of two angles 9-16 × 4 × 6 ins. in the lower stories, and the sizes get smaller in the upper part of the building. There will be a temporary erection bracing, as shown by dotted lines on the iron work elevation, Fig. 6, which consists of 1½-in. rods, with eye ends, pins and turnbuckles.

There will be two steel tanks of 10,000 gallons capacity, one in the cellar and one on the roof. Each will be 14 ft. diameter and 9 ft. high, of 5-16-in. steel plates, with a ½ × 4-in. band around the upper edge. The roof tank will be blocked up 15 ins. above the beams. The steel smokestack will be made in sections, one story high, riveted together, with expansion and contraction joints at every third and fourth story, each section being supported directly on the floor beams of its section. This smokestack will be of steel plate ⅜-in. thick for 100 ft., then 5-16-in. for 100 ft., and then ¼-in. to the top. All sills, mullions and lintels for windows will be of cast iron.

The treatment of the exterior can be credited to no established style of architecture, but may be classed as that of the "American skyscraper" style, the great height, narrow width and necessarily flat front or facade of such buildings rendering necessary a special treatment which it is difficult to make effective. The general appearance of the building, and the treatment of the Park Row front are shown in Figs. 1 and 2. The exterior masonry will be of granite to the top of the third story, then buff Indiana limestone to the sixth story sill on the Park Row and Ann St. fronts, and the remainder will be of buff brick, terra cotta and stone. The brick masonry backing will be of Haverstraw hard-burned brick, laid in cement, and grouted with liquid cement. The exposed portions of the side walls, court walls, and Theatre Alley front, will be faced with IXL brick, specially burned to a hard, impervious, glossy surface. The walls of the light courts will be 16 ins. thick, and the columns in those walls will be fireproof, with not less than 8 ins. of brickwork, the inner course of which is to be of hollow brick. Other columns will have not less than 4 ins. of common brickwork.

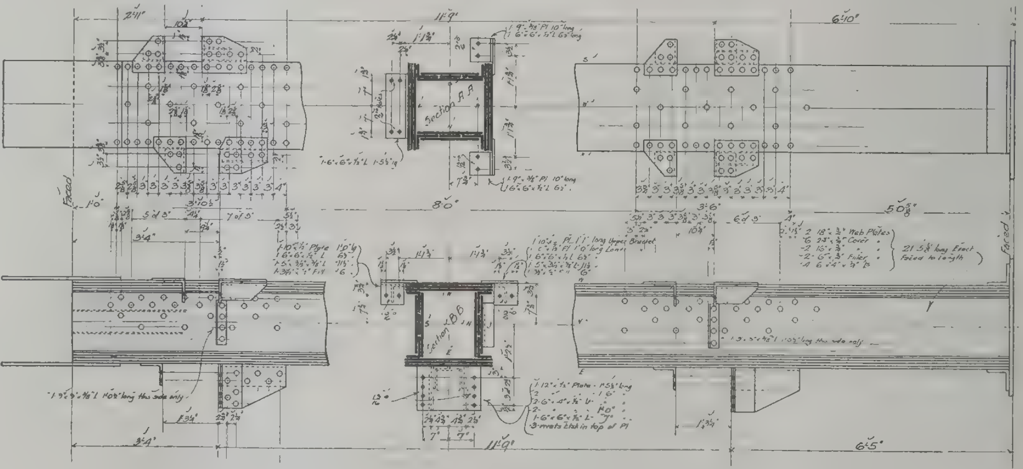


FIG. 9.—DETAILS OF MAKE-UP AND CONNECTIONS OF COLUMNS P 22 AND P 26.

Bluestone caps 24 × 20 × 12 ins. are used for the floor girders. All brickwork below the street will be laid in cement mortar of 3 sand to 1 Portland cement, and the coping will be set and pointed in Portland cement mortar and sand 1 to 1. There is to be a water-proof or damp-proof course laid through the vault walls, and all other walls in contact with earth, being carried up 2 ft. above the surrounding earth or to the level of the curb. This course consists of three continuous layers of hot asphalt or plastic slate and three layers of paper impervious to moisture. The concrete of the roof will be covered with five alternate layers of hot asphalt or plastic slate and four layers of moisture-proof paper, finished off with ¾-in. roofing tiles, gutter and leaders, laid in Portland cement and pointed. The kitchen and serving rooms will have rock asphalt floors. The sidewalk will be of 2½-in. bullseye lights, set in cement in cast-iron frames, with a stone curb 24 ins. wide.

The floors will probably be of terra cotta flat arches of end construction, the blocks being 12 ins. deep for the 15-in. floor beams, and 10 ins. for the others. The blocks will be set in Portland cement mortar, and covered with cinder concrete. The weight of this block construction and top filling must not exceed 65 lbs. per sq. ft. where 15-in. beams are used, or 45 lbs. where 10-in. beams are used. The partitions will be of terra cotta blocks, 3 ins. thick for the basement and all floors except the first floor, which will have 6-in. blocks. Porous terra cotta bands will be fitted, to which to nail the base, chair rail, picture molding, plaster grounds and trim. It is possible that the Roebling system of flooring and partitions will be used, if authorized by the Building Department. In this case there will be a steel ribbed wire cloth and concrete arch, at least 3 ins. thick at the crown, with suspended ceilings of No. 20 stiffened wire netting, leaving 1 in. air space below the bottoms of the beams. The floors would be guaranteed to carry 500 lbs. per sq. ft., uniformly distributed. The Roebling partitions would be 2 ins. thick between finished plaster surfaces. The smokestack will be enclosed by double partitions, with a 4-in. air space between them. The rough concrete over floor arches and for the tile flooring will be cinder concrete, composed of 8 parts clean, dry cinders (no ashes), 2 sand and 1 Portland cement. This will be filled in to within 1½ ins. of the finished floor surface or 3 ins. above the tops of the beams. A similar concrete, 3½ ins. thick, will be used for the flat roof. The roof filling of the towers will be 4-in. porous terra cotta blocks, laid in Portland cement. The entire building will be plastered with

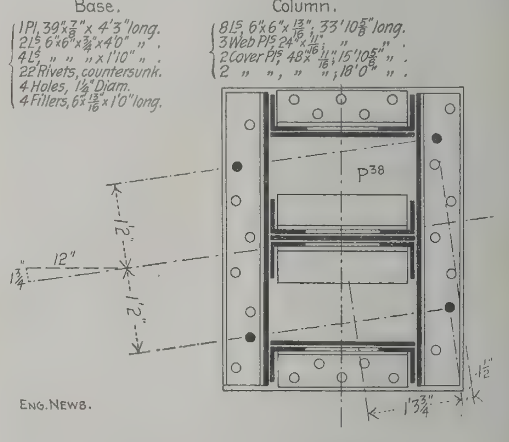


Fig. 8.—Section of Double Box Column, P 38.

a quick-drying material, such as rock or adamant plaster.

In the construction of the foundations, all adjoining walls will be shored up and strongly underpinned with brick work laid in Portland cement, this underpinning being 4 ins. thicker than the wall it supports. The underpinning will be carried down to a depth of 34 ft. 6 ins. below the Park Row curb, and will have a foundation of concrete 12 ins. thick and 12 ins. wider than the wall. Granite columns may be used by the contractor for the underpinning. Sheet piling and bracing may be used to protect the adjoining walls, while the shoring and underpinning are being done, and the braces are not to be removed until the work is thoroughly finished and set.

During the execution of the foundation work the side of the street will be sustained by sheet piling and shoring. Sidewalk bridges are built for pedestrian traffic, these being 6 ft. wide and specified to carry safely a load of 300 lbs. per ft. of the whole area, while the platforms for depositing the construction material must be strong enough to safely carry 500 lbs. per sq. ft. Along the bridges are 7 ft. fences of ¾-in. dressed and matched spruce boards.

The elevator plant for such a building is a very important detail,as it is necessary to carry passengers swiftly, yet easily. The plant will be tested by loading each car with 3,000 lbs. live load, and giving each car 200 full trips up and down within ten hours, running on a uniform schedule. One elevator will be for carrying freight and safes, and will have the front and sides removable, while the platform must be designed to carry a safe weighing 8,000 lbs. The power plant for the elevators will include three Worthington pumps (one triple-expansion and two compound), and a special duplex pump for the freight elevator when lifting safes. Separate elevators will extend from the top main floor up into the towers, as shown in Fig. 2. The elevator equipment is given in detail in the accompanying table.

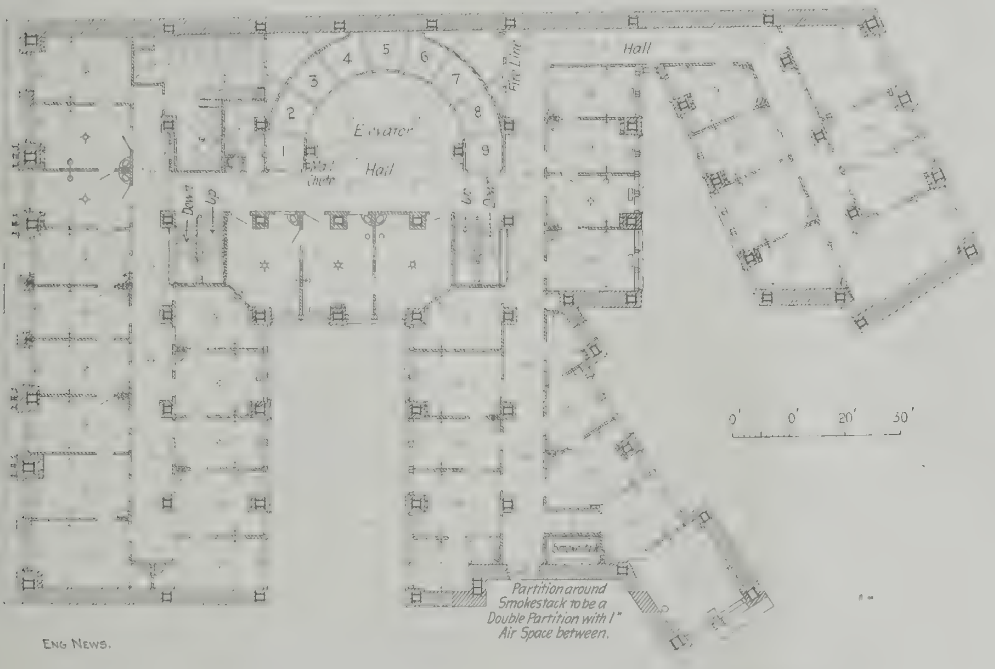

Hall
Elevator
Hall
1
2
3
4
5
6
7
8
9
Down
Up
Fire Line
0'
0'
20'
30'
Partition around Smokestack to be a Double Partition with 1" Air Space between.
Eng News.

FIG 13.—PLAN OF THIRD FLOOR, SHOWING ARRANGEMENT OF OFFICES.

The architect of the building is Mr. R. H. Robertson, of New York city, and Mr. A. Pauli is in charge of the building and its erection for him. The constructional steel work was all designed and worked out in detail by Mr. Nathaniel Roberts, M. Am. Soc. C. E., Consulting Engineer, of New York city and Jersey City, N. J., who also has charge of working out all the detail drawings of the steel framework of the structure. Mr. Geo. Shea Dayton, Chief Draftsman for Mr. Roberts, has had a large share in the responsibility for this work. The general contract was let to Mr. John Downey. The contract for the excavation and foundation work has been let to Mr. T. P. Galligan; that for the steel and iron work to J. B. & J. M. Cornell, and that for the masonry to Dawson & Archer. The building is being erected for the Park Row Construction Co., and its cost will probably be in the neighborhood of $2,000,000. We are indebted to the architect and the consulting engineer for plans and information made use of in the preparation of this article.

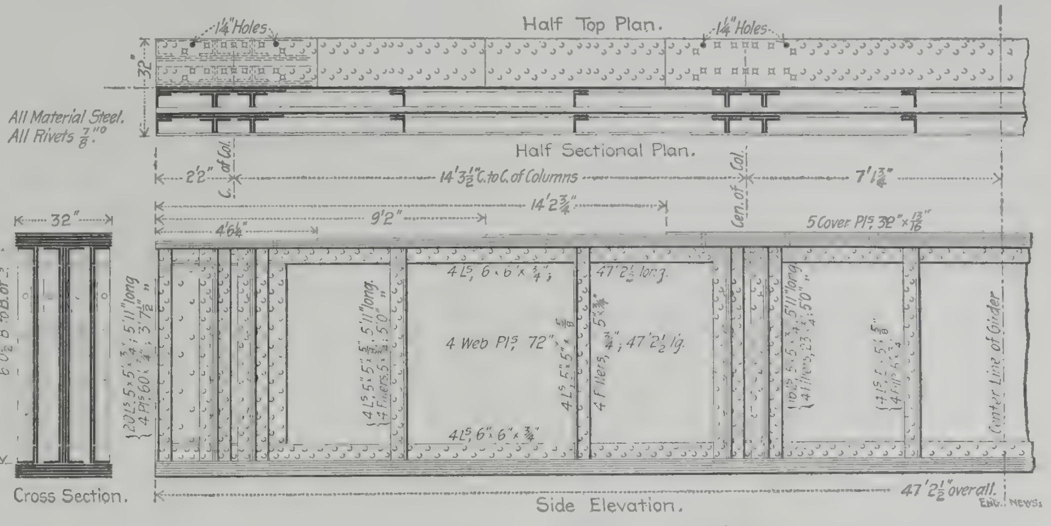


FIG. 11.—DETAILS OF DISTRIBUTING GIRDER.

Elevator Equipment for the Park Row Building, 30 Stories High.

No. of car.	Size of car.	Rise (floors).	Height of rise, ft.	ins.	Average load, lbs.	Safe lifting load, lbs.	Speed, feet pr.min.	Purpose.
Main elevators.								
1	6 ft. 9 ins. × 6 ft. 6 ins.	Cell. to 26	336	4	3,000	8,000	700	Pass. and freight.
2, 8	6 " 0 " × 6 " 0 "	1 " 26	308	9	3,000	.....	700	Passenger.
9	6 " 9 " × 6 " 6 "	1 " 26	308	9	3,000	.....	700	Passenger.
3, 4, 5, 6, 7	6 " 0 " × 6 " 0 "	1 " 25	297	0	3,000	.....	700	Passenger.
Sidewalk elevators.								
10	4 " 6 " × 7 " 0 "	Cellar to	27	1	2,500	8,000	50	Freight and safes
11	4 " 6 " × 7 " 0 "	sidewalk.	26	6	2,500	.....	50	Freight.
Elevators to 29th story.								
12	4 ft. diameter.	26 " 29	33	3	1,200	.....	300	Passenger.
13	4 " "	26 " 29	33	3	1,200	.....	300	Passenger.
Dumb waiters.								
14	2½ " "	26 " 29	36	3	250	.....	200	Restaurant serv.
15	2½ " "	26 " 29	33	3	250	.....	200	Restaurant serv.

THE PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTRICAL ENERGY.*

By Dr. Louis Duncan.**

It is my purpose to take up the different methods of transmission and distribution of electrical energy and to consider the limits that are actually fixed by the present status of electrical development.

Generating Plants.

A large proportion of the electrical plants in this country are steam plants. In the last ten years we have advanced from small stations using high speed dynamos for light and power distribution to large stations, using, as a rule, low speed direct connected machines. The simple engines that were used some years ago have, in many cases, been changed to compound and even triple expansion engines, and where it is possible condensers have been employed. Some of the latest plants have machinery of the highest possible efficiency, and yet if we consider the price per horse-power of the power generated, we will find that it is greater than we expect. This is partly due to the fact that for both lighting and power purposes the load on the station, is, as a rule, not uniform and the apparatus is not working under the best conditions for economy. In this country electrical energy is principally generated for electric lighting, for electric traction, and for supplying stationary motors, the stationary motors, as a rule, being supplied with current from lighting stations. If we take the load diagram of such stations in large towns, we will find that the average output is not greater than 30 to 40% of the maximum output. We have, therefore, to supply a large amount of machinery corresponding to the maximum demand on the station, while for distribution a large amount of copper is required that is only being used at its maximum capacity for a comparatively short period of the time.

In stations supplying power for traction purposes we find a variation of load, but the variation is a different kind from that found in a lighting station. In the latter the load varies at different hours in the day, but for any particular instant it is practically constant. In the former the average load for different hours during which the station is operated will be practically constant, but there will be momentary variations depending upon the size of the station and the type of traffic. Taking for instance a 2,000 HP. station in Baltimore, I find that the average load is 48% of the momentary maximum load. This difference in the kind of variation for the two types of stations necessitates employment of different apparatus to obtain the maximum economy for each type. For lighting stations, triple expansion engines may be used, while for traction work, where the variation in the load is sudden and

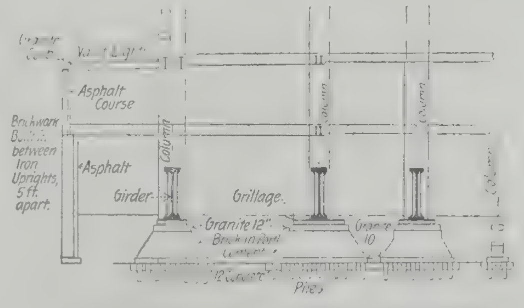


Fig. 14.—Section on Park Row, Showing Foundations and Distributing Girders.

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*Condensed from the presidential address before the American Institute of Electrical Engineers, Sept. 23, 1896.

**Pres. Am. Inst. Elec. E., Johns Hopkins University, Baltimore, Md.

may occur after the steam is cut off from the high pressure cylinder, it is not well in general to go beyond compound engines, and there is even a question as to whether simple engines are not more economical when condensing water cannot be obtained. In any case, however, it is of the utmost importance as regards economy of operation that the load should be made as constant as possible.

Two distinct types of distribution are used for incandescent lighting in this country—the single-phase alternating current and the direct current three-wire system. At the present time the former does not permit the supplying of power. As alternating distribution is at high potential, it does permit the location of the station where the conditions of maximum economy can be fulfilled. The three-wire incandescent system using low voltages may be used for supplying motors, but the amount of copper necessitated by the low pressure has caused such stations to be located near the center of distribution irrespective of the best conditions for the economical operation of the plant.

With the alternating system it seems impossible to provide even a moderately steady output, but with the continuous current system the motor load during the day gives an average output greater in proportion to the maximum. Some years ago the question of the relative values of the alternating and direct current systems was discussed, and for a while most of the stations installed were of the alternating type. At present the tendency seems rather in the direction of continuous current stations, especially in towns where there is a large demand for current within a comparatively small area. There is a great advantage of direct currents in that they allow the employment of storage batteries, which equalizes the load on the station. In almost all of the large lighting plants, both here and abroad, this plan has been adopted to a greater or less extent and the results have been so favorable that the battery equipments in many of our stations are being increased. The efficiency of batteries in lighting stations is comparatively high, while the depreciation has been greatly reduced, and is not now over 5 or 6% per annum. In most systems, however, the full benefit of the storage batteries is not realized, as the batteries are placed in the station, and while the advantage of an approximately constant load is obtained, yet the further advantage offered in distribution is not secured. I will take this question up later.

In New York, Brooklyn, Boston and Chicago a large proportion of the direct current lighting stations are situated where it is expensive to handle the coal and ashes, and where the economy due to condensation is not obtained. It is also the custom to use several stations instead of a single large station, and this increases the cost of production both in operating expenses and fixed charges. The question arises whether we have reached a point where it will be more economical to consolidate the stations in the best possible location for economical production of energy, and make use of the means of distribution which have been developed in the last few years to increase the radius at which energy can be supplied.

As far as traction stations are concerned, their efficiency and output would be increased by the use of batteries, both because the machinery would be steadily loaded and because the most efficient type of apparatus could be used as is the case in lighting stations. By the consolidation of railroad properties that has taken place in the last few years, single corporations operate electric lines over extended areas. It is the custom to build a number of stations, each running a certain section of the line, the idea being that the decreased cost of copper and the decreased possibility of a shut down would more than compensate for the increased cost of operation and fixed charges. It is, again, important to consider the question whether we have not reached the point where a single station can be built in such a way that there is little or no possibility of any accident causing a suspension of the entire traffic of the system, and where improved methods of distribution will decrease the amount of copper so that it will not exceed that required by the present method of using a number of generating stations.

If storage batteries are used, the two types of variable load belonging to lighting and power stations demand different types of battery. For lighting stations a considerable capacity is required, while the momentary variations of power stations do not require any great capacity, but demand as great a maximum output as battery manufacturers can obtain.

In water power plants the conditions of economy are different. The location of the plant is, of course, definitely fixed, and the advisability of obtaining a uniform load, by means of batteries, depends upon the local conditions. If the water power is limited and is less than the demand, then it might be well to use batteries in order to increase the amount of salable power. Again, if the development is expensive, it might be cheaper to develop a smaller amount of power, pay for a smaller amount of machinery and increase the output by the addition of batteries. These are questions that can only be decided by a knowledge of the local conditions.

Electrical Distribution.

The distribution of electrical energy to consumers as distinguished from its transmission to long distances, has been largely accomplished by the agency of continuous currents although alternating currents have played an important part in incandescent lighting. As I have stated a considerable proportion of current for lighting is distributed at constant potential on the three-wire system, or at constant current on arc light circuits, while power for traction circuits is distributed at approximately constant potential at an average of say 550 volts.

I shall first consider the condition of affairs in a traction system in a large city, where a number of suburban lines are operated. If direct distribution is attempted from a single station, it will be found that when the distance exceeds five or six miles a large amount of copper must be employed to prevent both excessive loss and excessive variation of potential on the lines. On suburban lines it is the latter consideration that usually determines the amount of copper used, and this is especially true on lines where there is a considerable excursion traffic. Even in the city itself, the supplying of sections at distances three or four miles from the station may require so much copper that it would be less expensive to operate separate stations. Several methods other than the direct method may be employed to remedy these difficulties. For outlying lines where the traffic is mainly of the excursion order, being variable both during the day and for different seasons, boosters may be advantageously used. It is perhaps best from reasons of economy to run the boosting dynamos from motors. These dynamos are series wound and are connected to feeders of such resistance that the fall of potential in the wire for a given current is compensated for by the rise in voltage of the booster. There is a decreased cost of copper incidental to this system, due to the fact that the drop is not limited by considerations of regulation—the voltage at the end of the feeder being constant—while the transmission is at an increased potential. If the average station potential is 600 volts, and it is boosted 300 volts, then the copper for a given loss would be decreased in the ratio of 36 to 81. The booster system has the advantage of the direct system when the cost of the additional apparatus together with the increased loss on the line, capitalized, is less than the increased cost of the copper necessary to produce the same result by the direct system. Whether the balance is in favor of one or the other depends on the distance and the variation of the load, and it is indifferent whether the variation in the latter occurs often or not.

If any transforming device is employed to feed a distant section of the line it must be remembered that the capacity of the device must be great enough to look out for the maximum demand on this section. Suppose now that we wish to feed some suburban line where the load has considerable momentary fluctuations but where the traffic is moderately constant during the year. In this case the booster could be used with a storage battery at the end of its feeder, the battery supplying the line. The advantages of this combination are greater than with the simple booster and in many cases they will compensate for the interest and depreciation on the battery and the loss in it. If the arrangement is properly made, the load on the booster and line wire will be practically constant, thus decreasing the capacity of the booster to that required for the average load, while less copper will be required for a given loss. As to the latter point, suppose a given amount of power is to be distributed in 24 hours, say 200 amperes at 600 volts, if the load is uniform, the loss will be proportional to $200^2 \times 24$ hours. If it is all distributed in 12 hours, the loss will be proportional to $400^2 \times 12$ hours, or twice as much. So in the case of the steady load the same power could be transmitted with the same loss with half the copper. It makes no difference whether the variation extends over 12 hours in 24 or it occurs every other minute, the result will be the same. It is apparent then that it is of the utmost importance to keep the line steadily loaded, as well as the station, and this points to the location of the battery near the points of consumption and not in the station. By this system—a booster with storage batteries—it is possible, assuming the same loss, to transmit power to a distance of ten miles with approximately the same amount of copper that would be required for a five mile transmission on the direct system. It would increase the economical radius of distribution twice and the area of distribution four times. A single station could economically supply lines within distances up to ten or twelve miles. If it is desired to still further increase the radius of distribution, it is possible to do this by employing some of the alternating current methods that have come into use. I will discuss these methods later, but at this point I may remark that the use of stationary rotary transformers permits the energy to be transmitted in the form of alternating currents, and to be changed again into continuous currents of any required voltage. These rotary transformers supplied by an alternating current which is transmitted from the station at a high voltage, may be used to feed the line directly or they may be used to supply storage batteries which are connected to the line. In the latter case we have the advantage of decreased size of apparatus, of steady load on the station, and of a minimum cost of copper on the line; which system it would be best to employ would depend upon the distances and the character of the line and load.

Of the systems that I have proposed for city and suburban distribution from a single station three have been successfully employed, namely: the booster system; the booster system with batteries and rotary transformers operating directly on the line. When we consider the advantages of a single station and a steady load, it seems evident to me that many of the large traction systems would do well to concentrate their stations into one and to use the booster system with batteries for their outlying lines, and if necessary use rotary transformers for lines beyond the limit of ordinary suburban work. As to the possibility of the complete shut down of such a station, we have reached such a point in the construction of machinery, both electric and mechanical, that with a proper reserve, a careful system of duplex steam piping, and with fire proof construction of the station, such a possibility may be disregarded; while the batteries would look out for any momentary interruption on the feeders.

Continuous Current Low Voltage Distribution.

Some of the most important stations supplying incandescent lamps are operated on the three-wire continuous current system. In the last few years a considerable advance has been made in the sale of power for motors from these stations, and this has increased the revenue and has given better average output. The tendency in this country has been in the direction of using storage batteries in such stations, and abroad practically every continuous current station uses batteries. As in the case of traction systems it has been the custom in large cities to build a number of separate stations instead of building a single plant and distributing from it. The batteries have been placed in the stations themselves and no attempt has been made to decrease the amount of copper used by employing a number of centres of distribution and giving the main feeders a steady load. The same considerations that apply to stations for traction work will also apply to stations used to supply lights and the same methods of distribution may be used. It would unquestionably be more economical, in many instances, to use single stations, to transmit power from these stations to centres of distribution, where batteries may be located and to distribute from these centres on a three-wire system. A case in point is the system used at Buda Pesth, where the energy is distributed from the central station to rotary transformers at sub-stations, these rotary transformers feeding batteries, current being distributed from these batteries on a three-wire system. The reports of the operation of this station show that it is both economical and successful, and it might well be copied by some of the companies in this country. The gross receipts of some of the large illuminating companies bear such a large proportion to the company's stock that a comparatively small saving in operation would mean a considerable increase in the dividends, and there is no doubt in my mind that by using one power station, with battery substations for distribution, that the operating expenses can be considerably decreased.

Alternating Currents for Lighting.

Alternating currents have been employed for lighting in this country, and they have been especially valuable where a district is to be supplied in which the distances are considerable as compared with a number of customers. It has been almost the universal custom to supply small transformers for each consumer, and while the average size of transformers is greater now than it was a few years ago, yet they are comparatively small. No power has been supplied from such stations, and although alternating arc lamps are used to a limited extent, yet the number is not increasing, and in some cases continuous current arc lamps have been substituted for the alternating. Under these conditions the load on the station is even more variable than in the case of a continuous current supply where motors may be employed, and the constant loss due to the large number of small transformers used, places this system at a disadvantage as compared with the continuous current system. The great advantage it possesses lies in the increased area of distribution rendered possible by the high voltages that are used, together with the possibility of locating the stations where power can be cheaply made. Abroad in the last few years most of the new stations that have been built use continuous currents, although some years ago the greater proportion of them were alternating current stations. It is also the custom abroad to use sub-stations with large transformers for distribution, thus doing away with a considerable part of the constant loss due to the small transformers used here. It is not possible, at the present time, without greatly complicating the system, to obtain a steady load on the station, and the only question that arises is the value of sub-stations, and the possibility of using some form of alternating current other than the single-phase.

Methods of Electrical Transmission.

Coming to the question of transmission of electrical energy as distinguished from the supply to customers from distributing centers, there have been great advances made in the last few years, and these mainly through the introduction of multi-phase alternating currents. Single-phase alternating currents permit the transmission of power to long distances and its distribution for lighting purposes. It is also possible to supply power from such circuits to large motors working under a steady load. It is not possible, however, to distribute power economically for ordinary uses. As most long distance transmission schemes contemplate the substitution of electric motors for steam engines, and as their success will, in many cases, depend upon the possibility of such substitution, single-phase alternating currents are not at present able to comply with the conditions imposed by the desired service. The introduction of multi-phase alternating systems, where two or more alternating currents are employed, the currents differing in phase, has completely changed the situation with respect to long distance transmission. I shall consider briefly the possibilities of such systems and their value as compared with any direct current system.

Continuous Current Transmission.

The first long distance transmission plant was operated by the continuous current system, and even now plants are being built in which continuous current of high potential are used to transmit energy to distances up to 15 miles. As compared with transmission by means of alternating currents, we will find that the continuous current system posseses some advantages and some disadvantages. If we consider the relative cost of the copper in the line for a given amount of power transmitted and for a given maximum potential between the conductors, we will find that the relative amounts for the continuous current and the different alternating current systems, will be as follows:

Continuous current	100
Single-phase alternating	200
Two-phase "	200
Three-phase "	150

We see then that the continuous current has a marked advantage over the alternating current systems as far as the cost of copper is concerned. There are, however, certain practical disadvantages belonging to this system. The high voltages necessary for long distance transmission makes it impossible to distribute the current at the receiving end without first reducing the voltage. With continuous current this can only be done by employing a rotary commutator of some kind. A plan which has been practically and successfully used has been to run a number of dynamos in series at the generating end of a line, while at the receiving end are a number of motors, also arranged in series, which are used to drive other generators to give the required type of current and the desired voltage. It has not been found possible to make either dynamos or motors of any great output, as there are practical difficulties in running dynamos of high potential where the current taken from them has a considerable value. M. Thury has installed a number of continuous current transmission plants that have apparently given excellent results. At Biberist, a transmission of 15 miles is employed. At Brescia, 700 HP. are transmitted over 12 miles at a maximum of 15,000 volts. M. Thury states that generators for 45 amperes can be constructed up to 3,000 volts, and he thinks that 4,000 could be successfully used. These machines, however, are small when compared with the 5,000-HP. dynamos in use at Niagara, for instance, and where the transmission is a large one the great number of machines necessary would be a serious objection to this type of transmission. It will be seen that the greatest possibility of trouble in such a transmission lies at the ends of the line, in the generating and receiving apparatus. It is necessary, no matter what our voltage is, that both the dynamos and motors shall be directly subjected to it, and this with commutated machines will always be a source of danger. If we are to do any considerable amount of lighting from such a station, our energy for this purpose undergoes three transformations before it reaches the lamps, and the efficiency would not be so high as in a corresponding alternating current system. It would hardly be possible to supply motors for ordinary work at the high voltages used for transmission, and the current for them would have to be transformed in the same manner as the current for the lamps. It must be recognized, however, that this system has been successfully used and has given excellent results in a few cases of transmission. Its great advantages lies in the decreased amount of copper as compared with the alternating systems, and in the absence of induction effects, which are a drawback to alternating current transmission.

Transmission by Alternating Currents.

A large proportion of the transmission plants that have been installed in the last few years have been of the alternating current type. These have, as a rule, given satisfactory results, and the installations that are now being erected or planned are almost exclusively on an alternating current basis. The great advantage of this system lies in the fact that it is possible to change the voltage of the current without the use of rotating apparatus, and at once economically and safely. Low voltage dynamos may be used, the voltage may be increased in any desired ratio by stationary transformers, the energy may be transmitted at an increased voltage and at the receiving end of the voltage may again be reduced by transformers. If we compare this method with the continuous current system, we will see that to obtain an alternating current of the required pressure at the receiving end of the line, we would use the same number of transformations required by the continuous current system. We have the great advantage, however, that our changes in voltage have been obtained by the agency of stationary apparatus, which is much cheaper, is more efficient and is safer than that required in the continuous current system. It is possible to increase the voltage by means of transformers to almost any value with perfect safety and with an efficiency as high as 98% or 99%. If then our alternating current, when it has been reduced at the receiving end, is as valuable for distribution as the current obtained by the direct current system, there will be no doubt that alternating transmission has great advantages over continuous currents.

I have spoken of the relative amounts of copper required by the single-phase, two-phase and three-phase alternating currents. I do not think it necessary to explain minutely the difference between these systems, as they are well understood. In a single-phase system a single alternating current is used. In a two-phase system two alternating currents, whose phases differ by 90°, are employed, while in the three-phase system, there are three currents differing in phases by 60°. I shall consider the characteristics of these three systems, as there has been much discussion especially as to the relative value of the last two of them for transmission work. I shall not discuss the various modifications of the systems, but shall confine myself to general considerations. There is no single-phase motor in successful commercial operation that does not require to be started from rest by some outside means. This prevents a single-phase current from being used at the present time for power distribution; and as, in most transmissions, the distribution of power is an important item, single-phase currents are not suitable for this purpose. In a two-phase system the currents are usually carried on separate pairs of wires, while in the three-phase system, three wires are generally used, a common return being unnecessary as the sum of the currents is zero, unless the circuits are unbalanced. In distributing on the three-phase system, a fourth wire can be employed, as it gives an advantage in the amount of copper used.

In all these alternating systems the great difficulty lies in the fact that the inductance of the circuit causes the current to lag behind the electromotive force. This decreases the amount of energy transmitted by a given current at a given voltage; it causes a drop in the voltage of the line, and it increases the armature reaction of the dynamo for a given current. The total inductance of the circuit is made up of the inductance of the transformers, of the dynamos, of the receiving apparatus and of the line. In the case of transmission to very long distances the line inductance is a large proportion of the total, while the inductance of the receiving apparatus depends upon whether lights or motors are to be supplied and upon the construction of the latter. When the different wires of the multi-phase system are fed from windings on the same dynamo armature, then the drop in voltage due to any excess of load on one of these circuits cannot be compensated for on the dynamo itself. If the amount of current and the lag of the current is the same for all of the circuits of the system, then it is easy by a compound winding of the dynamo, or by changing the current in the field winding, if there is no compounding, to keep the voltage constant at either the sending or receiving end. When the load on the different wires of the system is not the same, however, it is, as I have stated, impossible to keep all of the circuits at the proper voltage. Where a two-phase transmission with separate circuits is used, then if the separate circuits are wound on different armatures, each can be regulated to give a constant voltage at the receiving end. This is the case, for instance, in the large dynamos built by the Westinghouse Company for use at the World's Fair in Chicago. The difficulty due to the uneven loading of the circuits is specially marked in the case of the three-phase system, and it is one of the principal objections that have been urged against the employment of this system for distribution. It should be pointed out, too, that it is not enough to balance the quantities of current for the three-branches of the system, but the character of the current must also be considered. A non-inductive load on one wire, with an inductive load of equal value on the others would cause an unbalancing just as if the currents differed in amount. In most of the transmission plants that are being operated and that are proposed, it is required to run both lamps and motors from the same circuits, and while a slight variation of potential on the motors would not cause any particular trouble, yet the successful operation of the lamps requires a practically constant voltage. I think, however, and the same grounds have been taken by others, that in any practical transmission of considerable size, it is possible to so balance the loads that this difficulty will not exist to an extent to cause any serious trouble. When the distributing part of the lines is reached it is usually the custom when a three-phase transmission is used to employ four instead of three wires. As for line induction in the two-phase and three-phase systems, there is no question that the latter has an advantage in this respect. By suitable arrangement of circuits the line inductance can be brought to a minimum, and this is of the utmost importance in long distance transmission. I will not take into account the supposed increased efficiency of three-phase motors and dynamos as against two-phase apparatus, as there is a question as to whether a superiority exists, but simply considering the decreased amount of copper required and the decreased inductance of the line, there is no question, in my mind, that for transmission, the three-phase system is superior to the two-phase. It is well known, of course, that the inductance of the circuit can be, in some measure, compensated for by the use of condensers or over-excited synchronous motors. The first of these remedies is, however, a very uncertain quantity commercially, while the second should be used as much as possible, that is, as many synchronous motors should be connected as is practicable. The best remedy, as things stand at present, lies in the careful construction of the line and the apparatus, so that the effects, although they exist, can be reduced to a minimum.

It has been shown by Mr. Scott, and others, that it is possible to transform a two-phase into a three-phase current, to transmit it and to transform it back again to a two-phase current. This will allow us, if we wish, to use two-phase dynamos for generating the current, to transmit with the advantage incidental to the use of three-phases and at our reducing end to use two-phase circuits for transmission. This has some advantages as far as balancing the voltage on the circuits go, and it has been proposed in the case of several plants whose installation is being considered.

Looking broadly at the value of alternating transmission as against continuous current transmission, we have a gain in the simplicity and safety in the transmission, and at the distributing end the use of multi-phase currents enables us to supply both lamps and power with an economy and success comparable to that of the continuous current system. If it is necessary to use continuous currents for certain types of distribution at the receiving end, they can be obtained by the use of rotary transformers, by which the alternating current is transformed into a continuous current. These machines have approximately the efficiency of corresponding continuous current dynamos, while the output for a given size is about 50% greater.

Possible Voltages and Distances of Transmission.

A number of calculations have been made as to the possibility of transmitting electrical energy to very long distances. If the question of cost of transmission alone is considered, then where water powers or culm heaps are within distances of 100 miles of some large center of consumption, it has been shown that it would be profitable to generate and transmit electrical energy. In these calculations, however, voltages are assumed that have never been employed for commercial plants, and whose availability is problematic, while sufficient stress is not ap-

(Continued on Page 235.)

Plants for Long-Distance Electric Power Transmission.

Name.	Type.	Distance, miles.	Line voltage.	HP.	Remarks.
Ouray, Colo.	Direct.	4	800	1,200	Successful, increasing.
Geneva, Switzerland	"	20	6,600	400	Successful.
San Francisco, Cal.	"	12	8.000	1,000	Successful, nine years.
Brescia	"	12	15,000	700	
Pomona and San Bernardino	Single-phase Alt.	13½ to 28¾	1,000	800	Successful, increasing, 4 yrs.
Telluride, Colo.	" " "	3	3,000	400	To be increased, 3,200 HP.
Bodie, Colo.	" " "	12½	3,400	160	Successful.
Rome, Italy	" " "	188	6,000	2,000	Increasing, 9,000 HP., 3 yrs.
Davos, Switzerland	" " "	2	3,660	600	Successful.
Schongeisung. Germany	" " "	4½	2,600	820	"
Springfield, Mass.	2-phase Alt.	6½	3,600	820	"
Quebec, Can.	" "	8	5,000	2,130	"
Anderson, S. C.	" "	8	5,500	200	"
Fitchburg, Mass.	" "	2¼	2,150	400	"
Winooski, Vt.	3-phase.	2½	2,500	150	"
Baltic, Conn.	"	5	2,500	700	"
St. Hyacinthe. Can.	"	5	2,500	600	" two years.
Concord, N. H.	"	4	2,500	5,000	" two years.
Fresno, Cal.	"	35	11,000	1,400	" to be increased.
Big Cottonwood to Salt Lake City, Utah	"	14	10,000	1,400	"
Lowell, Mass.	"	6 to 15	5,500	480	"
Sacramento-Folsom, Cal.	"	24	10.000	4,000	One year.
Redlands, Cal.	"	7½	2,500	700	3 yrs., ext'd'g to other towns.
Lauffen to Frankfort, Germany	"	100	30,000	300	(Experimental.)
Lauffen to Heilbronn	"	9	5,000	600	Successful.
Oerlikon Works, Zurich, Switzerland	"	15½	13,000	450	"
Portland, Ore.	"	12	6,000	5,000	"
Silverton Mine, Col.	"	4	2,500	400	" to be increased.

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In the description of the Water Power and Electric Transmission Plant of the Big Cottonwood Power Co., in our issue of Oct. 1, we neglected to state that the photographs which accompanied the article were furnished by the courtesy of the General Electric Co., through its representative, Mr. J. McGhie.

◆

The notable increase in exports of American manufactures during the present year was discussed editorially in our issue of Aug. 13. We are now able to present figures showing how considerable and rapid has been the growth of our exports of manufactured goods during the past four years and especially during the past year:

Year.	Exports of manufactured goods from U. S. during first 8 months of year.
1890	$99,887,607
1891	113,532,976
1892	99,125,836
1893	113,618,131
1894	118,049,055
1895	129,441,726
1896	163,112,670

The "Journal of Commerce," from which we take the above table says:

> It will be observed that the increase in exports of manufactures for eight months is larger this year than for any previous year in the commercial history of the country. The increase over six years ago is nearly 66%, and would soon give the United States a firm footing in manufacturing exports if it could be repeated through successive series of six years.
>
> The details of the manufacturing exports for August last have not yet been fully compiled at the Bureau of Statistics. If they follow the record of other recent months, however, they will show that a large part of the increase is in classes of goods in which American skill and inventive genius are important factors. There has been a large increase of the export of refined mineral oil and of copper ingots, but the increase in these items does not begin to represent the total increase. The increase in the export of bicycles, electrical and scientific apparatus, stationery and other manufactures of paper, and railway cars and locomotives indicates that the United States have little to fear from foreign competition in these articles.

The success of American manufacturers in securing foreign orders during the present year is something of which the nation may well be proud. It is to be hoped that the trade which has been fairly won in open competition with the manufacturers of Europe may be held from this time forward. As we said some weeks ago, there is no reason why the greatest manufacturing nation of the world should not excel all others in its exports of manufactured goods.

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The separation of ashes and other non-organic matter from household garbage is becoming a troublesome question in many of our large cities, and will soon be a subject of anxiety, if not of controversy, in smaller cities and towns. It has been forced to the front largely through the adoption of garbage utilization systems, which can only be profitably operated upon pure garbage, and hence require the separation of ashes, paper, etc., from the mass. But experience and reflection is teaching that all these non-organic matters in city wastes, if kept free from the contamination of the garbage can, are perfectly sanitary and thus are in no more need of expensive treatment by cremation than by utilization processes; nor do they need to be towed for miles out to sea, nor hauled for miles into some remote suburb of a city. The clean ashes are a valuable filling material. The rags, bottles, paper and various other materials are either of some commercial value or may be easily reduced to small bulk without offense by burning. It has been claimed by some of the manufacturers of crematories, that they prefer ashes mixed with the garbage on account of the fuel value of the unburned coal, but where a longer haul is required to cart ashes to the crematory than to low lands where they may be used for filling, the force of this claim is reduced or lost altogether, especially as the ashes must be handled twice at the works, once before and once after treatment, and still remain for final disposal.

New York city has, since Aug. 1, been compelling the separation of garbage from all other refuse, in preparation for the opening of the garbage utilization plant now under construction. If the system can be enforced in New York with its large apartment houses and crowded tenements, it certainly ought to be practicable in smaller places. True, New York has well organized health and street cleaning departments, which are absolutely essential to the success of the plan. Other communities may have the same if they will.

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Going almost to the other extreme in point of size, the town of Montclair, N. J., a suburb of New York, with some 12,000 inhabitants, is trying through its board of health to enforce the separation of garbage from non-organic material. The method of garbage disposal in vogue at Montclair, is the primitive but sanitary one of burying beneath a few inches of soil. Farm land is leased for the purpose, but the lease prohibits the dumping of matters that will unfit the land for future cultivation. This provision, coupled with the fact that the haul is a long one, and the expense of trenching for and covering ashes altogether unnecessary, has led to the inauguration of an attempt to prohibit public scavengers from hauling mixed garbage. There are plenty of places where by short hauls ashes may be used for filling, but right here the Montclair board of health experienced one of the greatest difficulties in connection with its work. Ashes mixed with garbage, and sometimes garbage alone, were frequently used to fill in land intended for immediate use as building sites. In one instance, a property owner was fined $50 for allowing mixed garbage and ashes to be dumped in such a manner.

In view of the attempts of so large a city as New York and so small a town as Montclair, the controversy at New Orleans, briefly detailed at the close of an article in another column, seems puerile in some of its details. The city of New Orleans entered into a contract with a company to remove and dispose of the garbage of the city, the contract specifically stating that ashes and other refuse should not be mixed with the garbage. The citizens have failed to perform the separation, the company has refused to take mixed garbage, the city council has voted to annul the contract, and the matter is now in the courts. It is alleged in behalf of the citizens that carrying out the clause of the contract relating to separation would compel them to perform menial service for the profit of a corporation, an argument which appears to be a cross between a legal technicality and a political stump speaker's style of argument. The necessity of separation and its real advantage does not seem to be realized by the people, who appear to consider themselves imposed upon by the company and to forget that the contract is specific on the points named, and the company is only insisting upon its rights under the contract.

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How important the construction of fireproof buildings has become, as a factor in the consumption of iron and steel, is well illustrated by the lofty Park Row Building, which is illustrated on our inset sheet this week. The total metal in this structure will reach in round numbers 9,000 tons. This is as much steel as would be required to lay 100 miles of track with 50-lb. rails, so that the construction of this single building furnishes as much business to steel works, blast furnaces and iron ore miners and shippers as the construction of a railway 100 miles in length.

Still more impressive is the comparison with bridge work. The famous Memphis bridge across the Mississippi River has the greatest span of any truss bridge in the world, except the Forth bridge, but its main cantilevers and the side spans with a total length of about 2,600 ft. weigh 7,000 tons, or 2,000 tons less than the steel in the Park Row Building. Comparing with another class of bridge work, an ordinary country highway bridge of 100-ft. span may have perhaps 500 lbs. of steel per lin. ft. in its trusses and floor, or 25 tons in the whole structure. It will be seen that no less than 360 such spans could be built, reaching, if placed end to end, nearly seven miles, with the steel which will be placed in the Park Row Building.

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And this matter of the weight of the structure is of much interest in connection with the much-talked of question as to the stability of such very lofty structures under high wind pressures. We account it a remarkable instance of high wind pressures when an iron bridge is blown down; but the above comparison shows that for a given area of base, the weight of the metal work in even the heaviest bridges is trifling compared with the weight of metal in a modern "sky-scraper." Engineers accounted it a well-nigh inexplicable phenomenon when a few years ago a wind lifted from its piers an uncompleted span of the Louisville & Jeffersonville bridge, weighing 1,000 tons, and dropped it in the river. But this span covered a length of 550 ft. and a breadth of 32 ft., while the Park Row Building has a frontage of 156 ft. and a depth of 104 ft.

Of course the weight of the metal-work in the building is only a part of the weight of the structure. Besides the metal-work we have the weight of floors, partitions, ceilings, plastering, fireproofing, and the weight of the contents of the structure. Probably the entire weight of the building when completed and occupied is not less than three times the weight of the steel in its framework, or a total of 18,000 tons. What these figures represent in the way of mass and inertia, and resistance to any external force such as wind pressure is difficult for even an engineer to fully comprehend; but the comparison, when carefully made, between the mass of such a structure and the pressure that even the most powerful gust of wind might momentarily exert against it, gives one full confidence in the stability of the building.

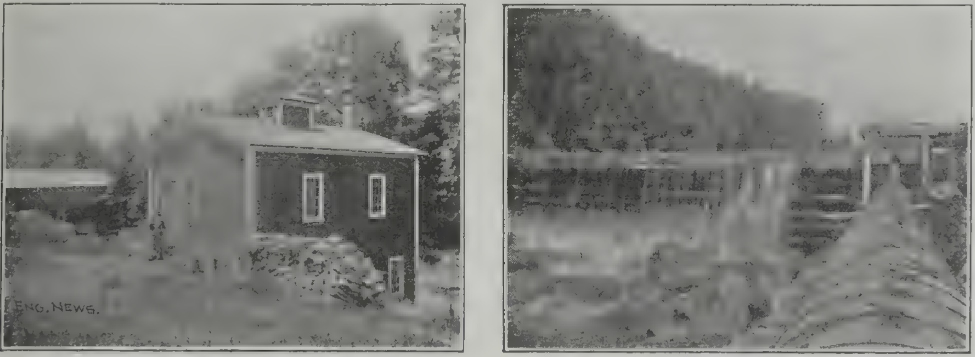
THE CHEAPEST ELECTRIC LIGHTING PLANT IN THE WORLD.

It is quite a common thing to see in the displayed head lines of the daily newspapers the statement that this or that or the other thing is the largest or longest or smallest or shortest, or whatever particular quality is named, in the world. If one stops to analyze this statement, he must necessarily reach the conclusion that what is meant is merely that the writer of the description in question does not know of anything in existence that is larger or longer, or whatever the particular characteristic may be, than the thing of which he writes. For however wise he may be or however broad his experience, it is quite sure that his knowledge is not world-wide; and that whether he be an expert or amateur, there is a possibility or a probability that other things of which he has never heard may excel that of which he writes.

We are not in the habit of taking the daily newspapers for a guide, but in this instance we have concluded to copy for once their practice in this respect and to call the electric lighting plant which we are about to describe, the cheapest in the world. The reader will understand from the above explanation that we give no guarantee that there may not be other cheaper plants somewhere in existence. We simply assert that we have never heard of any such, and further that the circumstances in this case lead us to believe that electric light is being furnished by this particular plant at a cost about as small as would be possible under favorable conditions anywhere.

It is not alone because of its cheapness that this system is of interest. It is a notable instance of an enterprise carried out by a municipality with remarkable economy and success, and it is typical of what has been and may be done in hundreds of small towns to furnish them a cheap and convenient system of street and private lighting to replace the dim kerosene lamp and lessen the consumption of the world's fast diminishing store of petroleum.

The plant we are to describe is located in Johnson, Vermont, a small village in the heart of the Green Mountains, about 30 miles south of the Canadian line. The population of the village is about 600. Its assessed valuation for taxing purposes is a little short of $225,000. It contains two or three small manufactories, and the churches, school buildings, stores, etc., which one would expect to find in a New England village of its size.



View of Power House. View of Dam and Penstock.

POWER STATION OF THE ELECTRIC LIGHT PLANT AT JOHNSON, VT.

The residents are, with few exceptions, people of very modest incomes, living plainly and simply, and a dollar goes as far in the payment of living expenses as five dollars would go in a large city.

About the only one of Nature's gifts with which this region is lavishly blessed, is water power. Within the limits of the township, mountains rise in various parts to an elevation of some 2,000 ft. above the valley in which the village lies, and the water power which runs to waste in the township aggregates probably over a thousand horse-power. Within the bounds of the village itself there has been for several years an abandoned mill-dam, which once furnished power to a large saw-mill. With the exhaustion of the timber supply the saw-mill was dismantled, and the water power was left unused.

Up to the time when the electric light plant we are about to describe was installed, kerosene was, of course, the sole illuminant. The streets were not lighted at all save as an occasional public-spirited citizen maintained a kerosene street lantern in front of his house. But stumbling along dark streets and living in dimly-lighted houses, while water power ran to waste close by, was an anomaly which at length attracted the attention of some of the more enterprising residents, and after a careful canvassing of ways and means, a village corporation was organized and the work of installing an electric light plant was begun. The abandoned mill dam and mill site above referred to was purchased for a small sum; the dam was rebuilt in a substantial manner, and on the site of the old saw-mill a small wooden building was erected for a power house. The old Humphrey turbine, which had formerly run the saw-mill was purchased with the mill site. It is a vertical 33-in. wheel, rated at 45-HP., and runs at 160 revolutions. A round wooden penstock leads to it from the dam, a distance of some 50 ft., and is hooped with round iron bands, such as are used on wood stave pipe in the West (illustrated and described in Engineering News, Jan. 5, 1893). The accompanying views show in one case the dam and penstock and in the other the power house. It will be noticed in the view of the dam that the clear water of the mountain stream as it falls over the crest in a thin veil is so perfectly transparent that in places it is not seen at all in the photograph.

The power-house machinery is very simple. A bevel gear on the vertical turbine shaft drives a gear on a jack shaft; and from a large pulley on this jack shaft a belt runs directly to the dynamo pulley on the floor above. The belt is a two-ply leather belt, and it is of interest to note that such few stoppages as have occurred since the station began running have been chiefly due to this belt.

The dynamo is a Wood alternating current machine, built by the Fort Wayne Electric Co., and rated at 750 lights, or 37 amperes at 1,000 volts. The power house has a rock foundation, and the masonry pier supporting the dynamo rests on solid rock. A small independent dynamo driven by a belt from the main dynamo shaft furnishes a 110-volt current to excite the field of the larger machine.

The switch board is of skeleton wooden construction and carries the lighting arresters, ammeter and volt meter, switches for the house lighting circuit and for the series circuit, a converter and a rheostat. It will be understood that the system in use is the one which has come into great favor within a few years for lighting small towns, in which the street lamps are connected in series and take current from the same dynamo which furnishes current to the converters for the house lighting. The street lamps are of 30 c. p. each and are placed on the same poles that carry the wires of the primary circuit. They are set at a height of 15 ft. beneath a reflector shaped like an inverted cone, with an angle of about 165°. The lamps are spaced 125 ft. apart. There are 53 of these lamps on the series circuit, and 7 other street lamps take current from the same converters that are used for house lighting.

These converters are placed on the poles of the street circuit and are small enough in size to be inconspicuous. The total extent of the primary circuits is about 1¾ miles.

Originally the system was projected solely for street lighting, but it was soon seen that to obtain light for private use was a much more important end. At present some 900 lamps are connected on the house circuits, and more are continually being added. The interior wiring was done at the outset by the contractors who erected the street circuits, and additional wiring is now done by the engineer in charge of the power plant.

Turning now to the operation of the plant, the most notable feature is the practice of running the station only during the hours when light is needed. The dynamo is started in the afternoon as soon as any lights may be needed, often before sundown on a stormy or cloudy day, and runs till 11 p. m. From the last of September until April the station is also operated from 5 a. m. until daylight. The street circuit is not turned on until the streets become so dark that the lights are actually needed. On very bright moonlight nights the street circuit is not operated.

The lighting of the streets is exceedingly satisfactory and fully exemplifies the superiority of incandescent lights over arc lights for street lighting, except in cities of such a size that brilliant street lighting can be afforded. For the average town or city of moderate size, much more satisfactory results will be obtained in street lighting if a given amount of money be expended for incandescent lights than for arc lamps. Popular ideas on this subject are often at fault. Single arc lamps at street intersections with long spaces in total darkness between, do not give as useful a light as twice the number of incandescent lamps, equally distributed. The advantage of placing the street lamps on a series circuit is that the cost of converters for these lamps, and the considerable percentage of current loss in the small converters is entirely saved.

We have been thus full in our description of the plant at Johnson in order that the figures of cost which are to follow may be understood and appreciated. The total cost of the water-power mill site, water-wheel, power-house, dynamo, and entire electric apparatus, poles, converters, street circuits, etc., complete, ready for operation, was in round numbers, $5,600, of which the principal items were as follows:

Water-power privilege, mill site, dam and turbine	$1,150
Repairs on dam, penstock and wheel tub	410
Stone foundation for power-house	84
Power-house (above foundation)	350
Pulleys, shafting, etc.	117 85
Belting	45.54
Dynamo	1,175
All other electrical machinery in power-house, and converters, poles, wires, erection, etc. (let in one contract)	1,850
House wiring (portion paid by village)	300
Consulting electrical engineer	33.10

The annual cost of operation is astonishingly small. The plant was first put in operation in January, 1895. One man is employed at a salary of $425 per annum, has the entire charge of the plant, and the hours of running are such that he not only requires no assistant, but is able to do house wiring, read meters and all other necessary work in connection with the station during the day hours. He is the only salaried employee of the corporation. The other expenses of operation are exceedingly small. The following are the principal ones, estimated as closely as possible:

Insurance (actual)	$29.25
Oil	2.00
Printing, stationery and postage	10.00
Lamps (for street lighting)	50.00

During the 20 months since the system was put in operation the repair account has been so small as to be almost nil. Two or three new steps were made for the water-wheel, and the commutator of the exciter dynamo was turned smooth, and this, with other trivial repairs, was chiefly done by the engineer of the power station, thus involving no additional cost.

The fixed charges of the plant amount to $244 per annum. The plant was paid for by the issuance of $4,000 in bonds bearing interest at 4%, and the borrowing of $1,400, which will be paid off from the surplus receipts of the corporation as they accumulate.

Turning now to the other side of the account, the revenue of the plant, the following is the schedule of rates charged for private lighting:

Stores, Offices, Etc.

For each light	$3.00
Each light in cellar or back room	2.00

Hotels.

First light in each room, except sleeping room	$3.00
Each extra light in each room, except sleeping room.	2.00
First light in each sleeping room	2.00
Each extra light in each sleeping room	1.00
Each light in bath-room or water-closet	3.00
Each light in barn or livery stable	3.00

Public Halls.

Each light	$2.00
Each foot-light	1.00

Churches and Society Halls.

Each light	$1.00

Private Residences.

First light in each living-room or hall	$3.00
Each extra light in each living-room or hall	1.50
Each light in cellar	1.00
First light in each sleeping room, bath-room and pantry	1.50
Each extra light in sleeping room, bath-room and pantry	1.00
Each light in barn or shed	1.00

Meter Rates.

One-third of a cent an hour, to apply only to lighting private residences, churches, halls, hotels and manufacturing establishments. Meters to be furnished by the Village at the expense of patrons.

Minimum rate, 70 cts. per lamp per annum.

Outside Limits of Village.

Same rates as above, except that each patron is to be at the total expense of wiring, and to pay to the Corporation $1.20 for each light installed.

Regulations.

The cost of inside visible wiring will be $2.25 per light.

The Village will at any time before the contractor completes his contract wire buildings with visible wire for $1.25 per light; concealed wiring at actual expense above this, the owner to furnish lamps and fixtures in all cases. This is done as an inducement to patrons to take the light at once. All renewals to be furnished by the Village, at the expense of patrons.

Bills will be rendered semi-annually in advance, on the first days of January and July in each year, and must be settled within 30 days or the lights may be turned off without notice.

In case of deficiency of light, or any defect, notice should be given forthwith at the office that the defect may be remedied without delay.

Landlords will be held responsible for rent of lights used by their tenants.

The Village reserves the right to turn off lights in case the rents, or bills for wiring or supplies, are in arrears. or in case of violation of any rules pertaining to lights or plant. There will be an extra charge of $2 for turning on the lights again.

Rates for incandescent lights are based upon 16 c. p. lights and are to be increased or decreased proportionately as the power of lamps are increased or decreased: Providing, that not less than the price of a 16 c. p. light shall be charged for any one room, and that the price of three 10 c. p. lamps shall be the same as two 16.

All lights, meters and wiring to be subject to inspection by order of Trustees at all times.

A room which is divided by an archway will be considered as two rooms and lights in the same will be charged for accordingly.

The above rates read like a romance, it must be confessed, to users of electric light in the cities, who are accustomed to pay the time-honored rate of 1 ct. per lamp hour for electric lighting; but, as will be seen later, these rates, low as they are, are considerably above the actual cost of the light to the village corporation.

About 20 meters have been set, and in the first year of operation the total revenue from current furnished, both through meters and to lamps charged at annual rates, was in round numbers $1,000.

Besides the revenue from this source the street lighting is paid for in an indirect way. Each year the township has voted an appropriation of $200 toward the expenses of the electric lighting system. This is done on the basis that the street lights are as much of a benefit to those living outside the village, who use its streets when they drive to town, as to the dwellers in the village.

We may then sum up the results of the first year's operation of the plant as follows:

Operating expenses (about)	$525
Interest charges	244
Total outlay	$769
Receipts from private lighting	$1,000
Received from township	200
Balance of profit	$431

The increase in the number of lamps since the plant was first installed is such that for the current fiscal year the net earnings of the system will probably be between $500 and $600.

It is commonly said in criticising such figures as these that operating expenses are low because all the machinery is new and the repair account is small. It is undoubtedly the case that in making up the accounts of every such enterprise, the element of depreciation should be covered by adding a percentage of the first cost. What should this percentage be? In the present case it will be seen that on the water-power and real estate there is no depreciation. On the powerhouse machinery the depreciation is very small. The poles are of cedar and will probably have a life of not less than ten or a dozen years. As for the element of risk which is ordinarily to be taken into account—the chance of the machinery growing obsolete in the course of years—this is of little importance here, for the system installed is sufficiently good to satisfy the users for at least 20 years to come, no matter what advances may be made in artificial lighting. Suppose we estimate the cost of the part of the plant which is subject to depreciation at $4,000, and say that the allowance for depreciation must be such as will replace it at the end of 20 years. Then figuring compound interest at 4% we find that the annual charge for depreciation must be 3⅓% in order to effect this. This makes a charge for depreciation of $133 per annum (3⅓% of $4,000). Adding this to the operating expenses and interest charges we find the total cost of electric light per annum in Johnson village as almost exactly $900 per annum.

As we have shown above, the receipts at the start from private lighting alone were in excess of this, and with the increase in the consumption of light which is steadily going on, it is apparent that the surplus receipts will soon pay for the plant, so that it will be owned free of debt by the village. This increase of patronage, moreover, while it may necessitate the installment of some machinery of greater capacity later on, will not increase the operating expenses to any extent. The principal item in the operating expenses is the salary of the engineer; and he could operate the station alone as at present, even if it supplied twice or four times as many lights. It is not at all improbable, therefore, that a few years hence electric light may be supplied in Johnson at a considerably less actual cost per lamp even than at present.

The most common test of an electric light plant with its users is the frequency or the reverse of its breakdowns. Nor is this an unfair test on the whole; for an electric light station should be so designed and so operated that a breakdown wholly disabling the station should be made as remote a possibility as circumstances will permit. Of course in the Johnson station anything like duplication of machinery was not attempted; but in the 21 months of its operation there have only been two nights when the station was not run. In both cases the trouble was due to the wetting of the belt from a leaky pipe, which softened the cement with which the belt is made up. On one other occasion the station was shut down at 10 p. m. instead of 11 p. m. on account of the wearing down of the turbine step, causing the wheel to drop till the bevel gears slipped.

It may be of interest to inquire in what respects the plant may be criticised. Probably the most notable feature is the variation in candle-power of the lamps. The water-wheel gate is operated by hand and is opened or shut by the engineer at the station as the switchboard instruments show the increase or decrease of the load on the circuits. This intermittent regulation makes a variation in the candle-power of the lamps, which, in a city, would cause some complaints from the patrons of the station. Here, however, it appears to be accepted with equanimity, as a trifling matter and one not worth much expense to overcome. An automatic water-wheel governor of the ordinary Snow pattern is probably too slow to give much better results than hand regulation. A governor of the newer, quick moving patterns would be too expensive to be afforded.

A more important feature in which the station design will soon prove defective is the deficiency of the water-power. This has already made itself felt; and the turbine is to be replaced by a more efficient one in a short time; but this will probably give only temporary relief. Eventually it will probably be necessary to raise the dam some 10 ft. or more, which can readily be done by purchasing a little-used water-power on the same stream some 40 rods above. This would probably be sufficient for many years to come, as the village, like most country villages in Northern New England, cannot look forward to any considerable increase in size.

The Johnson electric light plant is very interesting as an example of municipal operation of a public lighting system. It will be apparent at once that if the village had waited until private enterprise furnished it with electric lights, it would have waited a very long time. The profits of the station at the very low price at which it furnishes light are too small to induce any one to undertake such an enterprise. On the other hand, if a private company had set up a station and offered current at rates materially higher than those now in force in Johnson, they would undoubtedly have had smaller net returns than those of the present station, for it must be constantly be borne in mind in the study of this case that most of those who are using the light in Johnson could not or would not afford it if its price were not so phenomenally low.

The corruption and incompetence with which municipal affairs are apt to be handled is an old story; but in the country towns of New England, where the "town-meeting" system of government still prevails, corruption or dishonesty in the management of town affairs is practically unheard of, and public matters are handled, as a rule, as intelligently and wisely as is the private business of the dwellers in the towns, which is of course all that can be expected.

The Johnson electric lighting plant was built and is managed by the trustees of the village corporation, elected annually at a village meeting and serving without compensation. The original trustees were Messrs. I. L. Pearl, O. B. Landon, C. H. Stearns, W. H. Nye and T. A. Riddle. At the last election Messrs. Enos Sherwin and B. A. Hunt succeeded Messrs. Pearl and Landon. Mr. Elmer Balch is the engineer of the power station; the writer is indebted to him and to members of the board of trustees for information used in the preparation of this article.

The reader who has carefully followed the above description will see that there are two principal reasons why electric light is furnished so cheaply at Johnson. First is the use of a water-power that costs when actually developed at the turbine shaft only about $32 per HP. The second is the construction and operation in the most simple and economical manner. The third is, we believe it is entirely fair to say, the owning and operation of the plant by the village, making it perfectly secure from competition and enabling the capital for construction to be secured at a low rate of interest, and also eliminating the element of speculation from the enterprise to a large extent.

It is because we have felt that there were some lessons in the experience with this Johnson plant which communities elsewhere might profit by, that we have given this much space to its description. There are still hundreds of country villages which, if they have not unused water-power at their doors, as had the village of which we have written, could develop water-power within a distance not so great as to make its cost prohibitory, and could thus have well-lit streets and homes in place of their present dependence on kerosene lamps.

There are other and larger communities whose water-power should be put to tenfold its present use in the distribution of electric light and power, and this will be done, when rates are lowered to a point which will encourage the extended use of electricity instead of being maintained at a point at which it is rightly regarded as a luxury.

Nor are we sure that the steam-operated electric stations have nothing to learn from the experience of the insignificant little village of which we have written. Production on a large scale is always cheaper than production on a limited scale. Other things being equal, electric light should be furnished in a city of 100,000 inhabitants more cheaply than in a village of 1,000. Is there not too great a disparity at present between the actual cost of steam power on the shaft of the engines in an electric lighting station and the cost of the same energy to the consumer when transformed to electric current and delivered at his house?

It is frequently urged that few electric lighting companies are paying good dividends, but may not this be due in many cases to the expenditures incurred for other things than legitimate and economical construction and operation?

We find manufacturing concerns installing electric lighting plants and lighting all their establishments at a trifling cost compared with other systems. We see street railway companies heating their cars by electric current although well aware that half or two-thirds as much current may be required to heat the car in cold weather as to propel it. All these things tend to show that when the business of manufacturing electrical current and transmitting it to consumers is conducted on an economical basis, it can be furnished at prices much below those now generally charged; and the large demand which will result when prices are lowered will very likely leave larger profits to owners than those that are now received.

THE CAPE COD CANAL CO., officially known as the Maritime Canal Co., has been authorized by the joint board of Railway and Harbor and Land Commissioners to issue "from time to time" the $6,000,000 stock and $6,000,000 bonds provided for in its charter.

LETTERS TO THE EDITOR.

Railway Construction in Japan.

Sir: The Sanyo Railway is the southernmost trunk line on the Hondo Island. We are just starting on the construction of 85 miles from Hiroshima to Mitashiri. After this piece is completed we have about 45 miles left from Mitashiri to Shimonoseki, which is the southern terminus of the line.

In all, Japan has now 2,350 miles of railway in operation, and the proposed lines, chartered and unchartered, amount in all to 12,000 miles. What percentage of these latter will be built, we, of course, do not know; but we conjecture that in 15 to 20 years Japan will have about 9,000 miles of railway, which would be about enough, as the geographical situation makes sea transportation very easy and economical.

While in America I thought American railway materials might be exported to Japan; but at present this seems well-nigh impossible. A few American rails have come; but at present it seems almost impossible to import them. Until a Central American canal is built the United States cannot export bulky goods to this country to any considerable extent.

Yours truly,
C. Kadono,
Assistant to Chief Engineer and Engineer of Construction,
Sanyo Ry. Co.
Hiroshima, Japan, Sept. 8, 1896.

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The Conversion of Silver into Gold.

Sir: My attention has been called to your issue of Aug. 17 in which you quote some remarks from the "Engineering and Mining Journal" of Sept. 5 with reference to myself. Those remarks were fully replied to by me in the next number of that periodical; but as many of your readers may not have seen my answer I trust you will permit me to make, in your columns, the following statement respecting my attitude on the question of the transmutation of metals.

I assert, and am ready to prove, if challenged to do so, that many of the most eminent men of science of to-day, as well as of past times, regard the transmutation of metals as being possible.

I assert, but am NOT ready to prove, that the conversion of silver into gold is an accomplished fact. I do not make this assertion in the hope or expectation of its being believed by anybody, whether scientific or unscientific. If Lord Kelvin or M. Berthelot or Prof. Ira Remsen were to make the like assertion, unsupported by proof, I should not feel myself called upon to believe it. I should not, indeed, doubt the personal veracity of such eminent men, but I should hold myself at liberty to deem them mistaken.

All that I intend or really do in the premises is to enter what may be termed a public caveat. I am firmly convinced that the end of this present century will see the advent of a new school of chemistry and physics which shall teach the way to technical progress far surpassing what has been accomplished under the doctrines hitherto accepted. I am not alone in this conviction; it is shared by many of the leading chemists of the day. I therefore conceive it a matter of scientific duty on my part to boldly throw down the glove of priority at the feet of my fellow-investigators. I issue my challenge to the whole world of science. If anyone thinks himself my predecessor in the art of transmuting metals, let him make public his claim. I will meet him, claim for claim, and proof for proof. If none take up my gage, my claim to be the pioneer and leader of the new chemistry will at least remain undisputed, and must be universally conceded whenever I may think proper to reveal its foundation of fact.

Stephen H. Emmens.
1 Broadway, New York, Oct. 1, 1896.

(In view of the present political situation, we cannot refrain from expressing regret that Mr. Emmens is not ready to prove at the present time that silver can be converted into gold.—Ed.)

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Nicaragua Canal and Earthwork Slopes in the Tropics.

Sir: In the issue of your paper of Aug. 13 I find two letters which refer to a letter of mine published in your issue of the 25th June.

The letter of Mr. J. T. Ford shows the necessity for further surveys on the Atlantic slope of the Nicaragua Canal, but Mr. Ford seems to infer that there is no such necessity on the Pacific slope, and, furthermore, thinks that I am not familiar with the ground near the Pacific terminus. Now, it is because I am familiar with the ground, and have been in Salinas Bay (although not over the line I propose), that I believe a survey should be made from the Lake to this port. I will admit that the cost of the canal itself, between the Lake and Salinas Bay, will be somewhat larger than that of the present line, but I believe that a proper survey of this route will demonstrate that the cost of the canal would not greatly exceed the cost of the present location plus the cost of making a suitable port at Brito, nor would the Salinas Bay line be much, if any, longer than the present location of the canal. As far as I am aware no survey has ever been made of the Salinas Bay line, and one should certainly be made of this route before the final location is decided.

I do not know enough of the Colorado outlet as it is at present to confirm Mr. Ford's projected port at that place, but believe that proper surveys should be made to demonstrate whether it is practicable and better than the Greytown one or not. The whole Nicaragua Canal project requires more complete, more thorough and more extensive surveys before any further work be done thereon, and everyone interested in the successful conclusion of the canal should continue to din this into the ears of Congress until they appropriate a sum sufficient for these complete surveys.

With regard to the letter of Mr. Charles Thornton, if he had carefully perused mine of May 9, he would see that I referred particularly to the slopes of the cuts on the railway, and this in view of the report of the Commission. I certainly did not intend to intimate that any such slopes as one-half to one should be used in the canal excavation, although I fail to see why steep slopes should not be used above water line where the nature of the soil will admit, nor did I intend it to be inferred that embankments would stand at that slope. Mr. Thornton also says: "All of nature's laws are in full force in the tropics as elsewhere," to which I take exception, for, as I stated before, we have no frosts to contend with here, and everyone who has had experience in excavations in the temperate zone knows that frosts in that climate is a great disintegrator and destroyer of slopes of excavations.

Respectfully,
Silvanus Miller, M. Am. Soc. C. E.
Puerto Barrios, Guatemala, Sept. 18, 1896.

(Salinas Bay is about 20 miles due south of the point where the present location of the canal strikes the west shore of Lake Nicaragua. It is on the boundary line betwen Nicaragua and Costa Rica.—Ed.)

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THE PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTRICAL ENERGY.

(Concluded from Page 231.)

parently laid on the question of the reliability of the power. If the industries of a large city depended upon a single transmission plant, it is evident that the question of reliability is of paramount importance. Where energy is supplied to manufacturers, the street car systems, and for lighting, a break-down that would involve the cutting off of current for a day would mean an enormous pecuniary loss to the community. As the distance of transmission increases, the possibility of accident is increased in greater ratio because we have not only the higher voltages to control but the length of the line that must be looked out for is also increased. The best guide lies in the practical experience which has been obtained in the present transmission plants and the consideration of the difficulties that have arisen and the remedies that have been employed. I have prepared a partial list of the principal transmission plants that are now in operation.

It will be seen that the longest transmission is at Fresno, Cal., the distance being about 35 miles. The highest alternating voltage used is 13,000 volts at Zurich, Switzerland. The highest direct potential is 15,000 volts at Brescia.

All of these plants are working successfully, and this fact will lead to still longer transmission and higher voltages. No limit of either distance or potential has as yet been reached. It we consider the record of the present transmission plants, we can safely say that it would not be going outside of the safe limit of development to transmit at least 50 miles at a potential of 20,000 volts, provided the energy could be delivered at such a price as to be considerably lower than the cost of a corresponding amount of energy obtained from a steam plant. This, of course, is a matter of local condition entirely, and the commercial value of such a transmission will depend upon local conditions.

Long-Distance Transmission for Railway Work.

The possibility of long-distance electric railway lines is intimately connected with the possibility of long-distance transmission of power. We have seen that it is possible to transmit considerable distances from a single station. The current so distributed is not, however, such that it can be applied directly to railway motors, but it must be transformed at points along the line, the distance apart of these points of distribution depending upon the system that is employed. At present continuous current motors are used and considerations of safety would lead us to use line potentials not greater that 700 volts. By distributing rotary transformers at distances of five or six miles apart, we would be able to supply motors with current without any great investment in copper. The amount of copper required could still be further reduced by using rotary transformers with storage batteries, thus keeping a constant load on the transmission line. It will be found, however, that on any long-distance railroad line, the load on any section of the line is exceedingly variable and the discharge rate of the batteries will have to be very high in order to prevent excessive cost for our reducing stations. It is doubtful whether we have reached a point in battery construction that this system of transmission would be economical. It is certain, however, that when the distances are comparatively short, say, within 15 miles, and where the traffic is not evenly distributed, that rotary transformers, with or without batteries, can be economically employed for railway work.

Conclusion.

My conclusions, subject always to the influence of local conditions, are as follows:

1. In both direct-current lighting and traction systems, where the power is generated in or near the area of distribution, it is best to use one station situated at the most economical point for producing power.
2. In the case of the traction systems, when the economical area of direct distribution is passed, boosters should be employed directly or in connection with batteries, to a distance of ten or twelve miles from a station, and beyond this rotary transformers, whether with or without batteries, should be used.
3. In the case of direct-current lighting systems, the energy should be transmitted to storage batteries situated at centers of consumption either directly or by means of a rotary transformer and distributed from them.
4. Where batteries are used it is best to place them at the end of feeder wires to obtain the advantage of a constant load on the wire.
5. The best system for the long-distance transmission of energy, for general purposes, is the three-phase alternating system.
6. Commercial transmissions are in successful operation for distances of 35 miles, and for voltages as high as 15,000 volts.

Experience with these plants shows that the transmission of 50 miles with a pressure of 20,000 volts is practicable, beyond these limits the transmission would be more or less experimental.

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THE NATIONAL BALL NOZZLE CO. is being sued, at Trenton, N. J., by the Columbia Hose Nozzle and the American Nozzle companies for an infringement of patent. The defendant answers that the essential and substantial features on which the patents are based were known, among others, to "One Herod, now deceased, but formerly of Alexandria, Egypt, living at said Alexandria and elsewhere 1,000 B. C."

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A TAR FILLER FOR SOME OF THE JOINTS IN BRICK pavements has been used at Cortland, N. Y., in place of Portland cement, which was used for the main part of the work. The specifications for this work were written by Mr. Wm. B. Landreth, M. Am. Soc. C. E., who, at the suggestion of Mr. F. W. Dalrymple, Assoc. M. Am. Soc. C. E., City Engineer of Hornellsville, N. Y., called for a strip of the paving three joints wide along the crown of the street, and across the street every 100 ft., to be filled with common tar paving filler, to allow for a movement of the pavement, caused by the heat or the expansion of the cement in setting. One block of the pavement, 600 ft. long and 29 ft. wide, has been completed as above specified, the cement joints being filled with a high grade of American Portland cement. In three days after the joints had been filled the expansion began to force the tar filler from the joints, although the temperature had varied but little and at no time had exceeded 65° F.

The expansion seems to have been caused by the expansion of the cement in setting, although the cement was carefully tested for expansion before using. Since the cement became set hard the expansion seems to have ceased.

◆

OLD BRICK ARE BEING USED instead of sand to make lime mortar, in the rebuilding of the new Union Station in Columbus, O. The refuse brick from the old walls are ground in a crusher. It is said that a quality of mortar for color work superior to that obtained with sand is produced.

◆

A GREAT PLATE GIRDER, 54 ft. 6 ins. long, 6 ft. deep and 24 ft. wide, was hauled on a truck to one of the new buildings in Nassau St. The weight is said to have been about 32 tons, and 20 horses were required to haul it. It was built by the New Jersey Steel & Iron Co., of Trenton, N. J.

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THE LOVE CONDUIT SYSTEM of electric street railways is to be installed on a quite extensive scale in Chicago, according to recent reports. The General Electric Ry. Co. of that city obtained some months ago a franchise for about 18 miles of line on the south side of the river, and it is upon this line that the conduit system is reported as to be used. According to the published statements of the General Electric Ry. Co., the work of construction is to begin at an early date, and besides this line, for which a franchise has already been secured, some 20 miles additional are to be built. The down-town terminus of the line will be at Jackson St. and will extend south as far as 57th St. The Love Traction Co. is reported to be the controlling interest in the scheme, but so little regarding the company's plans has been made public that it is impossible to give any definite statements regarding the prospects for construction.

GARBAGE UTILIZATION AT CINCINNATI AND NEW ORLEANS.

Of the 16 cities in the United States having populations of over 200,000 in 1890, there have already been established in ten cities, or soon will be, some improved system of garbage disposal. The 16 largest cities of the United States, in order of population, with the system of garbage disposal adopted, if any, are as follows:

City.	Population, 1890.	System.
New York	1,515,301	Utilization.
Chicago	1,099,850	None.
Philadelphia	1,046,964	Utilization and cremation
Brooklyn	806,343	None.
St. Louis	451,770	Utilization.
Boston	448,477	None.
Baltimore	434,439	None.
San Francisco	298,997	None.
Cincinnati	296,908	Utilization.
Cleveland	261,353	None.
Buffalo	255,664	Utilization.
New Orleans	242,039	Utilization.
Pittsburg	238,617	Utilization.
Washington	230,392	Cremation.
Detroit	205,876	Utilization.
Milwaukee	204,468	Utilization.

It is the purpose of this article to describe the utilization plants at Cincinnati and New Orleans, built under the Simonin system.*

The Simonin Process.

Before describing these two plants some information may be given regarding the Simonin system, though the details of this will be best understood by referring to the description of the Cincinnati plant, below, where the progress of the garbage during the whole process is described, as seen on the spot by our representative.

The patent on the Simonin system was issued on Jan. 5, 1892, to Chas. F. and Isaac M. Simonin, as No. 466,579, and is still controlled by these gentlemen, who have offices at Trenton Ave. and Clearfield St., Philadelphia, under the name of Simonin & Simonin. Regarding the development of the process and the plant at Providence, which latter has given rise to some misconception, Simonin & Simonin have given us the following information:

> This process was developed at Providence, in the works built by private parties to utilize the garbage of that city, by the Simonin & Adamson process. -This latter process not proving a financial success was discontinued. No city contract ever existed at Providence, but the garbage was delivered at the experimental plant by the garbage contractor.

The patent specification mentioned above describes a process for the removal of grease from garbage containing water, and the claims are for the combination by which this is effected, including the use of a heated liquid reagent, solvent to grease and of less specific gravity than water; the separation of the grease and water and the recovery of the reagent, together with the certain extractors, settlers, stills, cooling coils and means of connecting the same. The broad method of the extraction of fatty matters by means of benzine, naptha or other volatile reagents of low specific gravity is not claimed, this having "long been known and practiced."

The plant at New Orleans has been shut down for some months past, but the causes for this seem to be local, so we do not on that account refrain from making use of the detailed information so kindly furnished us, as acknowledged below, regarding the character and extent of the works. Both the New Orleans and Cincinnati plants have been visited by a member of our editorial staff, but circumstances were such that our representative could see and learn more of the workings of the Cincinnati than of the New Orleans plant, so it will be described first.

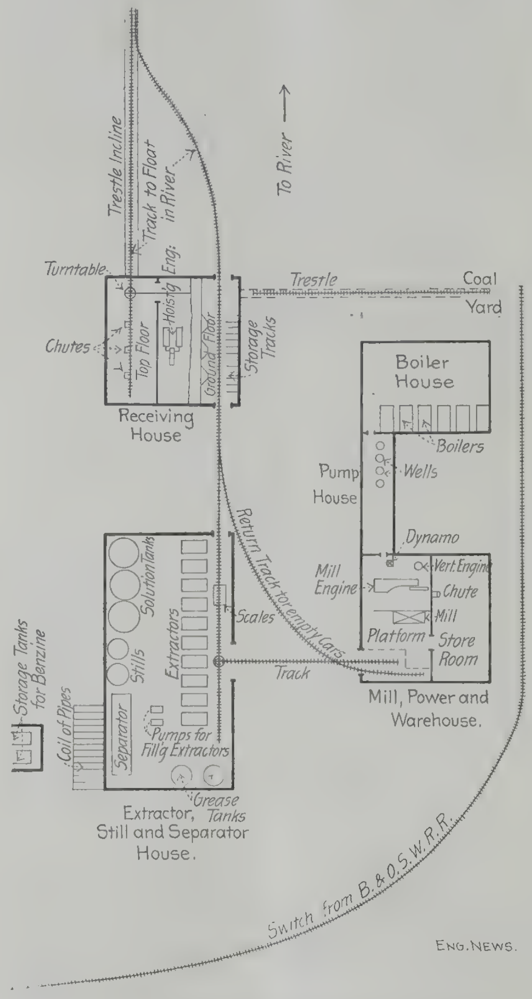
The Plant of the Sanitary Extracting Co. for the Treatment of the Garbage of Cincinnati.

We learn from Simonin & Simonin that the garbage of Cincinnati is treated under a contract running for ten years from June, 1892, the compensation being $15,000 for the first, $17,000 for the second, $19,000 for the third, $21,000 for the fourth, and then increasing $1,000 a year to $27,000 for the tenth year.

The following further information regarding the Cincinnati plant was obtained by our representative on a visit to Cincinnati, Dec. 24, 1895:

The garbage of the city of Cincinnati, O., is disposed of by the Sanitary Extracting Co., of that city. The president of the company is Senator J. B. Foraker and the secretary is Mr. E. F. Smith, both of Cincinnati.

The reduction plant of the Sanitary Extracting Co. is located near Riverside, a suburb, and about six miles from the business district of the city. The district is only sparsely built up and there are no houses within probably one-half mile of the works. The character of the dwellings indicates that the owners or occupants are people of very moderate means and in many cases (as indicated by the premises) not such as would be troubled by more than ordinary unsanitary conditions. It is said that complaints have never been made by these householders of any nuisance on account of the disposal works.



Sketch Plan of Garbage Disposal Plant at Cincinnati, O.

The plant occupies a tract of about five acres of ground lying between the north bank of the Ohio River and the tracks of the Baltimore & Ohio Southwestern R. R., and about 300 ft. distant from both the river and the railway. This ground is fenced in and no admittance is allowed except to employers and people on business. A written order is necessary to secure entrance. From the railway line a switch track enters the grounds. By means of this switch the works receive coal (at times) and other supplies, and ship away the grease and fertilizer. The grease is shipped away in tank cars supplied by the Standard Oil Co. Two tank cars were on the switch track on the day of the visit.

The accompanying illustration is a rough sketch plan of the works, which include a receiving house, extractor, still and separator house, mill, power and warehouse, pump house and boiler house. The sketch is not drawn to a scale.

The garbage is collected by the city and loaded into scows furnished by the company. Ordinary rectangular flat-bottomed wooden scows are furnished. When a scow is full, and not before, it is towed to the works. In summer about one scow is filled per day. At the time of the writer's visit about one scow per week was filled. The scows are furnished and the towing done by a local company under contract with the garbage company. The scows are anchored at a float in the river, and unloaded by hand into steel cars, of about 2,500 lbs. capacity, hopper-shaped, opening at bottom, of 4-ft. gage. During this loading of the cars all tin cans, etc., are separated from the garbage and left temporarily on the float. Afterwards the tin cans are taken from the float and dumped in a waste pile on the river bank. No use is made of tin cans. From the float a 4-ft. gage track runs up a trestle incline to the top floor of the receiving house. This track straddles the openings to the chutes leading from the top floor to the ground floor. The hoisting is done by a stationary engine and cable. There are three chutes, and four cars are used.

The hoisting engines for hauling the cars from the float to the receiving room are placed parallel and operate a single horizontal engine shaft which carries a pinion at its center. This pinion meshes with a spur keyed to a shaft on which the drums are mounted. These engines are a pair of 8 × 16-in. link motion reversing engines, from the I. & E. Greenwald Co., of Cincinnati. When possible, i. e., in summer, coal is received by scows unloaded at the float into the garbage cars, hauled to the turntable at the upper end of the incline, run onto the trestle and dumped into the coal yard. At other times it is received by the switch track. The garbage chutes discharge at the ground floor, this discharge being controlled by the necessary doors. A track on the ground floor runs directly under the discharge openings. In the Simonin process the garbage is loaded into a number of shallow pans perforated with numerous openings. A set or column of these pans is made by setting one on top of another, and the set or column carried on a metal truck. The truck, pans and all is run into the extractors. A tram car, with rails on top, runs on the track extending along the lower floor of the receiving, and to and into the extracting house. On this tram car is set the pan car. The pan cars with empty pans are stored on the storage tracks at one side of the main track in the receiving house, as shown in the sketch plan. A tram car is run onto the main track and stopped directly under a chute opening. A pan car is then run onto the tram car and blocked. The bottom pan is placed and filled; then the second pan is placed on top of the bottom pan and filled, then the third pan placed on top of the second pan and filled and so on until a "set" of pans is filled. The tram car is then run along the track to an empty extractor in the next building, and the pan car run off the tram car into the extractor, after being weighed on the scales. The head is then bolted onto the extractor and the process of extraction begun. The lids of the extractor, which are of cast iron, and very heavy, are handled by an overhead trolley.

As will be seen from the sketch plan, there are ten extractors; each is a 6 × 22-ft. cylinder, standing horizontally. When the car load of garbage has been fastened into an extractor, benzine is forced into the extractor until it is filled, by means of one of the pumps near by. After the benzine has taken up all the grease the solution of grease, benzine and water is forced into the three solution tanks. The solution then passes into the two adjoining stills, where the benzine and water are vaporized and sent into the coil of pipes, shown just outside the building. A constant cascade of cold water flows over the pipes, thus condensing both the steam and benzine vapor, which flow as liquids into the separator. The benzine is then taken off the water and conveyed to the storage tanks, shown in the separate building near by. The grease which remains in the stills is passed into one of the two storage tanks, in a corner of the building, where it is ready for shipment. Only one storage tank is used at a time, the other being held in reserve.

Meanwhile the solid matter in the pans in the extractor has been thoroughly dried by the steam heat. The head is taken off the extractor and the car, with its set of pans filled with dry "tankage," is hauled out, weighed and run onto a tram car and the tram car run along a track to the mill room. Each pan is dumped onto a platform in front of the mill. As each pan is dumped it is placed on a pan car, which is placed in turn on a tram car standing on an adjoining track. By this process the top pan of the first carload becomes the bottom pan of the second carload of "empties," which latter are sent back to the storage tracks.

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*Of the ten utilization plants included in the above list, those at St. Louis, Buffalo, Detroit and Milwaukee employ the Merz process, and were described at length in our issue of Nov. 1, 1894. At Pittsburg, the system controlled by the Consolidated American Reduction Co., and described in our issue of Oct. 3, 1895, was installed. The plant at New York will employ the Arnold process, which, as temporarily used in Boston, was described in Engineering News of March 28, 1895.

From the platform the tankage is shoveled into the mill and ground. A continuous bucket elevator takes the ground matter and conveys it to the second story, where it is dumped onto a sieve. The material passing the sieve falls into a chute which opens into the storage room. The bags are hung under a spout and filled. They are then stored for shipment.

The power room contains the engine for operating the mill and a vertical engine for operating an electric light dynamo. The mill engine is a 12 × 30-in.cylinder, automatic cut off, trip valve engine of the Brown type, and was furnished by the I. & E. Greenwald Co., of Cincinnati. Between the mill and boiler houses is the pump house, beneath which four wells, 100 ft. deep, supply the water. The water is pumped by four Laidlaw-Dunn-Gordon standard No. 4,040 deep well pumps. The water is forced onto the coil of pipes and then runs into an earth reservoir. The overflow from this reservoir drains along the surface of the ground to the river.

The boiler room contains six 16 × 5½ ft., 54 4-in. tubular boilers built by McIlvane & Speigel, of Cincinnati, O. Steam pipes run to the various engines and to the extractors, stills, etc., in the extractor house.

The extractor house is built of brick, but the other buildings are of wood, covered with corrugated iron. There are 46 "sets" of pans used altogether. About 24 men are employed at the works in the winter, and during the summer months four or five additional men are employed in unloading the garbage and other rough labor. No exhaust fans are used anywhere about the building. The plant is operated continuously as long as there is garbage.

Garbage Collection at Cincinnati.

The following information regarding the collection of garbage in Cincinnati was obtained from Mr. Fred. Amthauer, Superintendent of the Street Cleaning Department:

The garbage of the city of Cincinnati, O., is collected by the street cleaning department and expenses are paid from the general fund appropriated for street cleaning. Garbage collection in that city is thus a part of the work of cleaning the streets, and no especial provision is made for doing it. In collecting, the ordinary tight board wagons used for collecting ashes are used, the garbage being covered simply with a tarpaulin. The wagons are used interchangeably for collecting garbage and ashes. For example, a wagon may work half a day hauling garbage and the other half day hauling ashes. One day two wagons will haul garbage to every one which hauls ashes, while on the next day the exact contrary disposition of the wagons will be made, two wagons ashes to one wagon garbage. In winter, when the garbage can stand longer without offense and the snow and mud is the worst, street cleaning is placed first and garbage collection second. In summer the garbage is collected first and the streets cleaned second.

In the most populous districts garbage is collected daily during the summer. Elsewhere the collections are made every second or third day, as the conditions seem to demand. In winter collections are made less often everywhere. In other words, the superintendent of street cleaning uses his discretion in making the collections more or less frequent, the only point observed being to keep the garbage receptacles clean and inoffensive. It is intended always to keep the garbage inoffensive even at the expense of dirty streets.

Ashes are forbidden to be mixed with the garbage proper, but no reservation is made as to the inclusion of tin cans, bottles, etc. Of course, householders occasionally mix their ashes and garbage, and then the drivers refuse to take the mixture. Generally warning from the health officer is enough to stop the trouble, but occasionally fine and arrest is necessary.

It is realized that the education of the householders is as much the duty of the health officer as fines and arrests, and care is taken to instruct them not to mix garbage and ashes. The drivers of the collecting wagons and sanitary inspectors are instructed to warn careless persons and new householders. In addition, thousands of circular sheets of instruction are distributed annually.

No special receptacle is required to be provided by the householder and consequently a great variety of forms are used. The superintendent of street cleaning makes complaint of this, and says the work of collection would be lightened by having a common size and form of receptacle.

The garbage is all hauled to a scow provided by the Sanitary Extracting Co. and unloaded, after which the street department has nothing further to do with it. At this scow most of the tin sans, bottles, etc., are taken by junk men who seem willing to separate them from the garbage for what they can make from the salvage. A few cans and bottles, of course, remain and these are separated at the garbage plant.

From the big hotels the garbage is collected by the Sanitary Extracting Co., which has one wagon for that purpose. This is the only garbage collected by the company and which the street cleaning department does not collect. (Dead animals not included.)

Dead animals are removed without expense to the city by the Jones Fertilizing Co., which gets its compensation from the hides, grease, manure, etc. The Sanitary Extracting Co. does not handle dead animals at all. The Jones Fertilizing Co. is supposed to collect all animals, but the city wagons usually take in small animals whenever they come across them.

After unloading each wagon at the garbage scow it is flushed out with a few bucketsful of water, and before going into the stable at night it is washed with a hose and sprayed with a solution of copperas and water. The scow stands at its dock until it is filled.

A record of the loads of garbage hauled to the scow is kept, but no record of weight. As a matter of curiosity the garbage was weighed for a day or two and it was found that the loads weighed from 1,900 lbs. to 3,200 lbs. and averaged about 2,500 lbs. During the year 1894, 13,894 loads of garbage were hauled to the scow, which on the basis of the above average would be 17,368 tons. A daily record of the number of loads hauled during the month of August, 1894, is appended as follows:

Day.	Loads.	Day.	Loads.	Day.	Loads.	Day.	Loads.
1	41	10	77	18	3	26	78
2	99	11	3	19	101	27	92
3	71	12	98	20	78	28	75
4	3	13	85	21	57	29	48
5	90	14	58	22	52	30	92
6	90	15	49	23	89	31	81
7	57	16	92	24	80		
8	52	17	80	25	3	Total.	2,053
9	79						

At an average of 2,500 lbs. per load the amount of garbage collected in August would be 2,560 tons.

Dr. J. W. Prendergast, Health Officer, says that the disposal of garbage by the Sanitary Extracting Co. has caused no nuisance and is sanitary.

The Contract and Works of the Southern Chemical & Fertilizing Co. at New Orleans.

On March 15, 1894, a contract went into effect between the Southern Chemical & Fertilizing Co. and the City of New Orleans for the collection and disposal of the garbage, dead animals, ashes, street sweepings and general house and store refuse of the city, for a term of 20 years. The contract, we are informed, was based on an ordinance directing the comptroller to call for bids for this work and containing specifications for it. This ordinance provided that no contract should be closed

> until the successful bidder has presented a system of disposing of refuse vegetable and animal matter, including dead animals, in a manner which is scientific and sanitary, disposing of whatever is injurious to health and discomforting to the human race, at the same time preserving whatever is valuable in the material aforesaid.

Another part of the ordinance required the erection of a cremation or utilization plant.

The ordinance also provided that the means and methods provided and employed in collecting and treating the garbage should be satisfactory to the State Board of Health of Louisiana.

Garbage and dead animals were to be collected daily; street sweepings when the department of public works should direct, the latter to be gathered into piles by the department.

One section of the ordinance defined garbage and prohibited its mixing by house-holders with other matter, as follows:

> Sec. 4. Be it further ordained, etc., that the word "garbage" as used in this ordinance shall be construed to mean house and kitchen offal, and all refuse matter not excremental, whether solid or liquid, and composed of animal and vegetable substances, including dead animals coming from public or private premises of the city, and not destined for consumption as food. No ashes, dirt or other substances foreign to garbage shall be covered by this contract, except as hereinafter provided, and it shall be unlawful for any occupant or occupants of any premises in the city of New Orleans, to mix any such ashes, dirt, or other substance foreign to garbage, with the garbage to be removed from said premises as herein provided, under a penalty of not less than $5, nor more than $25 fine for each offense, or imprisonment for not more than 30 days.

Householders were required to deposit their garbage in covered metallic vessels and the contractor was required to use "inclosed, water-tight metallic vehicles" for removing the garbage.

The garbage wagon afterwards adopted by the contractor was illustrated and described in our issue of May 17, 1894.

The contract price for performing the services outlined above was $120,000 a year for the first five years, $134,000 for the second, $150,000 for the third, and $165,000 a year for the fourth five years. This amounted to a total of $2,845,000, or an average of $142,250 per year.

The company selected the Simonin process for the treatment of the garbage and erected an extensive plant. The following description of the plant has been prepared from information furnished us under date of Feb. 11, 1896, by Mr. T. A. Clayton, who was at that time General Superintendent of the Southern Chemical & Fertilizing Co.

The company began work on July 11, 1894, and has continued its collections since that time, but the disposal works have been shut down since Nov. 20, 1895, "partly on account of the low prices obtainable for the product, but chiefly on account of the difficulty in getting the citizens to refrain from mixing their garbage with ashes and other foreign matter." During the construction of the plant Simonin & Simonin were represented by Mr. W. H. Hughes, of Providence, R. I. Mr. Clayton states that many improvements have since been made. The plant has a guaranteed daily capacity of 75 tons of drained or about 100 to 125 tons of wet garbage.

The disposal works are located seven blocks from Canal St. and 34 blocks from the river. A switch runs into the works from the Mississippi Valley R. R. The New Basin Canal, which runs from the heart of the city into Lake Pontchartrain, is about 120 ft. distant.

Eight buildings house the plant, their character and uses being as follows: A pocket house for the reception of garbage and a rendering house for the treatment of dead animals, in one building 60 × 100 ft., 40 ft. to the ridge; brick, with slate roof. Attached to this is an inclined run for the garbage and dead animal wagons to get up to discharge their loads. This run is inclosed, covered with galvanized iron, and the lower part is used for a stable. An extractor room, 75 × 100 ft., 40 ft. to the ridge; of brick covered with slate, in which are contained the extractors, stills, solution and grease tanks. A brick building, slate covered, 60 × 183 ft. and 35 ft. in height to the ridge, of which 62 ft. contain the boiler and engine room, 35 ft. the mill room, 40 ft. a warehouse, and 46 ft. another warehouse, all divided by fire walls. A brick building covered with galvanized iron, 50 × 100 ft. used as a stable. A frame building, inclosed and covered with corrugated iron, 37 × 50 ft., two stories, with the lower story used as a blacksmith shop, etc., the upper story a machine shop, and having attached a cupola for melting tin cans and old metal of all sorts. A corrugated iron building, 30 × 65 ft., by 30 ft. high, inclosing a crematory for the destruction of garbage, etc. A frame building, 23 × 31 ft., containing the naphtha tanks, and a brick slate covered office 25 × 32 ft.

The steam plant consists of six 150-HP. horizontal tubular boilers. There are four engines. Of these, a 75-HP. Greenwald engine drives the grinding mill; a 15-HP. New York Safety runs the electric plant; a 10-HP. Racine engine drives an 18-in. exhaust fan used in connection with the rendering tanks for treating the dead animals; and a 15-HP. engine is provided for the cupola blast and for driving the machinery in the machine shop.

Two 12 × 10½ × 12-in. pumps are used to pump water over the condensing coils; a 7½ × 4½ × 10-in. pump is used for boiler feed; and two, 6 × 6 × 12-in. pumps for lifting the naphtha into the extractors. All these are Blake pumps. The water supply is from a 730-ft. artesian well and the canal. The utilization plant requires the use of 800,000 to 900,000 gallons daily, but when cremating the garbage only a few thousand gallons a day are consumed. From this statement it might be inferred that the garbage is burned when not treated by the utilization process.

There are two iron smoke stacks, one 52 ins. in diameter and the other 60 ins., each 80 ft. high, the top of one being 104 and the other 102 ft. above the ground.

The nine extractors are 6 ft. in diameter and 22 ft. long, and were made by McIlvain & Spiegel, of Cincinnati. The extractors are so connected that the steam and naphtha can be passed from one to another, if desired, thus economizing steam and saving the work to be done by the condensing coils. The stills for separating the naphtha and grease are two in number, each 6 × 15 ft. Steam coils run through these stills.

The tankage is ground, so far as necessary, by a 4-ft. Luttner cage mill with a daily capacity of 12 to 15 tons, according to the quality of the material.

When the plant is in operation about 20 unskilled laborers are employed at $1.50 a day; two firemen at $2 a day; and three skilled laborers at $2.50 a day. The plant is operated night and day and from November, 1894, to October, 1895, 14,300 tons of drained garbage was treated, to which 40% must be added, Mr. Clayton states, to get the weight of the equivalent amount of green garbage. The daily record of drained garbage treated in June, 1895, is as follows:

June	Lbs.	June	Lbs.	June	Lbs.
1	59,178	12	60,730	23	46,810
2	43,900	13	67,930	24	60,990
3	61,264	14	60,020	25	38,128
4	24,490	15	68,380	26	68,614
5	99,480	16	38,070	27	63,360
6	73,184	17	66,450	28	63,708
7	78,168	18	63,233	29	65,274
8	68,360	19	48,560	30	54,514
9	53,260	20	96,290		
10	62,162	21	46,680	Total	1,850,418
11	64,858	22	84,383		

The amount of grease derived from the garbage is given as 5 to 7%, and of tankage for fertilizing purposes, 25 to 30%, both by weight. The only material taken to the works which cannot be reduced is paper, rags, feathers and similar wastes, which, being very dry, are burned under the boilers. The waste liquids are run into the sewer.

The following information regarding the New Orleans plant was obtained by a member of the editorial staff of this journal during a visit to the plant in the fall of 1895:

The statement made by Mr. Clayton regarding the location of the plant may give the impression that the plant is not far from the thickly settled part of the city. Such is not the case. Canal St. extends north, slightly west from the river front, toward Lake Pontchartrain, and while a principal street its northern end penetrates a sparsely settled and poor quarter of the city. The houses are 1 and 1½ story frame structures and seem to be inhabited chiefly by negroes.

The most unsanitary things seen about the works were a dozen or so empty and uncleaned iron collecting wagons. Inclosed by a fence were the buildings of the plant, much the handsomest and best constructed buildings of any plant seen by our representative, except, possibly, those at St. Louis. Much of the area between buildings was paved with concrete or cement, and except where piles of dry refuse from the extractors temporarily existed until used in a further process, this pavement was very clean and dry. Inside the buildings there was the usual sour smell of green garbage and the odor of fertilizer, but only where the dead animals were handled were things very offensive, and then only in the building itself. A smelling excursion around the building did not impress one with the idea of there being any nuisance, and the day was hot and a slight breeze blowing. In point of odor this plant may be placed ahead of that at Cincinnati.

The impression received regarding the crematories was that they were used to handle garbage of very little value for extraction or otherwise unfit for the process by the admixture of ashes.

Since our representative visited the plant and since Mr. Clayton gave us the information quoted above the city has attempted to annul the contract with the company on the ground of non-fulfilment. After this action a receiver, Mr. Algernon A. Badgley, was appointed and he has appealed to the Federal Court to enforce the payment of the monthly sums stipulated in the contract and to prevent collection of garbage by the city. The following statement regarding the controversy has been prepared for us by Dr. Quitman Kohnke, chairman of the public health committee of the city council:

> The fight between the city and the garbage company (The Southern Chemical & Fertilizing Co.) need not reflect upon the efficacy of the "Simonin process" to dispose of garbage, but was brought about by violation of the sanitary laws on the part of the garbage company. It is charged that the company established dumping grounds within the city limits, some of these being on public thoroughfares where the collected garbage was deposited contrary to law and contract, and in violation of ordinary rules of health. It is claimed by the company that such disposition of garbage was made necessary by reason of the failure on the part of the householder to separate the garbage proper from the ashes and trash. On the other hand, it is claimed by the city that the company encouraged and assisted in the mixing of garbage and trash and deposited on the various dumping grounds pure garbage unmixed with ashes or trash—the real reason for dumping being that the increased price of naphtha and the decreased value of the products of the plant rendered it unprofitable to treat the collected refuse in the manner originally contemplated.
>
> Whether the company is released from its obligation to collect and dispose of garbage by reason of non-compliance on the part of the householder with that part of the contract providing for the separation of garbage from trash, will be decided by the courts. The position of the city appears to be that the company is obligated to remove and dispose of all garbage, mixed or unmixed, inasmuch as all others are expressly forbidden to remove it, it being incumbent upon the company to invoke the law against the householder who does not separate his garbage. A general complaint has been made by the company, but in no case has an individual householder been charged with violation of the law. This failure on the part of the company to prosecute the householder is supposed to have been due to fear that the law would be declared unconstitutional which compelled a citizen to perform without compensation a menial service for the benefit of a private corporation.
>
> The position of the Board of Health in this matter is that it recognizes no contract, but insists upon the prompt collection of all garbage and the suppression of dumping grounds for such refuse.

Under date of Sept. 28, 1896, Mr. Clayton wrote us further regarding the status of garbage disposal in New Orleans, as follows:

> It is a fact that when we are not using the reduction process we cremate the garbage in crematories that give perfect satisfaction in every way, and which I believe are the best and most economical in operation. These crematories are of our own design and construction, and are unique.
>
> With regard to the actual situation here in connection with the present status of the garbage disposal, I would say that our company is still collecting the unmixed garbage that is exposed by the citizens, transferring it to the plant and cremating it. The mixed garbage is being collected to a certain extent by the city. The authorities have refused to enforce the law which governs our contract with regard to the due obligation of house-holders to keep their garbage separate from foreign material, and are attempting to declare our contract null and void. The matter has been taken into the United States Courts through the appointment of a receiver, named at the request of some of the bondholders who live outside this state, and the case will come up in November, when we are confident of winning the suit.
>
> The city has gone back to the old system of sending garbage down the river and dumping it below the city limits, but their system is poorly organized, and is evidently of a temporary character.

From all we can learn on the subject, including reports of discussions in and out of the city council and statements by representatives of the company, it appears that the people of New Orleans awoke, after it was too late, to a realizing sense that Sec. 4 of the ordinance, quoted above, requires the separation of garbage from ashes and other refuse and rebelled against it. The requirement is a perfectly reasonable one, is a part of the contract, and essential to the successful operation of the plant required by the contract.

Whether it rests with the city officials or the garbage company to compel householders to separate the garbage, or whether the refusal of the company to collect mixed garbage is the proper course for it to pursue to secure its rights are questions now before the court.

In so far as the questions involved have any bearing upon the Simonin system of garbage disposal they apply equally to all other reduction or utilization systems in successful operation and must also be considered in connection with cremation, or even dumping at sea. We have discussed this matter further in our editorial columns.

THE INTERSTATE COMMERCE COMMISSION'S STATISTICS OF THE RAILWAYS OF THE UNITED STATES FOR THE YEAR ENDING JUNE 30, 1895.

An advance abstract of this report, as furnished by Prof. Henry C. Adams, the statistician of the Interstate Commerce Commission, was published in our issue of July 30; but from the full report, advance proofs of which have just been issued, much other interesting information can be gleaned relating to the status of the railways of the country up to the date of the report. The summary of mileage, equipment, classification, capitalization, earnings and expenses was given in the statement already published, but some of these will be repeated here in going into the details of the full report.

This report differs from its predecessors in not only making comparisons with the previous year, but in including, as far as possible, the years 1890 to 1894 inclusive. These six years, including 1895, cover a period of unusual commercial conditions, and the broader comparative statement is useful in any attempt to investigate and better understand the influences at work and their effect upon railways.

The Commission places the aggregate mileage of railways in the United States, on June 30, 1895, at 180,657, an increase during the year of only 1,949 miles, or 1.09%, which is less than the 1.27% of increase of 1894, the lowest in any year since the Commission was organized. In figuring out the miles of line per 100 square miles of territory for the whole United States there is, of course, a steady but slow increase, from 5.51 miles in 1890 to 6.08 miles in 1895. But population has been gaining upon railway construction in the same period, as is shown by the fact that in 1890 there were 26.05 miles of line to every 10,000 inhabitants, with a maximum of 26.51 miles in 1893 and a present ratio of 26.16 miles per 10,000 inhabitants. The report does not assume from this that there is any tendency towards a permanent change in commercial forces, and contends that until there is a more even distribution of railway facilities than there is at present, railways must still remain as the pioneers in industrial development. In looking over the summary of railway mileage for each state and territory there is still natually a wide diversity of percentage as effected by geographical position, age, density of population and facilities for producing goods for transport. Under the head of miles of line per 100 square miles of territory and omitting the small District of Columbia with 47.62 miles, we find New Jersey in the lead with 29.72 miles; closely followed by Massachusetts with 26.35 miles; Pennsylvania, Ohio, Connecticut and Illinois come next, with 21.67, 21.13, 20.81 and 19.02 miles respectively. The State of Nevada has only 0.83 miles per 100 square miles of territory; Oklahoma has 0.98 miles; Wyoming, 1.21 miles; Arizona, 1.22 miles, and Idaho, 1.29 miles. But these new and thinly settled states and territories, of course, rank highest in the ratio of miles of railway to 10,000 inhabitants; Arizona, Montana and Nevada having 208.51, 195.55 and 182.65 miles, respectively, as compared with 5.82 miles per 10,000 inhabitants in Rhode Island and 8.61 miles in Massachusetts.

In the year covered by the report there is still evident a slightly stronger tendency towards the development of existing property rather than to attempt to gain new traffic by extending lines. The percentage of increase in single track for the year 1895 was 1.09, that of second track was 1.34, of third track 2.32 and of fourth track 3.11%; the increase in yard track and sidings was 2.87%. The tendency towards consolidation of interests and greater simplicity in organization and operation is more marked than in previous years. Between 1890 and 1895, inclusive, there has been a decided decrease in lines operated under lease and contract, and a gain in lines owned, from 99,931 miles in 1890 to 125,334 miles in 1895. As showing the general tendency, it may be stated that while the increase in lines owned, between 1890 and 1895, was 25,404 miles, the aggregate extension of railway mileage in that time was only 17.060 miles. The Commission believes that this movement towards greater consolidation will tend to reduce the intricacies of intercorporate contracts which now so much embarrass those seeking to fairly understand the railway system of the United States. From a summary given it appears that 42 railway corporations now operate 100,714 miles of line, or 55.67% of the total mileage; but it may be said here, that for roads operating lines from 250 to 400 miles long and below 250 miles, the percentage of aggregate mileage was about the same in 1895 as in 1890. Of the corporations operating lines over 1,000 miles long, 40 controlled 47.51% of the aggregate mileage, in 1890; showing a general increase of over 5% in lines of that class in six years.

The equipment summaries of the report are especially interesting. With a total of 35,699 locomotives, on June 30, 1895, the increase over the previous year was 207, as compared with an average annual increase of 1,112 for the period 1890-1895 inclusive. The number of cars in service, at the date of the report, was 1,270,561, a decrease of 7,517 as compared with 1894. The freight cars showed a decrease of 9,050, and the passenger cars an increase of 94, and the cars assigned to company service an increase of 1,439. The decrease in the number of freight cars is partly ascribed to the increased use which railways make of private cars; and it is possible that the opportunity presented by slack business for the destruction of a larger number than usual of old and inferior cars may also account for some of the reduction. The average amount of equipment per 100 miles of line changed little or nothing from the year before; the proportion, in 1895, being 20 locomotives and 715 cars, of all types. The assignment of equipment to the amount of traffic, as compared with 1894, shows a decreased efficiency in passenger service and an increased efficiency in freight service. The first is probably due to decreased travel as a result of business depression, and it also suggests that travel has returned to normal conditions after being disturbed for some time by the Columbian Exposition. The freight service shows on its face increased economy in transportation; but the figures are not satisfactory as a large portion of freight moved in cars not owned by railway corporations is necessarily omitted from the computations. The assignment of equipment to the amount of travel, for the two years, is thus summarized:

	1894.	1895.
Passengers carried per pass. locomotive	54,654	50,747
Passenger miles per pass. locomotive..	1,444,400	1,218,967
Tons carried per freight locomotive....	31,909	34,817
Ton-miles per freight locomotive......	4,016,755	4,258,821
Passenger cars per million passengers.	53	65
Freight cars per million tons freight.	1,888	1,717

The report gives the rate of equipment with automatic couplers and train brakes, since 1889, as follows:

Year.	Total equipment.	Increase	Equipment.[1]	Increase	Equipment.[2]	Increase
1895...	1,306,260	*7,310	362,498	31,506	408,856	51,235
1894...	1,313,570	4,836	330,992	31,965	357,621	35,383
1893...	1,308,734	60,506	299,027	42,158	322,238	77,904
1892...	1,248,228	27,139	256,869	68,537	244,334	75,299
1891...	1,221,089	21,282	188,332	39,505	169,035	53,716
1890...	1,199,807	101,205	148,827	20,668	115,319	34,809
1889...	1,098,602	....	128,159	....	80,510	....

*Decrease. [1]Fitted with train brakes. [2]Fitted with automatic couplers.

From this statement it is very evident that the law will not be complied with, which requires freight cars to be fitted with train brakes and automatic couplers by January, 1898. The distribution of this equipment so far as cars of various types are concerned, may be given as follows from the various summaries in the report:

Type of car.	Number equipped with Train brake. 1894.	Train brake. 1895.	Automatic coupler. 1894.	Automatic coupler. 1895.	Total cars in service.* 1894.	Total cars in service.* 1895.	Total in 1895 still to be equipped, with Train brakes.	Auto. c'pl'rs.
Passenger	32,403	32,384	31,916	31,971	33,018	33,112	728	1,141
Freight service	264,884	295,073	317,896	366,985	1,205,169	1,196,119	901,046	829,134
Company service	4,466	4,976	2,676	3,438	39,891	41,330	36,354	37,892
Total	301,753	332,433	352,488	402,394	1,278,078	1,270,561	938,128	868,167
Leased	40,587	38,888	63,996	59,029	181,664	178,107	139,219	119,078
Fast freight	11,510	18,982	16,811	23,122	44,212	49,472	30,490	26,350

*Equipped and unequipped.

So far as locomotives are concerned, practically all passenger locomotives are equipped with train brakes; but 6,106 are still without automatic couplers, out of a total of 9,999 of this class in 1895. Out of 20,012 freight locomotives 16,712 were fitted with train brakes and only 2,039 with automatic couplers, on June 30, 1895. The report gives in detail the types of train brake and automatic coupler in use throughout the United States.

On June 30, 1895, there were 785,034 men of all classes in the employ of railway corporations, as compared with 779,608 in 1894, and 873,602 in 1893. Since 1893 the total number of men employed for each 100 miles of line has decreased from 515 to 441; but the number of men assigned to maintenance of way and structures, per 100 miles of line, was 151 in 1893, 123 in 1894 and 128 in 1895, showing a slight increase in this class of labor in the last year. The number of men assigned to maintenance of equipment, for the same unit of line was 103 in 1893, 86 in 1894 and 88 in 1895; for men engaged in conducting transportation, the ratio was 234 in 1893, 208 in 1894 and 204 in 1895.

From statements of the capitalization and valuation of railway property in the United States on June 30, 1895, the following comparative summary is prepared:

	1890.	1895.
Total stock	$4,409,658,485	$4,961,258,656
Stock per mile of line.....	28,194	28,602
Total funded debt	4,574,576,131	5,385,495,573
Bonds per mile of line....	29,249	31,048
Other indebtedness	453,108,804	616,830,156
Per mile of line	2,958	3,556
Total railway capital....	$9,437,343,420	$10,963,584,385
Total, per mile of line..	60,340	63,206

From another table given it is shown that on June 30, 1895, railway corporations owned 23.57% of all the outstanding stock and almost 10% of the outstanding bonds; the amounts of both held by these corporations being considerably larger than in the previous year; a fact that may be ascribed to railway consolidation rather than to any strengthening of reserve funds. The summary of stocks and bonds paying dividends and interest shows that during 1895 70.06% of all the outstanding stock paid no dividends and 16.71% of the funded debt paid no interest. This is the largest failure in payment, for both classes of securities, for any one year since the Commission was organized. The percentage of dividend paying stocks has decreased from 38.56% in 1888 to 29.95% in 1895.

The comparative passenger and freight service for the years ending June 30, 1890, 1894 and 1895 are summarized as follows:

	1890.	1894.	1895.
Pass. carried ..	492,430,865	540,688,190	507,421,362
Per mile of line	75,751	81,333	68,572
Tons:			
Freight car'd.	636,541,617	638,186,553	696,761,171
Car'd 1 mile..	76,207,047,298	80,335,104,702	85,227,515,891
Average haul* .	119.72	125.88	122.32

*Per ton-mile.

These figures indicate a marked decrease in the number of passengers carried in 1895 as compared with the previous year; but the freight traffic shows an increase over 1894. The gross income from the operation of the railways of the United States for the year ending June 30, 1895, was $1,075,371,462, an increase of $2,009,665 over 1894. For the same period the expenses of operation were $725,720,415, a decrease of $5,693,907 over 1894. The net income from operations was $349,651,047, an increase of $7,703,572 over 1894, but excepting that year it is the least of any year since 1890. The earnings from passengers, in 1895, amounted to 29.16% and that from freight to 68.27% of the total earnings from operation. The percentage of operating expenses to operating income is gradually increasing; this item being 65.80% in 1890; 66.73 in 1891; 66.67 in 1892; 67.82 in 1893; 68.14 in 1894 and 67.48% in 1895.

The Commission gives a general summary of results, as deduced from their numerous tables, covering the period 1890-1895 inclusive, and the whole United States. This table is interesting as showing the late trend in revenue and cost of operation and it is given in full as follows, the cents being reduced to the nearest decimal:

Item.	1895.	1894.	1893.	1892.	1891.	1890.
Revenue per passenger per mile	$0.02040	$0.01986	$0.02108	$0.02126	$0.02142	$0.02167
" per ton of freight per mile	.0839	.0860	.0878	.0898	.0805	.0941
" per passenger train-mile	.98	1.05	1.07	1.07	1.06	1.08
" per freight train-mile	1.61	1.56	1.63	1.65	1.64	1.65
" per train-mile, all trains	1.36	1.37	1.43	1.45	1.43	1.44
Average cost of running a train 1 mile, all trains......	.09182	.09348	.09727	.09658	.09571	.09601
Per cent of operating expenses to operating income....	67.48	68.14	67.82	66.67	66.73	65.80

Had the rates of 1890 been maintained in 1895 the passenger revenue would have been increased for the latter year by $15,479,326, and the freight revenue by $86,932,066. From this it appears that if we take the rates of 1890 as a standard, the people of the United States have saved, in passenger and freight charges in a single year, a sum exceeding $100,000,000. With the above statement and as illustrating the effect of the business depression upon railways, the report states that as contrasted with a surplus from operations of $8,116,745 in 1893 and $14,036,056 in 1892, 1894 showed a deficit from operations of $45,851,294, and 1895 shows a deficit of $29,845,241.

The length of line operated by the 75 companies whose gross annual revenue exceeds $3,000,000, is 119,810 miles, or 67.41% of the total operated mileage. The aggregate revenue of these 75 companies is $874,542,695, or 81.32% of the total gross revenue for the entire country, which was $1,075,371,462. For these companies the average gross revenue per mile was $7,299 as compared with $6,050, the average per mile of line of all roads; they perform 84.08% of all the passenger service and 84.55% of the total freight service. The chief interest centers in the fact that while this group of roads enjoyed a net revenue of $2,862 per mile of line in 1890 this was reduced to $2,425 in 1895; a decrease of $437 per mile of line, equivalent to a total reduction of about $50,000,000 in net revenue, for 1895, for the roads under consideration.

The total number of railway employes killed in 1895 was 1,811 and 25,696 were injured. This is a decrease, over 1894, of 12 killed and an increase of 2,274 injured. Of passengers, 170 were killed and 2,375 injured; a decrease of 154 over the killed and 659 in those injured in 1894. The record for 1895, in respect to the number of passenger casualties is less than for any year for which complete statistics are available. The statement of "other persons" for 1895, foots up 4,155 killed and 5,077 injured, as returned to the Commission. The total chargeable to railway accidents, for 1895, is 6,136 killed and 33,748 injured. A summary of employes and passengers killed and injured in the United States in 1890-1895 shows that the record for 1895 is more satisfactory than for any previous year of record; the number of employes killed has decreased from 1 in 306 to 1 in 433, while those injured have decreased to 1 in 33 from 1 in 31 in 1890. The number of passengers killed was 1 in 1,727,780 in 1890, and 1 in 2,984,832 in 1895; while the proportion of passengers injured has decreased from 1 in 203,064 in 1890, to 1 in 213,651 in 1895. The Commission believes that the fitting of equipment with automatic devices is beginning to show a beneficial effect; as while 1 trainman in every 105 was killed in 1890, the ratio in 1895 was 1 to 155.

The Commission renews its recommendations of previous years, and further recommends that Congress establish a Bureau of Statistics and Accounts, which shall have the right of inspection and control of the accounting departments of the common carriers. This bureau was suggested in the ninth annual report of the Commission and the considerations favoring it are given in full.

A NEW WATER-METER.

A simple form of positive water meter adopted for general service has recently been perfected by the National Meter Co., of New York city, by making some important changes in its "Empire" meter. This meter has been in use for a number of years, but principally for measuring hot water and other liquids requiring all-metal construction.

The general design of the new meter is shown by the accompanying illustrations, Figs. 1 to 3. Fig. 1 shows the cylinder and piston, the top cylinder head being thrown back to show the piston in place, Fig. 2 shows the base and screen, and Fig. 3 the whole meter, in two parts, the cover being thrown back to show the intermediate gearing.

The piston is of hard rubber, having the same specific gravity as water. It has a revolving motion around the centre of the case and an oscillating motion on its axis.

The base casting is made considerably thinner than the cap, and the bulk of the water in the meter being in the base, in case freezing occurs, the base will be the only part injured, and the moving parts, register, etc., will not be affected. This greatly simplifies and cheapens the work of repairing frozen meters.

The meter has a straight reading register, which is instantly read without liability to error. and is provided with the same style of intermediate gearing that is used in the Crown and Nash meters, made by the same company.

Another point claimed for the meter is that if the piston stops for any reason it shuts off 85% of the normal flow through it. By this means the consumer, while not absolutely deprived of water, is pretty sure to notify the water department, or otherwise see that the meter is set right, instead of placidly continuing to use the water without having it charged against him.

The old meter, designed, as stated, for special service, had a gun metal piston. The new meter has a rubber piston, giving great lightness, and its proportions have been changed to give greater strength. The latter has been effected by increasing the diameter and decreasing the height, or length, of the piston, which strengthens the latter at the lips, or where the ring of the piston is cut away for the bridge, as shown in the left of Fig. 1. For special service, as for measuring hot water, the new shape will be used, made of metal as before.

The main wear of the meter comes on the cylinder heads and the top and bottom of the piston. The former can be easily tooled down to a plain surface, and the latter can be offset by shortening the cylinder ring, both processes requiring only simple tools and ordinary skill. Of course these processes could not go on indefinitely without using up too much of the material and seriously impairing the accuracy of the meter, but they might be so employed as to greatly increase the life of the meter, especially as under ordinary circumstances the wear would be very small. What is most feared now, it may be added, in the wearing out of meters, is sharp, gritty matter, of some size, rather than finely divided, smooth particles of mud and clay, such as is carried by the Ohio or Mississippi and most rivers of the West and South.

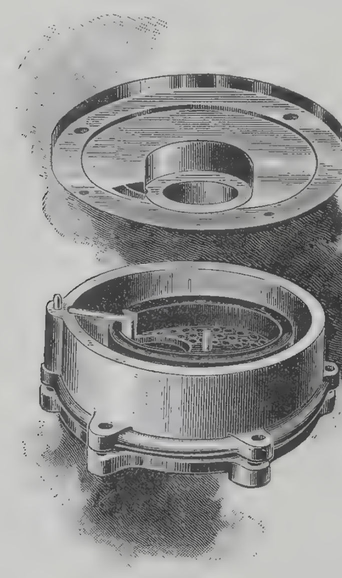

Fig. 1. Cylinder and Piston.

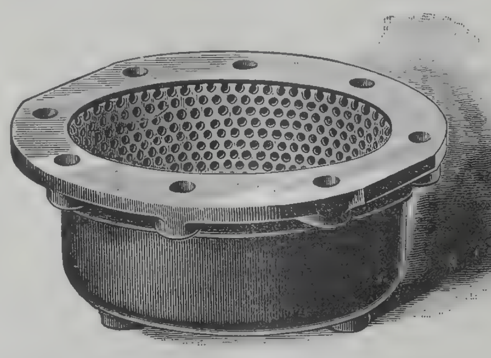

Fig. 2.—Base and Screen.

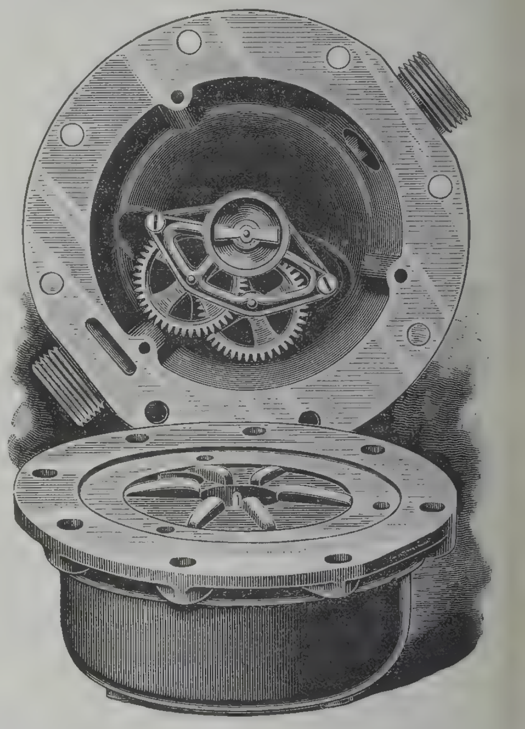

Fig. 3.—Intermediate Gearing and Meter Complete.

THE IMPROVED EMPIRE WATER METER. Made by The National Meter Co., New York City.

◆

A NEW PROCESS FOR THE DIRECT PRODUCTION of iron and steel from the ore is being introduced in Sweden by Dr. De Laval, the well-known inventor of the cream separator and the De Laval steam turbine. According to a description in the "Iron Age" by Mr. Fred. H. Daniels, general superintendent of the Washburn & Moen Mfg. Co., of Worcester, Mass., who has recently returned from Sweden, the process consists in mixing pulverized iron ore with carbon, probably in the form of pulverized peat, and subjecting the same in some form of a rotating cylinder to heat, after which it is brought into direct contact with an electric arc of tremendous power, which reduces the ore to metallic iron. The melted iron then flows into a large and highly heated furnace, where it can either be manufactured directly into steel or cast in any suitable form for further treatment. Dr. De Laval commenced his experiments something like three years ago at Trollhattan. During this period he has been assisted by a competent corps of mechanical engineers and metallurgists, and it is evident these experiments have produced results, from the fact that he has purchased one side of the entire water power at Trollhattan, which is made up of four falls, an aggregate horse-power of from 60,000 to 70,000. He has also purchased at considerable expense very much larger water powers in the north of Sweden. It is interesting in this connection to note that quite a number of the iron and steel works in Sweden have become so interested in the possibilities of this process that they have purchased all of the available water power in their vicinity.

◆

A NEW AND LARGE DEPOSIT OF IRON ORE of the finest Bessemer quality has been discovered at Iron Mountain, Mich., according to a press despatch. It was discovered when the water was turned into the new channel dredge for the Michigamme River, for the purpose of reclaiming the Mansfield mine, which was flooded several years ago, drowning 27 men. Six inches below the sand covering the river bed was found the new bed of ore, which was traced nearly 300 ft. The depth has not yet been tested.

◆

AN OHIO RIVER SURVEY is being made for the U. S. Government by Mr. R. R. Jones, U. S. Assistant Engineer under Major W. H. Heuer, Corps of Engineers, U. S. A. It is officially known as the Marietta-Pittsburg Survey, and covers about 180 miles of the river, and comes under the Act of Congress appropriating $1,100,000 for the construction of locks and dams, Nos. 2, 3, 4 and 5. This survey is to be the most exhaustive ever made of this part of the Ohio River, covering the position of the channel, location of channel eddies, shallows, bars, islands, geological formation of the banks, high and low water marks, velocities and volume of the river and precise leveling. The last authentic survey from Clipper Mills to Cairo, a distance of 696 miles, was made in 1868; the river, from Clipper Mills to Letarte, 37 miles, was last surveyed by C. A. Fuller, in 1844, and the 234 miles, from Letarte to Pittsburg, was last surveyed in 1837, says the Pittsburg "Chronicle." It is evidently time that the whole river was resurveyed, and those most interested expect that Congress will order the continuation of the present survey so as to cover the whole river, from Pittsburg to Cairo, at least.

◆

BRIDGES OVER THE OHIO RIVER, between Pittsburg and Cairo, number 22. The list is given as follows by the Pittsburg "Chronicle" in connection with a protest from rivermen against the manner in which they are built, the height above low-water mark is included: Point bridge, highway, 73.3 ft.; Ohio Connecting railroad, 83.5 ft.; Rochester, under construction; East Liverpool, building; Beaver, highway, 88.9 ft.; Steubenville, highway, 89.6 ft.; Wheeling and Marietta, highway, 91.66 ft.; Wheeling suspension, highway, 91.5 ft.; Wheeling bridge, 96.2 ft.; Bellaire, railroad, 90 ft.; Marietta, building; Parkersburg, 90 ft.; Point Pleasant, railroad, 91.4 ft.; Ceredo, railroad, 98 ft.; Newport and Cincinnati, railroad and highway, 98.1 ft.; Newport and Cincinnati, highway, 102 ft.; Covington and Cincinnati, highway, 105.5 ft.; Chesapeake and Ohio, railroad, 104.4 ft.; Cincinnati Southern, railroad, 105 ft.; Louisville and Jeffersonville, railroad, 92.8 ft.; Ohio Falls, 92.8 ft.; Kentucky and Indiana, railroad, 106.5 ft.; Henderson, 101.3 ft.; Cairo, 105.2 ft. In addition to these charters have been granted for bridges at McKees Rocks, Sewickley, Ironton and several other places. Ten years ago the rivermen succeeded in having a law passed requiring all bridges over the Ohio and below the Kanawha to give a clearance of at least 90 ft. above low-water mark. They now demand a channel span of 800 ft. instead of the 500 to 550 ft. used in the later structures.

◆

THE POTOMAC RIVER RETAINING WALL, at Washington, D. C., is almost completed. This wall, which will be nearly six miles long when finished, was authorized in 1882 as a protection to the land filled in and reclaimed on the Washington and Georgetown side of the Potomac River in the improvement of that river. The reclaimed land is in three sections, aggregates 621.12 acres, and this area is set aside for park purposes. The wall, commenced in 1890, is now 28,172 ft. long, and 2,000 ft. are yet to be built. It is founded upon a riprap base 20 ft. wide at the bottom and 5 ft. at the top and the wall itself is 6 ft. high and about 3½ ft. thick, extending 3 ft. above high tide. The wall is backed with oyster shells or gravel and back of this is the filling material taken from the Washington Channel, deepened under the same act of Congress. A tidal basin is included in one of the filled areas, and this basin is provided with automatic gates admitting water at high tide from the Georgetown channel and emptying it into the Washington channel at low tide.

BLACK AND WHITE ASPHALT ROADWAYS have been proposed by the Public Works Department of New York for the Western Boulevard. The purpose is to separate the truck, or heavy vehicle traffic, from the light traffic, by dividing the 26-ft. roadways on each side of the car tracks into two distinct roadways by the difference in color. This would only be done in case of the passage of an ordinance now before the aldermen compelling trucks to keep to the gutter side of the street and leaving the inner half of each roadway clear for light traffic. An alternate plan proposes a 1-ft. strip of white asphalt as an indicator of the dividing line of traffic. Since writing the above, the ordinance has been passed.

◆

A TREADLE-MOTOR HOSE CARRIAGE is being tried by the Berlin Fire Department. This carriage carries six men; two in front, who attend to the steering, while four men in the rear operate a treadle which communicates motion to the two rear driving-wheels by belts. The body of the vehicle is made of wood and steel tubes and the apparatus is claimed to be generally successful in operation. This standard of excellence, however, is based upon the comparatively slow methods of the German fire department.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXVI., No 16.

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THE DESIGN FOR A BASCULE BRIDGE, prepared by Mr. Thomas E. Brown, Jr., M. Am. Soc. C. E., of New York city, has been adopted for the crossing of Newtown Creek at Vernon Ave., Brooklyn, N. Y., by the joint bridge committee of the Brooklyn board of aldermen and the Queens County board of supervisors. The clear span is to be 150 ft., and the bridge will have two leaves 85 ft. long, with 75-ft. swing, operated by cables passing over sheaves in towers on the abutments, these cables being attached to three points in each leaf. The hoisting plant will be operated by hydraulic power. It was at first proposed to have a swinging leg under the free end of each leaf, to rest on a foundation in the bed of the creek when the bridge was closed, but this feature has been wisely abandoned. The bridge will have a 34-ft. roadway, two 6-ft. sidewalks, and will be 8 ft. above the water line. The estimated cost is $105,000, or $200,000 including the piers. Mr. John J. McLaughlin, M. Am. Soc. C. E., County Engineer of Queens County, is engineer for the bridge committee. Some of the other competitors have entered protests against the acceptance of the Brown designs, but the committee has decided to ignore them.

◆

THE COLUMBIA BRIDGE, over the Susquehanna River, at Columbia, Pa., was swept away by the recent great wind storm. This bridge was about 1¼ miles long, and was claimed to be the longest covered bridge in the country. The first bridge at this point was completed in 1812, at a cost of $232,000, but the structure was carried away by an ice freshet in 1832. It was rebuilt at an expense of $157,300, and was burned in June, 1863, to prevent the passage of Confederate troops, who were then in the adjoining county to the south. The Pennsylvania R. R. Co. bought the old piers and, in 1869, built a wooden railway bridge across the river, with one iron span in mid-stream. This bridge was used for freight trains to Baltimore and other points. The iron span alone remains. The storm lifted the wooden spans clear from the piers, but left the latter uninjured.

◆

THE NEW YORK & BROOKLYN RY. CO. has filed a certificate of incorporation for the purpose of building and operating a railway tunnel between the two cities, two miles long. The New York end would be near Broadway, somewhere between Canal St. and the Battery, and the Brooklyn end would be near Fulton St., "between the City Hall and the East River." The capital named is only $20,000, and the directors for the first year are Alonzo B. Cornell, B. S. Henning, Otto Andrae, Jr., Fritz Hill, J. D. Miller, Jr., P. C. Schnitzer, S. R. Haxtun, E. R. Hoadley and Irving Washburn. This is apparently a revival of the Henning gravity railway tunnel project.

◆

THE IMPROVEMENT OF THE EAST RIVER FRONT of New York has been reported upon by the board of consulting engineers, made up of Mr. George S. Morison, Prof. William H. Burr, and Gen. William P. Craighill. This report supplements that of Feb. 6, 1896, on the North River front, given in abstract in this journal. In the former report provision was made for railways along the proposed marginal North River street and the board believes that the same should be done for the East River, and some radical changes are called for in this connection. A large part of the freight traffic of the New York, New Haven & Hartford R. R. naturally comes to this section of the city and it would seem better to reach this district by land than by water. A single large ferry-house at the Battery would also better suit public convenience and occupy less space than the several existing houses. The board considers the transfer of the Sound steamboat business from the North to the East River as desirable, and as better accommodating the public by saving at least a half hour in time; but the transfer involves so many questions that it must be handled with a great deal of care. The full report divides the East River front into four sections and discusses each section with reference to docks, piers, etc.

◆

THE DREDGING OF THE CHICAGO RIVER, ordered by the U. S. Government and to be commenced on Nov. 15, is likely to destroy abutting dock property if early precautions are not taken by the owners. The contract calls for the removal of 1,306,942 cu. yds of material and an increase of the depth of the river to 17 ft. Many docks and other structures on the banks are founded at a depth of 12 to 15 ft., and Capt. Marshall, Corps of Engineers, U. S. A., now warns property-owners that they cannot recover damages from the U. S. Government if their docks are undermined and slide into the river. On the contrary, if such accidents occur, the owners make themselves liable to penalties, under the law relating to the obstruction of navigable channels being improved by the government. After the government has finished its work, the Drainage Channels Trustees will increase the depth in places to 24 ft., thus adding to the danger to adjacent property.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a derailment caused by the explosion of the boiler of a locomotive Oct. 4, near Osage City, Kan., on the Atchison, Topeka & Santa Fe Ry. The engine was hauling a passenger train and should have stopped at Osage City for water, but being late it was run on towards the next water station. When about two miles beyond the city the boiler exploded, and as a result of the sudden check some of the forward cars were telescoped, and others were overturned, while all the cars were derailed. There were seven persons killed (including the engineman and fireman) and four or five injured.——A train of freight cars on the Quinnimont Coal & Iron Ry., near Quinnimont, W. Va., ran away on the steep grade Oct. 7 and left the track at a sharp curve. The engine and all the cars were wrecked; two men were killed and two others badly hurt.

◆

A LOCOMOTIVE BOILER EXPLOSION occurred Oct. 7 at Meriden, Conn., on the New York, New Haven & Hartford R. R. The engine was hauling a northbound freight train at the time. Nobody was killed or badly hurt.

◆

A BOILER EXPLOSION at the Montour Iron Works, Danville, Pa., on Oct. 8, killed six persons and seriously injured 30 more, some of them being fatally injured. The boiler was about to be put out of service to allow of repairs being made, and men were at work repairing the brick work of the furnace.

◆

AN EXPLOSION IN A FOUNDRY CUPOLA occurred Oct. 8 in the works of the Singer Sewing Machine Co., at Elizabeth, N. J. The iron had just been tapped and run off and the furnace men were moving away when the side of the cupola was blown out. Two men were badly injured and burned.

◆

AN EXPLOSION OF ACETYLENE GAS occurred Sept. 12 in a restaurant at Lyons, France, causing a great amount of damage to the building and the neighboring buildings, while five persons were injured. The fire underwriters submitted a report on the case to an expert, who gave the opinion that the acetylene system may be accepted if an additional premium is charged, and the apparatus installed outside the building or in an unoccupied and well ventilated place.

◆

THE AMERICAN LINE STEAMSHIP "PARIS" was disabled, on Oct. 2, by the fracture of the starboard shaft in the tube next to the outboard shaft tube. The "Paris" was 320 miles east of Sandy Hook at the time of the accident bound to Southampton. She proceeded on her journey with one engine, at the reduced speed of about 15 knots per hour, after sending the news to New York by the "Fuerst Bismarck."

◆

STREET CAR FENDERS OR WHEEL GUARDS which can be dropped by a catch operated by the motorman are to be tried at New Haven, Conn., the Railroad Commissioners having given permission for the use of these fenders instead of the present ones which are operated by an automatic trip released by any obstruction on the track.

◆

THE BROOKLYN NAVY-YARD CAISSON ACCIDENT is practically disposed of by the announcement that the Secretary of the Navy will take no further action in the case. Experts called during the final sitting of the court of inquiry declared that the calculations of Mr. Menocal were entirely correct and that by these figures he was justified in removing the ballast. His friends also contend that other and unknown causes may have been at work, as no one knows what happened in the several hours intervening between the completed removal of the ballast and the accident. As the Secretary has expressed doubts as to Mr. Menocal's responsibility, it is understood that he is to have the benefit of this doubt.

◆

AIR-POWER FROM COMPRESSED AIR is being supplied to all tenants of the Havemeyer Building, New York, who may desire it, by the Ingersoll-Sergeant Drill Co., which has its offices in the same building. A steam-driven compressor is located in the engine-room and the building is piped throughout, through the elevator shaft, with branches at the several floors. The Ingersoll Company will be the largest consumers in operating tools and machines of all kinds for exhibition; but this power is also used in their offices to open the doors, ring call bells, operate the letter presses, dust furniture and clean the carpets, rugs, etc.

◆

AN ELECTRIC PLANT, to be operated by water power, is in course of construction at Tampa, Fla., by the Consumers' St. Ry. & Power Co. A wing dam has been constructed across the Hillsborough River, which is stated in a press report to be 22 ft. high with a 60-ft. base. The river flow is 50,000 cu. ft. per minute. The total horse-power of the plant is 1,400. A steam plant is also to be added for use when the steam is low.

◆

THE BOSTON PNEUMATIC TRANSIT COMPANY'S permission from the Boston Aldermen to lay and operate underground pipes in that city has been vetoed by Mayor Quincy. The ground of objection is that the franchise is not accompanied by a contract protecting the interests of the city and securing some pecuniary returns to the city treasury. The grant from the Aldermen simply defined the route and stipulated that the company shall transport free all matter pertaining to the official business of the City of Boston which can be transmitted through its system.

◆

LOW BIDS FOR CEDAR BLOCK PAVING were recently received at Port Huron, Mich., the contracts being awarded at 37 cts. per sq. yd. for cedar blocks upon a sand foundation. The detailed bids were published in our Construction News Supplement last week. Mr. F. F. Rogers is City Engineer.

◆

THE PRESENT AND FUTURE WATER SUPPLY OF Brooklyn is discussed at some length in a special report by Mr. I. M. de Varona, M. Am. Soc. C. E., Engineer of Water Supply, made public Oct. 6. Mr. de Varona was requested to report on the cause of and remedies for the recent taste, odor and color in the Brooklyn water supply, the time when an additional supply, outside of sources now under development, would be needed, and the best means of securing such a supply. The report states that the cause and remedies cannot be stated with definiteness until the water has been more extensively studied, especially from a biological point of view. The general cause of the taste and odor is decaying organic matter, but whether this arises chiefly from growths in the surface or driven-well supplies cannot yet be said. An additional water supply, Mr. de Varona says, should be available in five years, which would require the immediate beginning of construction. Further investigations for a new supply must be made before selecting the source. Although strongly in favor of municipal control of all portions of a municipal water supply, Mr. de Varona believes that financial conditions may make desirable a contract with a private company for the development and delivery of more water, with ultimate private ownership.

◆

AN EXHIBIT OF VALVES AND HYDRANTS and their accessories will be held on Nov. 10, by the Department of Public Works of New York city. Manufacturers of such supplies are requested to send illustrations and literature explanatory of the same to Gen. Chas. H. T. Collis, Commissioner of Public Works, 150 Nassau St. Only articles selected will be placed on exhibit. The exhibit will be held at the corporation yard. Exhibitors must bear all the expense of their respective exhibits and have a representative on hand to explain the same. The mayor, board of underwriters, engineers of city departments and the press will be invited to inspect the exhibit and "experienced judges will be appointed to examine and report upon the merits." The object of the exhibit is stated to be "to ascertain the state of the art relative to such contrivances with a view to improving the city service." All communications on this subject should be addressed to Gen. Collis, as above.

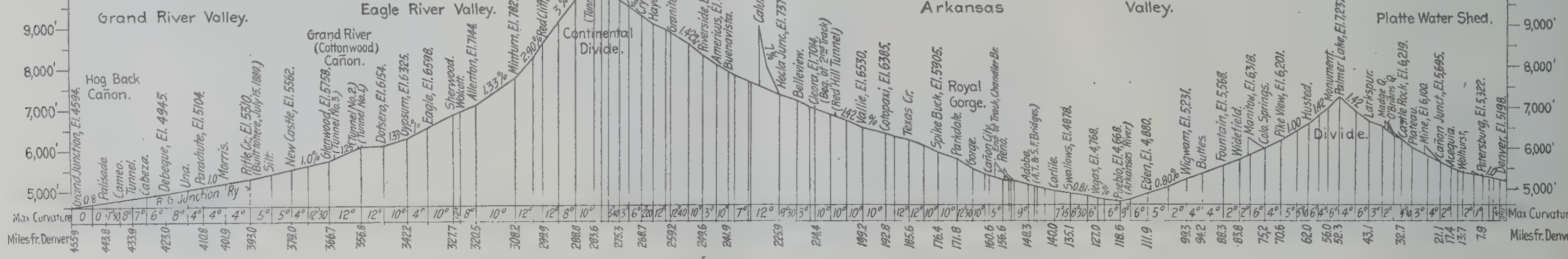
NOTES OF A TRANSCONTINENTAL TRIP.

III.

Denver & Rio Grande R. R.

This noted railway was first projected and built at the time when the narrow gage fever was at its height among promoters and engineers, and a 3-ft. gage was adopted as promising a lower cost in construction and operation and a greater facility for the sharp curves of a mountain railway than could be obtained with the standard gage. The construction was commenced in 1871, and for a long time this railway was held up as an example of the benefits of a narrow gage line, especially for mountain railways, the old arguments about the lower cost, the greater facilities for sharp curves, the greater proportion of live load to dead load, etc., being worked pretty hard for some years. As the fallacies of these arguments became more fully recognized, and as the standard gage system extended, the Denver & Rio Grande R. R. became isolated, possessing no facilities for through traffic. This led to the adoption of the standard gage, and the change was commenced on the main line between Denver and Pueblo, in the summer of 1880, at which time the system had a total extent of 337 miles (all narrow gage), but it was not until 1890 that the standard gage track was completed through to Grand Junction, the western terminus (and the connection with the Rio Grande Western Ry.). The line has now 305 miles of standard gage main line from Denver to Grand Junction (via Pueblo and Leadville), and south from Pueblo to Trinidad; 296 miles of narrow gage main line, extending from Salida south to Santa Fe, N. M., and west to Grand Junction (via Gunnison); and 278 miles of mixed gage, from Denver to Pueblo and Leadville. This latter is maintained in order to provide for through trains over both lines and also for the through haul of ore from the narrow gage branches at the mines about Leadville to the smelters at Pueblo.

Some interesting notes on the rails used on this line, with illustrations of the various sections from the 30-lb. rail of 1871 to the 85-lb. rail of 1896, were given in Engineering News of Sept. 3. Reference was there made to the use of a combination of 85-lb. and 65 lb. rails on the mixed gage on three-rail track, so that one of the outer (85-lb.) rails carries wheels of standard gage rolling stock only, while the other carries the wheels of both standard and narrow gage rolling stock. In answer to an enquiry as to the relative wear of these rails, Mr. M. H. Rogers, Chief Engineer, stated that thus far very little difference has been observed in the wear of these rails. The narrow gage trains passing over this track are usually hauled by standard gage engines, so that no difference in wear on the two rails would be due to the engines, and the load on the wheels of the narrow gage freight cars is small in comparison with the load on the driving wheels of the engine. It is to be remarked, however, that the difference in height of the two rails forming the narrow gage track probably have some influence on the steadiness of running of the trains and on the wear of the wheels and trucks. On another page of this present issue is shown the track construction with 85-lb. rails, and also a turnout and crossover on the mixed gage track, where the three rails make a somewhat complicated arrangement. The stub switch is almost universal. Some of the new 85-lb. rails are being laid south of Colorado Springs, new ties are being put in (and they are badly needed in places), and a considerable amount of gravel is being put in to raise the track to grade and shoulder out the ballast.



PROFILE OF THE DENVER & RIO GRANDE R. R.

There are some very fine locomotives on this line, but no very new narrow gage engines, as the extension of the standard gage system has given the road a surplus of these and none have therefore been built or bought for some time. Both diamond-top and straight smokestacks are used. The narrow gage freight engines were originally built with diamond stacks, and have never been altered, but the straight stack and extension smokebox are the present standard, and are applied on nearly all the standard gage engines, and narrow gage engines in passenger service. It was noted that the height of most of the straight stacks had been increased by putting on a piece extending about 12 ins. above the top molding of the original stack. On enquiry it was found that this has been done on account of the trouble experienced from smoke blowing into the cab when steam was shut off. The straight stacks are made as high as possible consistent with the limits imposed by bridges, tunnels, etc. The doors of some of the roundhouses, however (built for narrow gage engines), are unusually low, and the tops of the smokestacks are made movable so that they can be removed by the hostler when the engines are put into the roundhouse. Mr. Henry Schlacks is Superintendent of Machinery.

The main shops are at Burnham, just outside Denver, but there is not much work going on, with the exception of ordinary repairs and some new narrow gage car work. From the look of a number of driving and truck wheels waiting to have their tires re-turned, it would seem that a limit of tire wear is not very closely observed, but that engines are allowed to wear their tires pretty hollow before being sent to the shop. The responsibility for this may perhaps rest with the traffic department rather than with the mechanical department, as is the case on a good many roads.

Frogs (rigid) and switchstands are manufactured at these shops. The narrow gage sleeping cars and day cars are practically the same as those for the standard gage lines, except that they are somewhat smaller and have narrower berths and seats. The narrow gage sleeping cars were all built by the Pullman Palace Car Co.

Denver to Salt Lake City (D. & R. G. R. R. and R. G. W. Ry.).

All narrow gage trains on the mixed gage portions of the Denver & Rio Grande R. R. are hauled by standard gage engines, the drawheads on the tenders having three sockets (side by side) for the coupling pin, so as to fit the coupling of standard and narrow gage cars. The narrow gage engines are also similarly fitted, so as to haul either narrow gage or standard gage cars. The New Mexico express (for Santa Fe, N. M.) by which I traveled from Denver to Colorado Springs on July 7, is a narrow gage train hauled by a standard gage engine, a shackle bar (like that on an engine pilot) connecting the drawhead on the car with that on the tender. Owing to this arrangement an extra length of brake hose was required between the tender and car, but as this sagged to the ground the brakeman gave it two turns around the shackle bar, so that a casual observer (even uninfluenced by Colorado whiskey) might not unreasonably have thought that he saw a snake crawling from the engine to the train.

The California Fast Mail, on which I left Colorado Springs, July 9, is a standard gage train with through cars to San Francisco. It has no dining car, but stops at Pueblo for lunch and at Leadville for dinner. At the former place there is a handsome station, with a very poor lunch room, the principal article of food available being the usual imitation chicken (apparently manufactured of leather and parchment specially for railway use). At Leadville the station does not amount to much, but there is a good and plentiful meal provided. The hurry and scramble, however, are very objectionable and trying, and while the patronage does not probably warrant running a dining car service it would seem as though a buffet car service might be afforded.

Pueblo, 120 miles from Denver, is an important railway center and a manufacturing city, having the large iron and steel works and rolling mills of the Colorado Fuel & Iron Co., flour mills, and extensive smelting and reduction works for the treatment of the ores brought from the mining districts. It is 4,667 ft. above sea level and has a population of 35,000. At Florence, the junction of the branch to Cripple Creek, are sidetracks crowded with cars loaded with machinery and supplies for, and ore from, the Cripple Creek gold mines. Oil and coal are found in this vicinity, the present output being given as 5,000 tons of coal and 2,000 barrels of oil per day, while natural gas is supplied for domestic use. The railway now approaches the mountains, following the course of the Arkansas River, and then enters the Grand Canyon of the Arkansas at the narrowest part of which (the Royal Gorge) the walls rise almost vertically for a height of, in some places, 2,600 ft. For eight miles the line runs along the bottom of this narrow and tortuous gorge, following every curve and bend of the river, and not far above the water, the roadbed being in many places a gallery cut in the face of the rock. In this gorge is the notable plate girder bridge over a tributary stream, the outer girder being suspended at the middle from an iron inverted V spanning the Arkansas and abutting in the rocky walls of the canyon. This bridge was described in the "Transactions of the American Society of Civil Engineers." The noise of the rushing water and the reverberating roar of the train are almost deafening. Salida (elevation 7,049 ft.) is the junction of the two main lines to Grand Junction (one standard gage and the other narrow gage), and the narrow gage line to New Mexico. At Granite (elevation 8,945 ft., 259 miles from Denver) are extensive placer mining workings.

Just beyond Granite, while running along an embankment, the engine (a ten-wheeler) struck a boulder lying on the track, throwing it to one side so as to derail the front pair of truck wheels. Fortunately the truck did not slew very much out of line, and the train made an emergency stop in three or four car lengths, with the wheels not far from the rails. Wrecking wedges or frogs of hard wood were put behind the wheels, and the engine backed up until the wheels dropped into place on the rails. The delay did not exceed 10 or 15 minutes.

Leadville is reached by a long loop with heavy grades, and two engines are used for the ascent, taking a run at the grade at high speed and going up in fine style. This city was the center of a great gold mining district from 1859 to about 1870, being then known as California Gulch. It then became partially abandoned, but the discovery of the carbonate silver ores in 1876 gave it a new start, under its present name, and it is now the center of a silver mining industry, its population being about 20,000. Its elevation is 10,200 ft. above sea level, but the highest point reached by the railway is the summit of the Tennessee Pass, 10,240 ft., where a tunnel effects the passage from the Atlantic to the Pacific slopes. The Grand River canyon and the 250 miles of the Colorado Desert were passed at night. At Grand Junction, 456 miles from Denver (elevation 4,594 ft.) the two lines of the D. & R. G. R. R. from Salida and the line of the Colorado Midland R. R. converge. This point is the western terminus of the Denver & Rio Grande R. R. proper, but the Rio Grande Western Ry., which extends from here to Salt Lake City and Ogden is practically an extension thereof, giving the D. & R. G. R. R. a connection with the Southern Pacific Ry. for through communication with the Pacific coast.

THE TABERNACLE, SALT LAKE CITY.

THE TEMPLE, SALT LAKE CITY.

Soon after passing Grand Junction, the line crosses the 250 miles of the Colorado Desert, a rolling plain of fine sand which I first saw about 5.30 a. m. on July 10, when near Green River. The sand permeates everywhere in spite of double window sashes and closed ventilators and doors. From this plain rise rows and blocks and pillars of rock, with vertical sides and horizontal strata, their outlines (as cut by the sand and wind) resembling massive castles and long lines of fortifications. The main range of these hills, north of the railway, is said to be 2,000 ft. high, and there are seams of coal visible, while in the higher plateau, north of the cliffs which form the face of the hills, are deposits of asphalt, gilsonite, ozocerite, etc. The sand of the desert has enough loam in it to break into a thin crust or scale, cracked like the bottom of a dry pond, while the irregular surface is gullied and washed, showing the effects of the heavy rainstorms which sometimes occur. It is said, on good engineering and agricultural authority, that the land is richly fertile if watered (being specially adapted for fruit growing), and that sufficient water can be obtained from the Grand River, and other rivers in the neighborhood, to enable a large part of the desert to be reclaimed. In fact a considerable amount of reclamation has already been effected. An example of what may be done here by irrigation is afforded at the little town of Helper, where the train stopped for breakfast (July 10), and where the bright fresh green of the trees, bushes and lawns, and the spray from numerous lawn sprinklers, were most refreshing after the unbroken yellow and gray colors of the desert. Similar oases are to be seen at Price and other stations. In addition to this, there are great coal deposits underlying this district, and west of Helper there are coal mines and nearly 100 coke ovens.

Leaving the desert the railway begins to descend the Wasatch range to the Utah or Jordan valley by a long steep grade full of curves. The summit of the grade is 7,465 ft. above sea level. The brakes are kept on most of the time, and the brakemen are on the alert, standing in the vestibules ready to pull the emergency cord in case of necessity. The speed is about 35 to 40 miles an hour, checked at sharp curves, and, of course, a hot box developed. It was on a mail car, and the journal had a lead-lined bearing. A copious application of cold water enabled the repair men to change the brasses and repack the box in a very short time, the journal, of course, being popularly supposed to be able to take care of itself if heated to a high temperature, and then dosed with cold water. At Midway, on this steep grade, is a catch siding with switch set normally for the siding, so that a runaway train will be diverted from the main track and turned onto the sand. Above the switch tower is a "Stop" sign, and the train comes to a full stop here, the towerman not setting the switch for the main track until the train is at rest.

In the valley there is more vegetation, with signs of the irrigating ditches, by means of which the sagebrush desert has been converted into orchards, farms, and gardens. The bottom of the valley, between the toes of the mountain slopes, is almost perfectly flat. Besides agriculture, there is the mining of rock salt, soda, gypsum and kaolin. Most of the towns here are practically Mormon towns. After seeing so much sandy desert and barrenness, the sight of the blue waters of Utah Lake is wonderfully refreshing to the eye and mind. This is a fresh water lake, about 10 × 30 miles, and from this the little Jordan River flows to the Great Salt Lake. At Provo is a woolen mill employing some 500 men, and at American Fork is what is said to be the largest beet-sugar factory in the country. The line passes the junctions of several branches to coal and gold mining districts (including that of the Salt Lake & Mercur Ry., described and illustrated in Engineering News, July 2, 1896), to the soda beds at Manti, to the rock salt deposits at Salina, and to the deposits of gypsum and potters' clay. The Mercur gold mining district is spoken of as a rival of the Cripple Creek district in point of importance, but I learned that considerable difficulty has been and is being experienced in satisfactorily extracting the precious metal from the ore. The cyanide process is used, with some modifications. After all these places the railway enters Salt Lake City, which I reached about 1 p. m. on July 10.

Salt Lake City.

It must be acknowledged that this city is somewhat disappointing in its first appearance, and hardly comes up to one's expectations. The streets are wide, but not in very good repair on the whole, and are very dusty. The irrigation ditches along the streets are either lined with cobblestones or overgrown with rank grass, and even the grass along these ditches is yellow, burnt and dusty in July. Nevertheless, the city is certainly imposing, and from a little distance one realizes that it actually is an oasis in the flat valley, few trees being seen outside of the irrigated limits.

The city is 4,228 ft. above sea level, and has a population of 50,000. It was laid out by the Mormons in 10-acre squares (666⅔ ft. square), with streets 132 ft. wide, every street having a stream of water flowing along each side (either in a ditch or in an ordinary gutter), and most of the streets having plenty of large trees. There are many modern office buildings, and the municipal and county offices are in a handsome structure known as the City and County Building, shown in the accompanying illustration. It is of Utah stone, from Kyune, and is 160 × 273 ft., 250 ft. high to the top of the dome. The two wonderful buildings here are the Tabernacle and the Temple, both situated in Temple Square, together with the Assembly Hall. The square covers ten acres, and is surrounded by a high stone wall. The Tabernacle is an oval building, 150 × 250 ft., with an elliptical domed or "turtle-back" roof, 100 ft. high at the center. This roof is composed of wooden arch trusses, as shown in Engineering News of Oct. 5, 1895, the top chord of which carries the outer covering or roof, which is of tin roofing, while the lower chord carries the smooth turtle-back ceiling, the trusses being entirely concealed. The building will seat 12,000 persons, but its acoustic properties are wonderful, owing largely to the peculiar form of the ceiling. The Temple is a fine stone structure, 100 × 200 ft., with three towers at each end. It was commenced in 1853, but was not completed and dedicated until 1893. Its cost aggregated nearly $5,000,000, and it is said to be the costliest ecclesiastical structure in the United States, with the single exception of St. Patrick's Cathedral in New York city. It is an imposing structure, but does not in reality appear so large as it appears in the accompanying picture, a remark which will apply equally to the Tabernacle. The general dimensions of the Temple are as follows:

Length		200 ft. 0 ins.
Width		100 ft. 0 ins.
Height:		
Central west tower	204 ft.;	with spire, 219 ft. 0 ins.
Central east tower	210 ft.;	" " 222 ft. 6 ins.
Side west towers	182 ft.;	" " 194 ft. 0 ins.
Side east towers	188 ft.:	" " 200 ft. 0 ins.
Height to top of main walls		167 ft. 6 ins.
Thickness of walls, bottom		9 ft. 0 ins.
" " top		6 ft. 0 ins.
" buttresses		7 ft. 0 ins.

Business is dull now, and there is but little engineering work in progress. Several water power and electric power schemes are projected to utilize the water powers available in the mountain canyons, and two or three important ones are already in operation, notably those of the Pioneer Power Co. and the Big Cottonwood Power Co., noted in Engineering News, Oct. 1. It is not easy to see, however, that a sufficiently wide field is open for the application of the power when generated. On one hand it is stated that some of these projects are planned now so as to get control of the water rights, while the extremely low rates for machinery, supplies and labor are favorable to carrying on the work of construction. On the other hand it is argued that the promoters would hardly be likely to sink money in such plants without having some definite idea as to the application of the power to be generated. Irrigation works are somewhat numerous in this state, and one important enterprise—that of the Mount Nebo irrigation system—will shortly be described and illustrated in this journal. Mr. O. R. Young, the engineer for these works, has prepared a somewhat novel set of earthwork tables, which give closely approximate quantities for slopes read off on the clinometer. They are thus specially advantageous for preliminary estimates, and it is believed that they are the only tables of the kind which have been prepared.

City Engineer's Department; Salt Lake City.

The office of City Engineer was only created on April 1, 1890, Mr. A. F. Doremus, M. Am. Soc. C. E., being appointed to that position for a term of two years, and then reappointed. On Feb. 13, 1894, Mr. Doremus was appointed chairman of the Board of Public Works, and Capt. Willard Young was appointed City Engineer. Mr. Doremus resigned his position on the board on Aug. 8, 1896. Mr. F. C. Kelsey was appointed Assistant City Engineer on April 5, 1890, and served in that position until March 11, 1896, when he was appointed City Engineer (to succeed Captain Young), which position he now holds. It is only within these past six years that there has been a systematic surveying and monumenting of the streets and lots, this work having been inaugurated by Mr. Doremus. The main part of the city has now been most carefully surveyed, and the surveys have been plotted in beautiful shape in record books, strongly bound in canvas boards. In carrying out this work, a standard of length was first established, and a very substantial system of monumenting was adopted. The street monument used is a stone post set in concrete, and having its top (with the center mark) covered with a cap to protect it and afford easy access. These and other details will be given in a separate article. The engineer department has large and attractive offices in the City and County Building, and on the wall is an immense blueprint map of the city, together with a set of blueprint block plans of the city, showing by colors and symbols the paving, water mains, sewers, electric lights, street railways, contract work, etc., and being exceedingly convenient for reference. Adjoining the office is a very large fireproof vault for the records, drawings, etc.; a large table is provided so that the books or drawings can be consulted and examined without taking them out of the office. All the original field books are kept here. There is also on one side of the vault a long set of large shallow drawers for tracings, etc., which are all systematically arranged, indexed and labeled. A wedge-shaped cleat is attached to each side of each drawer, and a square stick extending across the drawer is slipped under these, so as to hold the tracings down and keep them from curling or from shifting about. Records of paving work and contracts, with prices of work are kept in a special book, with the style of construction drawn on one page, and the records and statement of cost on the opposite page.

THE CITY AND COUNTY BUILDING, SALT LAKE CITY.

The system adopted for lettering plans is specially interesting. All ordinary notes, explanations, etc., are written by hand, the Reinhardt style of lettering being adopted, but for large titles, etc., Ockerson's hand stamps, with ordinary printing type, set in a frame are used. The largest stamp will print a title 6 ins. long at one impression. A plain open type of letter is used, and for the smaller sizes a type as near as possible to the Reinhardt style is adopted. A special ink is used, being a printing ink with plenty of dryer in it. Great care is taken in the proper placing and printing of the titles, and very good work is done, with much greater rapidity than might be expected, while the saving in time over the hand lettering of large titles is very considerable. One boy, at $30 per month, does all this and looks after the type, ink, stamps, etc., and the result is that the work is done quicker and better than by an ordinary draftsman at higher salary, besides insuring greater uniformity. This plan was adopted partly on account of its efficiency, and partly on account of the difficulty in getting draftsmen who could do rapid plain lettering in large sizes.

The city has a considerable amount of asphalt paving, but it is hardly recognizable at first, on account of the dusty condition of the streets, the care of the streets being under the charge of a political non-technical office. The pavement laid with asphaltic sandstone mined at Santa Cruz and San Luis Obispo, Cal., is the best asphalt paving in the city, and some of it which has been in use for five years has cost very little for repairs. Some portions of the pavement laid with Utah asphalt are in first-class condition, while others are badly cracked and show signs of disintegration. This would appear to indicate that the material makes a good pavement if properly manipulated. The Salt Lake Stradamantic Asphalt Co. paved one intersection to introduce its material, which it called stradamantic asphalt, but the pavement was a failure, and the company failed to repair it when requested to do so. The following statement shows the amount, kind and cost of asphalt pavement contracted for up to the present time; the contract prices include grading, except in the case of the last contract for 1896; this contract was awarded on Aug. 25, 1896, and the work is to be completed by Nov. 1:

Year Laid.	Area. Sq. yds.	Asphalt.	Thickness. ins.	Concrete foundation. thickness.	Contract price. Per sq. yd.
1891	2,343	Cal. asphaltic sandstone...	2½	6-in.	$2.99
1891	1,100	Stradamantic asphalt	2	*4-in.	3.24
1892	14,989	Cal. asphaltic sandstone...	2½	6-in.	3.24
1892	2,871	Utah asphaltic limestone..	2	5-in.	2.90
1893	23,886	Utah asphaltic limestone..	2½	6-in.	2.79
1893	15,100	Cal. asphaltic sandstone...	2½	6-in.	2.97
1896	3,900	Utah asphaltic sandstone..	2½	6-in.	2.74

*Asphaltic cement concrete.

On several of the business streets, the gutters and sides of the street are paved with red sandstone, while asphalt is laid between the street-car tracks and from the outside of these tracks to the block paving. The street railway company paves its portion (along the tracks) by separate contracts from those for the rest of the street. In these business streets the irrigation water flows down the ordinary gutters, special covered crossings being provided at street intersections.

The water supply system of the city comprises some very heavy and interesting works, which will be described and illustrated in this journal shortly. One of the most important recent works is the sewage farm, for treating the sewage from the gravity outfall sewer described in Engineering News of Jan. 4, 1894. The sewage was first turned into the sewer and main ditch on July 11, 1896, on which date I had the pleasure of visiting the farm in company with Mr. Kelsey.

Railways.

There are several railways projected in the neighborhood of Salt Lake City, but most of them are short lines to mining districts. The most important of the projected lines is the Utah & California Ry., which is to give Salt Lake City direct communication with the coast towns of southern California, and thus avoid the present roundabout route over the Southern Pacific Ry. by way of Sacramento. The line will run south over the Frisco branch of the Union Pacific Ry. to Milford, 221 miles; will then follow about 125 miles of roadbed graded in 1890 by the Union Pacific Ry. (and which can be put in condition for about $500 per mile); and will then strike across the lower end of Nevada into California. The southern terminus is not yet definitely decided upon, but the line may make connection with the Atchison, Topeka & Santa Fe Ry. at Barstow, thus getting direct access to Los Angeles. The total distance from Salt Lake City to Los Angeles, by way of Barstow, will be about 803 miles, of which practically 488 miles are built. The distance by the present route is 1,225 miles. The line would open up a coal and iron ore district (magnetite and hematite ores), and pass through a district said to be rich in gold, silver and lead, giving a rail communication to the mining districts of Pioche, Bristol, De Lamar, etc. The maximum grade to the north is to be 79 ft. per mile, with the exception of short lengths of 106 ft. per mile, while going south the maximum grade will be 53 ft. The minimum curvature will be 8°, except for some 10° curves in getting over the edge of the Salt Lake basin. There will be very few bridges or trestles, and it is said that no very heavy work will be encountered, and that the line (including stations, water supply and shops) can be built for $14,000 per mile. Owing to present financial conditions the scheme is temporarily shelved, and all field parties have been called in, but representatives of the company have been in the east trying to negotiate for the necessary funds for carrying on the work. Mr. H. M. McCartney, of Salt Lake City, is the Chief Engineer. He is also Chief Engineer of the Salt Lake & Pacific Ry., which is intended to run southwest to the Dugway mountains, opening up a district rich in carbonate silver-lead ores and other minerals. It will cross the Sevier Desert, and will be mainly in desert country, with light and cheap construction, and maximum grades of 80 ft. per mile. All mining supplies and materials would be carried in, and water might also be hauled. Some of the mines already opened have been abandoned on account of the cost of teaming or the impracticability of teaming over a country where there is no water supply. It is not thought that this desert (which is a southern part of the Great American Desert) will ever be made available for cultivation, as there is no river available for a water supply and wells cost too much, except for irrigating fruit. Two lines of 100 miles in length have been surveyed, but further work remains in abeyance awaiting the improvement of financial conditions. The Rio Grande Western Ry. is proposing to build a line north from Provo to Park City, and to extend its Salina branch southwest to Richfield, Elsinore and Sevier, about 35 miles. The new Salt Lake & Mercur Ry. was described in Engineering News July 2, 1896. The Great Salt Lake & Hot Springs Ry., which is a steam dummy line, 15 miles long, has just completed an extension from Farmington to a new pleasure resort at Lagoon. The Chief Engineer is Mr. E. A. Vail.

STREET RAILWAY EASEMENT CURVES.

By Charles A. Alden, Steelton, Pa.

With the higher speeds and larger cars, which the advent of the electric railway brought in street railway work, the necessity of some sort of easement curve for the short radii required in street work very early became evident. The question as to its form has generally been considered as if the paths followed by all parts of the car were necessarily somewhat similar to the alinement of the track. This has led many engineers to believe that a three-centred curve was sufficient for practical purposes, besides being somewhat easier to design and calculate.

This assumption as to the path of the car is only true as to the small portion of the car which lies between the two axles or the center pins of a double-truck car. The parts of the car outside of this area describe rather peculiar paths, as is shown on the figures accompanying this article.

Fig. 1 is a case which the writer has seen repeated many times in the last few years. The curve is primarily designed to enable cars to pass each other on a double-track curve, but is also supposed to act as an easement. It will be noticed that there are four changes in the direction of rotation of the point A and also four abrupt changes in the rate of rotation of the point B.

It should be understood that the radii given for the short arcs in these paths are only given in order to convey an idea of the sharpness of curvature at these points, as these arcs would not be exactly circular, although nearly so.

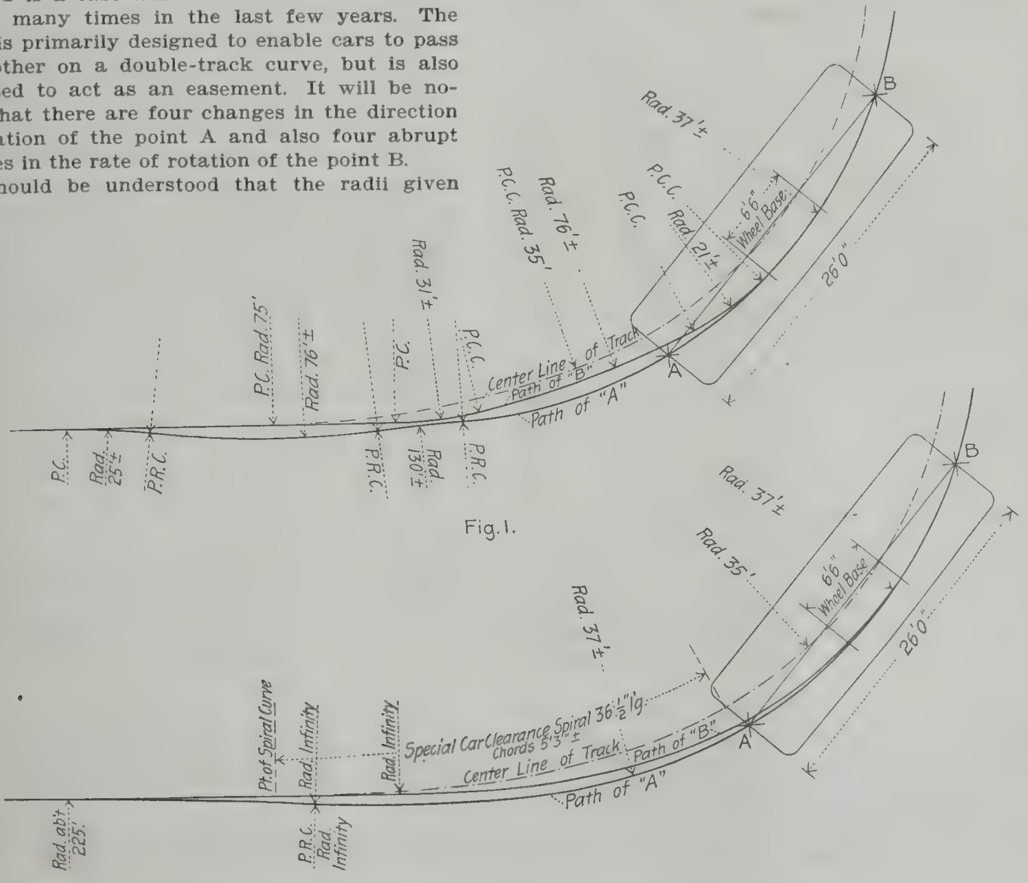


FIG. 1.—PATHS TRAVERSED BY POINTS AT ENDS OF A LONG ELECTRIC CAR IN PASSING ROUND A THREE-CENTERED CURVE.

FIG. 2.—PATHS TRAVERSED BY POINTS AT ENDS OF A LONG ELECTRIC CAR IN PASSING ROUND A CURVE HAVING SPIRALS AT ITS ENDS.

These changes of direction in the path of A will occur at any P. C. C. of a three-centred curve, if the first radius is sufficiently long to be of any use in preventing the jar of striking the P. C. of the curve. The sudden changes in the rate of rotation of the point B will be found to occur at every P. C. C. of a compound curve unless it is of the form of the railway spiral with chords of a length shorter than the wheelbase of the car.

Fig. 2 shows exactly the same main curve shown in Fig. 1, but connected with the tangent by a spiral of seven chords having the following radii: 300, 150, 100, 75, 60, 50 and 40. The "spiral" is somewhat forced on the last radius in order to keep the center of the curve in exactly the same position while at the same time maintaining the same car clearance. The track curve does not vary in position at the center of the spiral more than 4 ins. from that shown in Fig. 1.

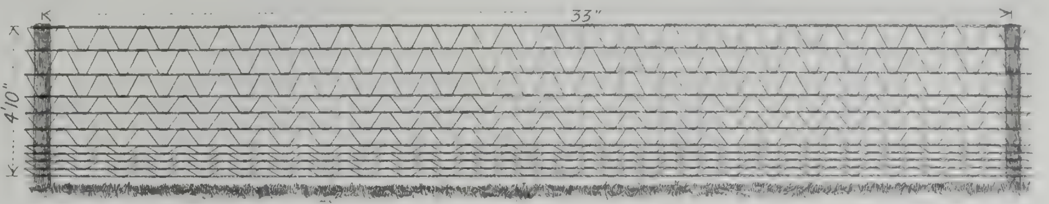
Note that there are but two changes in the direction of rotation of the point A. One of these is at the point where A leaves the tangent, from which there is a gradually decreasing curvature until it reaches the point of reverse curvature. From this point the curvature increases gradually until the point A attains its maximum rate of rotation parallel to the main curve. The rate of decrease and increase of curvature for both these arcs is somewhat less than that for the track curve. The point B also describes a curve with gradually increasing curvature until it reaches its maximum rate of rotation and follows the same path as A. The rate of increase of curvature would be somewhat greater than that of the track curve.

The car shown in these figures is by no means an extremely long car, as there are other cars known to the writer which are 30 ft. long, and others proposed which will be 38 ft. long and with only 6 ft. 6 in. wheelbase. The overhang of a double-truck car is nearly always as much as that shown in the figures. The sudden changes of motion shown in Fig. 1 exert a severe racking strain on the car framing which is particularly destructive to open cars as the connection between roof and floor framing is necessarily weak. The effect on the passengers is not pleasant, although this does not appeal so directly to the treasury of the railway.

The plan shown in Fig. 2 would cost for material just $12 more than Fig. 1, and would cost that much only for the most expensive track in use for surface roads.

The trouble involved in designing curves with spirals is very slight after adopting three or four spirals as standard suitable to the speeds of cars at the points in question. In fact, with proper formula, there is exactly the same number of operations required to solve for all the quantities that the constructing engineer needs, as there is to solve for similar quantities for a three-centred curve.

THE McMULLEN RAILWAY FENCE.



THE McMULLEN WIRE FENCE.

The growing favor with which wire fencing is being regarded by railway companies has resulted in bringing out a number of new designs of such fencing, and one of these (which was exhibited at the recent convention of the Roadmaster's Association of America) is shown herewith. The panel length, or distance between posts, is 33 ft. There are eleven horizontal wire cables, the top one composed of four No. 12 wires and the others of two No. 12 wires each. There are four lower spaces of 3¼ ins., then three of 6 ins., and three of 9 ins. The intermediate or binding wires are of No. 14 gage. This fence is manufactured by the McMullen Woven Wire Fence Co., 114 North Market St., Chicago, Ill., which also manufactures ordinary open mesh or woven wire fencing for railway and other purposes.

THE ROWAN STEAM STREET CAR MOTORS IN FRANCE

The combination steam motor cars of the Rowan system were first tried by the Paris Omnibus Co., during the Paris exhibition of 1889, four cars being used, and having a run of 1.55 miles in 10 minutes. At times each motor hauled a double-deck car seating 63 persons. After the exhibition the operation of this line ceased, but in October, 1890, the cars were put in service on the Pigalle-Trocadero line, for six months, and since September, 1891, they have been in service on the Auteuil-Boulogne line. The run of 1.86 miles is made in 12 to 15 minutes, including stops, and the three motors makes 122 trips per day, hauling a trail car on 38 trips. The motors are turned by switching on a Y at each terminus. The track is of standard gage. The following particulars are taken from an article in the "Revue Generale des Chemins de Fer."

There are six engines in operation, the two latest of which differ from the others in having double boilers. The car has an iron frame, the front end of which is carried by a four-wheel driving truck upon which is mounted the boiler (the engine and truck being detachable from the car), while the rear end is carried by a pony truck. The body of the car seats 22 persons, while 21 persons (paying a reduced fare) can stand on the two platforms, one of which is between the main body of the car and the engineman's compartment. The car is 30 ft. 6 ins. long, 6.56 ft. wide and 6.75 ft. high in the body. The distance from rear axle to center of truck is 18.6 ft. The engine consists of a vertical boiler (or two vertical boilers) mounted on a four-wheel driving truck, upon which rests the front end of the car, as already noted. The wheels are 25 ins. diameter, with a wheelbase of 5 ft. The frames are inside the wheels. The connection between the motor and car is effected by two vertical rollers at the back of the motor frame, between which slides a curved guide attached to the car frame. Side bearings are also provided, running in curved channel irons on the motor frame. To disconnect the motor it is only necessary to jack up the front end of the car until the guide is clear of the roller, then to raise the smokestack, disconnect the pipes leading to the water tank and condenser, remove the dashboard and run out the motor. The car body can thus be kept in service while the boilers or engines are being cleaned or inspected. The boiler is cylindrical, with rows of inclined water tubes passing through the upper part of the square firebox. The upper and lower parts of the shell are bolted together by outside flanges, so that they can be entirely separated for examination, which is done every six months. There are 131 tubes, 1.52 ins. diameter, with upset threaded ends screwed into the plates. The length between plates is 22.6 ins. The heating surface of the tubes is 95.01 sq. ft., and that of the firebox 17.43 sq. ft.; giving a total of 112.44 sq. ft., so that the evaporation is very rapid. The firebox is charged by means of small buckets instead of a shovel, each containing from 8 to 10 lbs. of coal. Three or four bucketsfull are thrown in, and this usually suffices for a round trip, but six extra buckets are carried for use on the road if necessary. The condenser is carried on the roof of the car. The weight of the motor is 121,000 lbs.

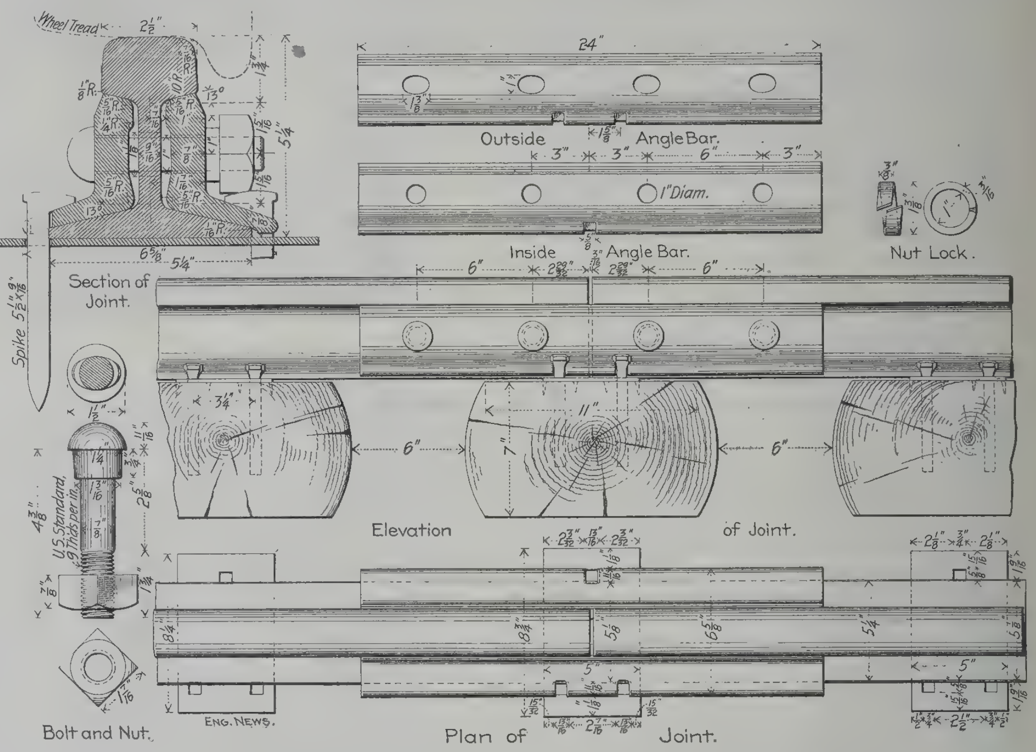


FIG. 1.—STANDARD TRACK WITH 85-LB. RAILS; DENVER & RIO GRANDE R. R.

The cylinders are horizontal, 6.6 × 13.6 ins., and drive the rear axle, which is cranked, the leading wheels being driven by coupling rods. The Winterthur valve gear is used, which resembles the Walschaert's gear. In the newer engines, the boiler has two vertical shells and fireboxes, connected by a horizontal shell of the same diameter. The rows of tubes diminish in diameter and pitch towards the top. The cylinders are inside, and slightly inclined. The valve gear is of the Stephenson link type.

The motors are fitted with brakes, operated by a treadle lever, which lever is also connected with a Lemoine brake, having belts to drums on the axle and shoes to the driving wheel tires. Trail cars have the brake mechanism coupled up to that of the motor car.

STANDARD TRACK AND THREE-RAIL SWITCH WORK; DENVER & RIO GRANDE R. R.

The Denver & Rio Grande R. R. began life as a narrow gage line laid with 30-lb. rails, but, as shown by the comparative sections of rails on this road, in our issue of Sept. 3, the weight of rail has steadily increased until now quite a considerable portion of the standard gage main line is laid with 85-lb. rails. This present standard type of track we illustrate herewith in Fig. 1, from blue prints furnished by Mr. M. H. Rogers, Chief Engineer.

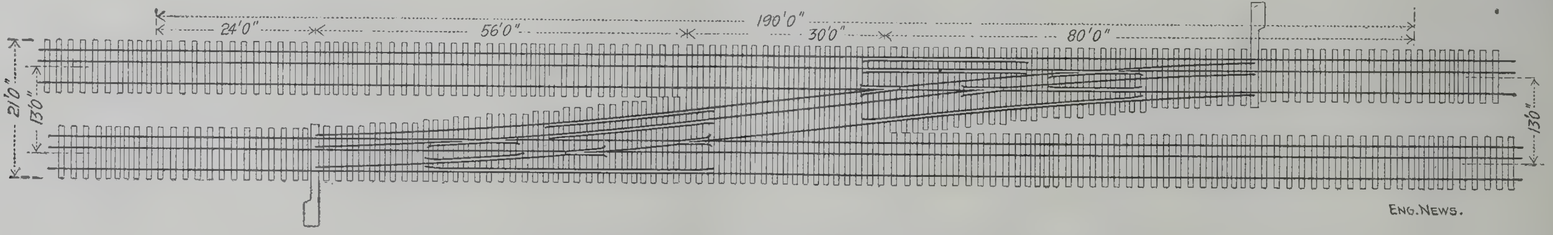


FIG. 2.—THREE-RAIL CROSSOVER; DENVER & RIO GRANDE R. R.

The rail is chefly noticeable for the roundness of its head, the top radius being 10 ins., with corners of 7-16-in. radius. The dimensions of this rail and the 85-lb. rail of the Am. Soc. C. E. section are given in the following table, and the weight of the steel of the D. & R. G. R. R. rail is taken at 10.204 lbs. for a section of 1 sq. in. one yard long:

The joint is of the supported type, with four-flanged Servis tie-plates on the joint and shoulder ties, these ties being 6 ins. apart in the clear. The the shoulder-ties are 5 × 8¼ ins. The rails are double spiked on the outside on each of these ties, the spikes being of the standard size, 5½ ins. long and 9-16-in. square. The angle bars are 24 ins. long, of heavy section in the web, the flanges being kept clear of the ties. They are of soft steel, have an area of 3.66 sq. ins., and weigh 47.6 lbs. per pair. The outer bar has oval holes, 1 × 1⅜ ins., and one spike slot; the inner bar has circular holes 1 in. diameter, and two spike slots, plates on the joint-tie are 5 × 8¾ ins.; those on the bolt holes in the rails being 1⅛ ins. diameter. The spike slots are ⅝ × 25-32 ins., with corners of ⅛-in. radius. Button-head bolts are used, ⅞-in. diameter, with oval necks 1¼ × ⅞ ins., and having nuts 1 7-16 ins. square and ⅞-in. thick. The nuts are put on the inside or gage side of the rail, with Verona nutlocks between the nut and angle bar. The bolts are 6 ins. c. to c. In laying track the expansion spacing at the joints is regulated as follows, according to the temperature:

102° F..........	1-16-in.	24° F..........	¼-in.
76° F..........	⅛-in.	— 2° F..........	5-16-in.
50° F. (normal)	3-16-in.	—28° F..........	⅜-in.

Dimensions of 85-lb. Rails.

	D. & R.G.R.R. ins.	Am.Soc.C.E. ins.
Height	5¼	5 3-16
Width of base	5¼	5 3-16
" of head (maximum)	2½	2 9-16
Sides of head	Inc. 4°	Vertical.
Depth of head	1¾	1 35-64
Height of web	2⅝	2¾
Depth of base	⅞	57-64
Thickness of web	9-16	9-16
Height to c. of bolt hole	2 3-16	.....
Radius of top of head	10	12
" of top corners of head....	7-16	5-16
" of bottom corners of head.	⅛	1-16
" of top fillets	5-16	¼
" of bottom fillets	5-16	¼
" of top corners of base ..	1-16	1-16
" of bottom corners of base.	Sharp.	1-16
" of sides of web	Vertical.	12
Fishing angles of head and base..	13°	13°
Area of head, sq. ins.	3.814	...
" of web, sq. ins.	1.506	...
" of base, sq. ins.	3.029	...
" total	8.349	...
Metal in head, per cent.	45.68	42
" in web, per cent.	18.04	21
" in base, per cent.	36.28	37

This road is notable for having a considerable mileage of three-rail track, extending from Denver to Pueblo and Leadville, so as to accommodate the passenger trains of standard gage and the trains of narrow gage cars of ore from the mining branches to the smelters at Pueblo. Some notes of this track have been given in the article on the D. & R. G. R. R. rails in our issue of Sept. 3, and in the transcontinental notes in our present issue. This arrangement of tracks makes the switch and turnout work somewhat complicated, and we illustrate in Figs. 2 and 3 a crossover and a turnout on the three-rail track. The crossover is for tracks 13 ft. apart c. to c., while for tracks 12 ft. c. to c. the only change is that the center distance between frogs is 22 ft. instead of 30 ft., making the total length over heel joints of switch rails 182 ft. instead of 190 ft. The turnout requires four guard rails, one of 45 ft., two of 26 ft. and one of 15 ft. in length, the flangeway for these being 2 ins. Stub switches are used, with 30 ft. switch rails, having 24 ft. of their length unspiked, the unspiked portion being connected by four tie rods and a head bridle rod, and conforming to a curve of 8° 26′ when thrown for the turnout. The main frog of the turnout shown is No. 8½ (angle 6° 44′), with a No. 10 frog for the narrow gage turnout rail and No. 1 or No. 2 double-point or crossing frog for the narrow gage main line rail, as shown by the diagram. There are 14 sawed ties for the moving portion of the switch rails; the headblock is of two pieces, 15 ft. and 4 ft. long, and beyond these headblocks are 40 timbers or ties. All the timbers are 7 × 9 ins., except the first two (headblock timbers) which are 9 × 12 ins.; the timbers aggregate 464 lin. ft., and 2,507 ft. B. M. The bill of timber is as follows:

1 piece	..15 ft. 0 ins. long.	3 pieces	..........11 ft. 6 ins.
1 "	.. 4 " 0 " "	2 "	..........12 " 0 "
4 pieces	.. 8 " 6 " "	3 "	..........12 " 6 "
5 "	.. 9 " 0 " "	3 "	..........13 " 0 "
3 "	.. 9 " 6 " "	3 "	..........13 " 6 "
3 "	..10 " 0 " "	2 "	..........14 " 0 "
4 "	..10 " 6 " "	2 "	..........14 " 6 "
3 "	..11 " 0 " "		

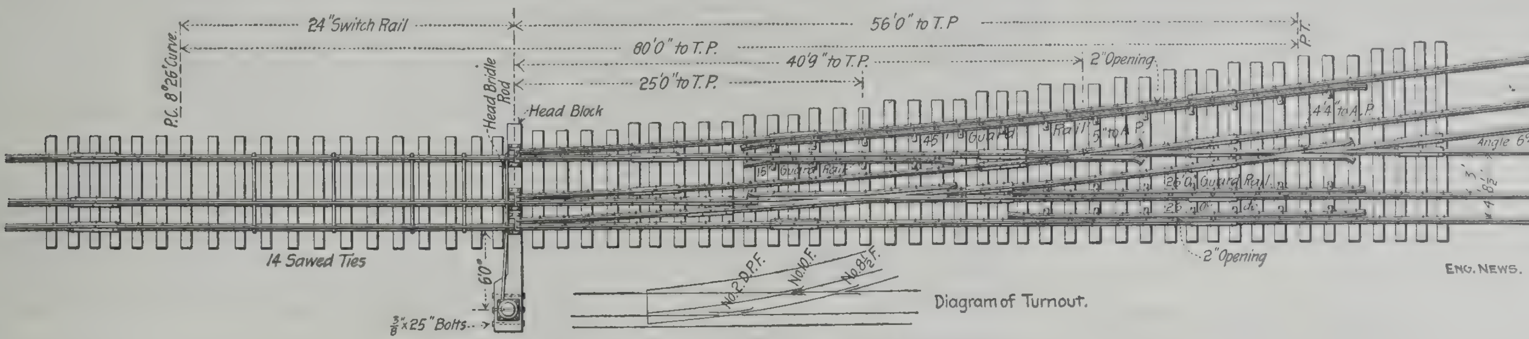


FIG. 3.—THREE-RAIL TURNOUT; DENVER & RIO GRANDE R. R.

PROGRESS IN THE EQUIPMENT OF CARS WITH AIR BRAKES AND AUTOMATIC COUPLERS.

In our review last week of the statistical report of the Interstate Commerce Commission, just issued, we gave particulars of the progress thus far made in the equipment of railway rolling stock with air brakes and automatic couplers. In addition to those figures we present a summary, abstracted from the report of the number of couplers of each special make in use, as reported to the Commission. The figures represent the total number of cars and locomotives of all classes, equipped with automatic couplers as reported to the Commission. The summary is as follows:

Kind of coupler.	Total cars equipped on June 30, 1895.	Kind of coupler.	Total cars equipped on June 30, 1895.
Janney	143,726	Standard	5,947
Gould	105,725	Thurmond	5,529
Chicago	22,964	Dowling	4,908
Trojan	17,646	Tower	2,873
M. C. B.	17,591	Pooley	2,505
Miller	17,123	Williams	2,251
Buckeye	14,938	American	2,035
Safford	8,642	California	1,980
Van Dorston	7,703	Mather	1,570
Smillie	7,606	Drexel	1,039
Hinson	6,636	Blocker	1,385
Missouri Pacific	1,036		

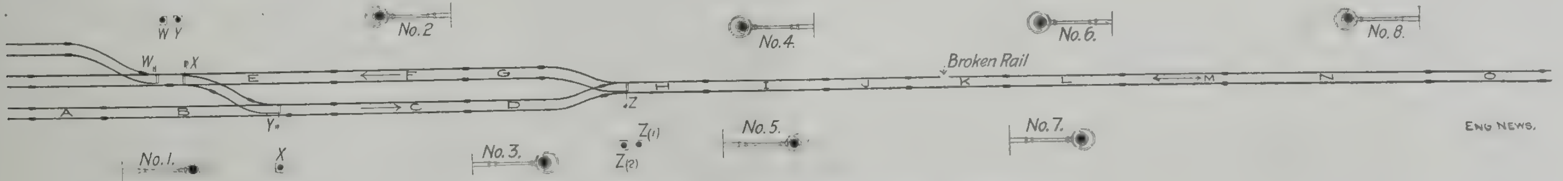
It is to be remembered that the Interstate Commerce Commission's statistics are made up from the reports furnished by railway companies, and on matters of this sort, of course, contain more or less errors. Thus the "M. C. B." couplers should be credited to the different makers, in some unknown percentage. The Miller couplers are, of course, all on passenger coaches. The automatic couplers of the link-and-pin type, which cut quite a figure in the Commission's statistics a few years ago, have, most of them, disappeared, but the Safford and Blocker couplers in the above list are of this type, and, of course, should not properly be reported.

In train brakes the "odd" brake equipment cuts a small figure. The totals given are as follows:

Kind.	Total equipment fit'd, June 30, '95.	Kind.	Total equipment fit'd. June 30, '95.
Westinghouse	345,836	Lansberg	601
New York	12,391	Haberkorn	27
Boyden	1,491	Unclassified	45

AN AUTOMATIC BLOCK SIGNAL SYSTEM FOR SINGLE TRACK RAILWAYS.

At the recent convention of the American Society of Railroad Superintendents a system of block signaling for single track lines, with automatic electric disk signals and overlapping blocks, was described by Mr. J. Schreuder, Chief Engineer of the Union Switch & Signal Co., and this system we illustrate herewith. The diagram plan represents a length of double and single track equipped with the signals, which are of the disk or banjo pattern, while the points of insulation are also marked.



AUTOMATIC BLOCK SIGNAL SYSTEM WITH OVERLAPPING BLOCKS.
Union Switch & Signal Co.

A train moving from A to O, the track being unoccupied and all switches propertly set, will find all signals clear. Signal No. 4, controlling movements from right to left, however, will be red, as it is, in part, controlled by the position of the switch Z, and will always show red while the switch is set for left to right movements.

The movement of a train from A to O, and the operation of the signals and indicators, will be as follows:

Entering A, the switch indicator Y is set to danger, thus giving warning at the crossover of the approach of a train. On entering B, indicator Y is still held red, while signal No. 1 is set to danger, thus protecting the rear of the train.

Leaving B, indicator Y is cleared, and on entering C indicator Z(2) shows red. This indicator is only operative when switch Z is set for left to right running.

Entering D, signal No. 3 is set to danger; as long as this section is occupied signal No. 1 remains red.

Entering H, signal No. 1 and indicator Z(2) are cleared, while indicator Z(1) is set to danger.

Entering I, signals No. 5 and No. 6 are set at danger. There is now no change until the train enters section K, when signal No. 3 and indicator Z(1) are cleared.

Entering L, signals No. 7 and No. 8 are set at danger.

Entering M, signal No. 6 is cleared.

Entering N, signal No. 5 is cleared.

Entering O, signal No. 7 remains at danger, while No. 8 is cleared. On leaving section O everything is returned to the normal position.

Now take a train running from right to left, with the switch Z set for the upper track, and signal No. 3 standing normally at danger. As the train enters section O it sets signal No. 7 at danger, and similarly sets signals No. 8 at N, No. 7 at M, and No. 6 at L. On entering section K, signals No. 7 and No. 8 are cleared, and at J the indicator Z(1) announces the approach of the train, signal No. 3 being already set to danger by position of switch Z.

Entering I, it sets signal No. 4 to danger, and at H clears signals No. 5 and No. 8, and continues to hold indicator Z(1) at danger.

At G, indicator Z(1) is cleared and indicators X and W are set to danger.

Entering F, it sets signal No. 2 to danger and still holds signal No. 4 red, while at E, signal No. 4 is cleared, but indicators X and W are still held red. Leaving E it clears signal No. 2 and indicators W and X.

A car on the fouling point of siding would set signal No. 2 and indicators W and X at danger; the siding switch being reversed the same danger signals would be displayed.

In setting the crossover, indicators W, X and Y and signal No. 1 would protect the movement.

A train moving from the siding to main line, single track, by way of switch Z, is protected by signals No. 4 and No. 1, set to danger by movement of switches, until it reaches C, where it sets indicator Z(2) to danger, and at D signal No. 3 is set to danger. When switches are set to their normal position all indicators are cleared except Z(2), and signals then protect the running as described in first movement.

In section K will be noticed a break in the rail. In practice the trainmen would be notified of such an occurrence by signals No. 6 and No. 5 being set to danger.

The function of the electric switch indicators, W, Y, X, Z(2) and Z(1), is to show trainmen working at a switch the condition of the track in both directions from the switch. That is, should a train be within the block in which the switch is located, the indicator will show red, thus giving notice that it would be unsafe to open switch. At each switch is placed a circuit shifting device, called a switchbox, which acts to set the signal to danger when switch is opened.

The following movements will show the protection afforded two trains traveling on the same track from opposite directions:

Train No. 1, on D, holds signals No. 3 and No. 1 at danger in rear, and signal No. 4 and indicator Z(2) ahead. Train No. 2 approaching from O, on reaching N will have signal No. 8 at danger in its rear and signals No. 7 and No. 5 in front. As train No. 1 is still in D, train No. 2 can proceed, and, on entering L will add signal No. 6 in its protection. Train No. 1 in entering H, clears signal No. 1 in rear, sets indicator Z(2) clear and Z(1) to danger, but as train No. 2, in L, is holding signal No. 5 at danger, train No. 1 is held by signal No. 5, and train No. 2 proceeds to signal No. 4 with the rear protection of signal No. 6. It will thus be seen that two trains cannot get together nearer than the distance of the overlap or the distance between two opposing signals on a single track.

This system is in use at the Pittsburg yard of the Allegheny Valley R. R.

DAMAGES FOR STREAM POLLUTION have been awarded against the Village of Saratoga Springs, N. Y., in one of the lower courts. The suit in question was one of several arising from the discharge of sewage in Kayaderosseras Creek. The decision holds that the sewage has rendered the stream flowing past the plaintiff's premises unfit for domestic use, that it has been rejected by domestic animals, and that it has caused the pollution of the atmosphere to such an extent during the warm months as to "seriously interfere with plaintiff's enjoyment of his right to live upon and occupy the said premises." Damages were ordered at the rate of $75 a year for six years or more, and it is averred that the plaintiff is entitled to an injunction to prevent the further pollution of the stream. The injunction is withheld for a year, but the plaintiff may apply to the court for continuing damages.

THE U. S. PATENT OFFICE, in the year ending June 30, 1896, received 45,645 applications for patents, reissues, designs, trademarks, etc. This is the largest number ever filed in any one year by nearly 2,000. The total receipts of the office for the fiscal year named were $1,307,090; and the total of receipts over expenditures now deposited in the U. S. Treasury to the credit of the Patent Office is $4,776,479.

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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

The preservation of cross ties, and the question of the relative first cost and ultimate economy of treated and untreated ties, is a subject which comes up periodically for discussion. It seems, now, to be pretty evident that while engineers very generally recognize the practical and financial advantages of treated ties, the managers and executive officers of railways are, as a rule, able to realize only the extra first cost of the tie, and do not yet sufficiently appreciate the economies due to increased life of ties and the saving of labor in tie renewals, so that the engineers have a campaign of education to conduct before they can expect to bring about the general use of treated ties. From a detailed estimate prepared by a railway manager some months ago of the relative cost of southern pine ties the following summary is taken: For untreated ties, heart-pine or pitch-pine is usually specified, and as this is valuable for sawmill purposes, it is only the logs which are defective for such purposes which are available for ties. Thus ties of this wood cost about 55 to 70 cts. each, delivered at New York, and have a life of about 7 years in northern or 5 years in southern climates. The life is limited by rail wear and checking as well as by decay.

For treated ties, pitch pine is not suitable, as it would not absorb sufficient of the oil, and short-leaf pine is, therefore, used, which has a much more open grain. This timber is in little demand for sawmill purposes, and is, therefore, cheaper than the other, the cost at New York being about 48 to 54 cts. untreated, or 85 to 94 cts. treated, while the life is about 12 years.

Let us now take the average of these figures and see what is the actual cost per annum of each tie.

	Untreated tie.	Treated tie.
Average first cost, cts.	51	90
Average life, years	6	12
Annual interest charge on first cost (4%), cts.	2	3.6
Annual outlay for a sinking fund which will replace tie at end of its life (interest at 4%), cts.	7.7	5.6
Total cost per tie per annum, cts.	9.7	9.5

It will be seen from the above that the actual annual cost of the two ties, on a road which can borrow money at 4%, is practically the same. With interest at 6% the treated tie would be more expensive than the other by 0.36 cts. per annum. On roads where the above conditions prevail, therefore, the economy in the use of treated ties will arise in the economy of labor expended in track maintenance, rather than in the cost of the ties themselves. But on roads located in warm climates, where ordinary ties have a short life, or those located in regions so remote from a timber supply that ordinary ties are very expensive, there may also be a saving in the cost of the ties themselves. As a matter of fact the railway companies which have done most in the way of tie preservation are those which are located in the far South or on the treeless plains of the West. In view of the labor and expense of replacing ties in street railway tracks, it may well be expected that the street railway companies will soon find it to their advantage to adopt treated ties for their lines.

For some years past State Engineers and others interested in irrigation engineering and the general development of several of the far-Western states have been urging the U. S. Geological Survey to permanently mark upon the ground the elevations obtained in connection with its surveys. It was pointed out that without such permanent record of easy reference, much of the work performed by the survey was valueless, except for mere map-making purposes; and as the monuments used were of a very temporary character, all local traces of the survey were soon obliterated, and it was practically impossible to identify upon the ground the points and elevations marked upon the finely engraved maps which the Survey publishes. Prominent among the advocates of this much-needed reform was Mr. Elwood Mead, M. Am. Soc. C. E., State Engineer of Wyoming, and it is pleasing to note that the labors of himself and his associates are bearing fruit, and the order has been issued to begin the new plan of monumenting in the State of Wyoming. A former assistant of Mr. Mead, Mr. McFarlane, is now running a line of levels from the Union Pacific railway, at Cheyenne, as a base, to an undeveloped irrigation district in and about Laramie County. Iron monuments are to be set at the township corners and their exact elevation established and permanently marked upon these monuments upon brass plates. Another party has commenced a similar work in the Big Horn, and a portion of the Shoshone basins. The subject of the monumenting of the Government surveys was discussed in our issue of Feb. 27, 1896.

A question of engineering ethics which frequently comes to our attention relates to the credit which an engineer who actually carries out a piece of work should give to a predecessor who has been connected with it in its preliminary stages. The obvious answer is, give exactly the credit due by stating the facts in the case. There may be exceptional circumstances which appear to demand a variation from such a rule, but on the whole it seems to be the only right course to follow. The main reasons which might be urged for pursuing a contrary course are: (1) That where an engineer designs and carries out work with practically no reference to previous reports or plans, or even when following only their general outlines, there is no reason for sharing with another the credit for the work; and (2) that an engineer in relating how he stepped in where another had begun may seem to be exulting over his predecessor. The answer to such arguments is that giving due credit never hurts any one in the long run, even when given with more generosity than the bare facts require, and that the facts in these cases are seldom such that they cannot be stated without giving any real cause for offense.

A case in point has recently come up in connection with the water filtration plant at Lambertville, N. J., described in our issue of July 2, 1896. The writer of the article, Mr. Churchill Hungerford, stated that he was the engineer for the plant and made no reference to the connection of any other engineer with the work. Our attention having been called, later, to the fact that Mr. J. B. Rider had something to do with the work at the start we addressed him on the subject and submitted his reply to Mr. Hungerford, who in turn has stated his case and supplemented it by a letter from one of the directors of the Lambertville Water Co. The whole correspondence on the subject is too lengthy and of too little interest to our readers to warrant its publication. We therefore present instead the main facts in the case as we gathered them from the letters submitted as follows: Mr. Rider made a report recommending sand filter beds, prepared designs for them and set some stakes for cuts and fills. He prepared to take the contract for the work and Mr. Hungerford was, apparently, on the ground to serve as his assistant, when on account of financial conditions Mr. Rider was unable to close the contract. The water company then engaged Mr. Hungerford as engineer and constructed the beds on its own account.

The general plan recommended by Mr. Rider was followed, but it was varied in its details. Of the most important modifications both parties agree that Mr. Hungerford made some, and Mr. Rider claims that some had been previously discussed by him and the water company. Both engineers undoubtedly deserve credit for their connection with the work.

Promotors of ship canals and possible investors in canal securities would do well to closely study the experience of the builders of the Manchester ship canal. The Cotton Association of that city now admits that if those interested could have anticipated all the difficulties that have been encountered, it is safe to say, that the canal would never have been built. The cost was just about double the original estimates, though these seemed very reasonable at the time, and the chief object for which the canal was constructed, that of transferring the great cotton market from Liverpool to Manchester, has not been realized. But while the canal shares return no dividends to those who supplied the funds actually used in construction, the City of Manchester incidentally derives benefit from the reduction in port dues and railway rates caused by the competition of the canal and by the rapid increase in the direct shipment of goods of all kinds from Manchester. The two things made plain by this enterprise are that preliminary estimates of cost and revenue are often misleading, and that it is an exceedingly difficult task to attempt to change the location of a long and firmly established trade. The existence of the canal is doubtless indirectly beneficial to Manchester; but this benefit has cost the canal shareholders about $70,000,000, and they must find what profit and satisfaction they can in thus doing good to some one else. This is not, however, the class of dividends they were led to expect by the original promoters of the scheme; and it is still a question whether like results to Manchester might not have followed the investment of the same sum in other directions and for other purposes, with some profit to those who took the risks of the enterprise.

THE STREET RAILWAY TRACK OF THE FUTURE.

Ever since the electric motor began to displace the horse as a motor for street cars, the managers of street railways have been engaged upon the problem of how to make a durable track, and in their study of it have expended sums reaching into millions of dollars. The old-fashioned horse cars cheerfully bounced along over the old flat rail laid on a stringer; and at the speeds at which they ran, the rough joints and the rattle and noise of the car as it passed over them were endurable. The advent of the electric car sent this type of rail out of use; it had already been discarded in progressive cities. But no one in the early days of electric traction dreamed of making a track which should exceed that of any steam railway in strength and stiffness. The old flat rail, with no pretence to longitudinal stiffness, had done duty, after a sort, so long, that a railway track with light ties, spaced rather far apart, and with rails of 50 to 60 lbs. per yd. was supposed to be ample for the heaviest street car traffic. But there were several things that were not taken into account. The first of these was the weight of the motor, resting directly upon the axles, and producing a hammer blow at every joint; the second was the high speed of electric cars, and the third was their great weight compared with the weight of horse cars. The combined effect of these factors was to make life a burden for the engineer responsible for track maintenance on electric railways. It was seen very soon that an electric railway required a heavier track than that above described, and the laying of girder rails was begun. The depth of these went from 5 ins. up to 6 ins., 7 ins., even to 10 ins., and the weight was proportionally increased. Of course with every increase in depth of rail an increased depth of foundation became necessary, which meant more excavation and placed the ties further underground. The net result is that the track of a street railway, which, in the old horse-car days, was a very light and inexpensive structure, is nowadays an exceedingly heavy and costly construction; and notwithstanding this, proves by no means so durable as was hoped when the heavy girder rails were first introduced

It is difficult to understand why electric cars should be so severe on the track, and especially upon the rail joints. This is usually ascribed to the electric motors, which were formerly mounted directly on the axles. Nowadays it is customary to support as much of the weight of the motor as is practicable from the truck frame; but with the increase in size of electric motors there is still complaint that the rail-ends are pounded down. Why should an electric car be more severe on the rails than a steam locomotive? Take, for example, a modern high-speed steam locomotive for heavy service. There is the driving wheel, 6 ft. or more in diameter, the weight of half the driving axle, and one eccentric, the weight of the axle-box and part of the spring, and finally the weight of the parts attached to the wheel, which, in case of the main driver are the crank-pin, counterbalance weight, half the weight of the parallel rod and more than half the weight of the connecting rod. When we have summed up all these weights, we find a total load on the rail not supported by springs which may equal or exceed the load that is not spring-supported on an electric car-wheel tread. Further the electric car may run at an average speed of 8 or 10 miles per hour, while the locomotive averages three or four times this; why, then, should not the locomotive be more severe upon the tracks than the electric car? Again, it is to be remembered that the cable railways also experience more or less trouble with their track-joints, though not as much as the electric lines. It would appear from this that the conditions under which street railway track is laid and maintained, may have something to do with the joint difficulties. Perhaps the fact that on a railway in a paved street the joints are let alone until their condition becomes so bad as to compel the removal of the paving to make repairs, has something to do with the troubles experienced. On steam railway lines, as is well known, the way to keep track in good condition is to constantly take the "stitch in time" that saves nine.

A very good proof of the serious nature of the joint problem on street railways is furnished by the radical treatment that has been accorded to it. The possibility of the use of continuous rails on steam railways was broached years ago; but it remained for the street railways to actually test the idea and prove its practicability.

At present there are in use in this country from 150 to 200 miles of street railway track, the joints of which have been all welded, either by the electrical or the "cast-welding" system, so that the rails are actually continuous. As to the success of this system, the testimony is rather conflicting; but the fact appears to be that the difficulties encountered have been no more serious than might naturally be expected to accompany so novel a departure from usual practice. The cast-welding system promises to supersede the electric welding system, according to our best information, because it produces as good or better results, at a less cost. Unless some further trouble should develop or those already found should prove more serious than they thus far have done, it seems quite probable that the street railway track of the future will have a continuous rail, at least wherever it is laid in paved streets.

Turning now to the foundation on which the rail rests, we find that the heavy punishment to which street railway track is subjected, is made evident here as well as at the rail joints. With heavier rails have come larger ties, more closely spaced, and of late there is a growing tendency toward the use of concrete in foundation work. All this means heavy expense; and it is a serious question whether the street railways of the country are at the present time getting the service from what we may call the sub-structure of their track that they should receive for the money they have expended upon it.

It is true in this department of engineering as in many another, that progress is in the nature of an evolution. The present street railway track has been evolved from the tracks of the steam railways. In the field of organic evolution we often see a bodily structure with members which no longer serve a useful purpose, but are traces of the structure of some ancestral race. In a similar way it is at least possible that in the evolution of the street railway track from that of the steam railway certain features have been retained which no longer serve their original purpose.

Let us see what qualities the ideal rail support on a street railway should possess. Its office, of course, is to spread the weight which it carries over a sufficiently large area to support the load without settlement. Whether in addition to this it should have a certain elasticity is a question which is undecided. There is, indeed, a general belief that the rail must have an elastic support; but it is unquestionable that the necessity for the elasticity arises mainly from the imperfections and inequalities in the foundation. Thus on cable railways the rails have been carried directly on the cast-iron yokes and no harm has resulted to either rails or rolling stock.

On a steam railway line the rail supports must fill several other requirements. They must keep the rails to gage; they must hold them from canting; they must permit the rails to be readily fastened to them; they must allow of quick repair and replacement in case of derailment or other accident injuring the permanent way. Now, all these requirements obtain in much less degree if at all, on a railway in a paved street. The paving itself holds the rails to gage and keeps them from canting, and the necessity for secure anchoring of the rail to the foundation is merely to prevent any hammering action taking place. Further, a derailment or other accident in a paved street cannot injure the rail supports.

We may now ask the question, why do we use cross-ties to support the rails of a street railway? Is it because they form the best and most economical support that could be devised, or is it, perhaps, because cross-ties have been used for rail supports almost universally since the first use of the railway? Is it not at least possible that a longitudinal system of rail supports for our street railways might prove more economical and durable, and reduce the cost and difficulty of track repairs? Again, is it necessary to bury such a large amount of wood beneath the pavement of a street railway as we do at present? Decay begins in it, we know, before it has been long in place; and with decay, settlement is inevitable, and this settlement will be by no means uniform. A rail in bad surface, and the entry of water and frost to the track foundation are the certain result.

In view of these defects of the cross-tie system of rail supports on street railways it is worth while asking whether we do well to adhere to it. Cannot a system of longitudinal foundations be designed which will give a continuous support to the rail, and which will fill all requirements better than the present system. Why not lay along the line of each rail a solid foundation of width sufficient to carry the required load without settlement, and either lay the rail directly upon it, or else, if some elasticity is found to be essential, interpose a stringer of wood as light as will give the required cushioning effect. In European practice it is very common to lay girder rails directly upon the concrete foundation of the street.

The first cost of such a system of rail supports would, perhaps, be a little greater than that of the present cross-tie system; but it seems probable that the reduced cost of track maintenance would much more than offset this. It will be apparent at once that with such a system repairs could be made on one rail of the track, or its supports, without at all disturbing the other and without removing the pavement at the center of the track.

If the street railway track of the future is to be made on the present system of cross-tie supports, it will only be because that meets the practical requirements better than any other. It is because the burying of a nearly continuous pavement of perishable and rapidly decaying wood beneath the tracks of a street railway appears to us to be an anomaly, that we have thought it wise to call attention to it, and to suggest the possibility of a better system. We know that in the process of organic evolution the organs which are inherited from former generations, but which are rendered useless by change of environment, continue for a time, and then gradually disappear. So in the case of the street railway tracks, if the system of cross-tie supports is a mere inheritance from earlier railway practice, we may expect to see it gradually disappear and something better will take its place.

LETTERS TO THE EDITOR.

Operating Steam Pumps without Oil in the Steam Cylinders.

Sir: We have recently noticed an article in your paper in regard to steam pumps operating without oil in their steam cylinders, in which credit was given to one of the manufacturers for having been the first and only company to adopt this practice. The machines referred to were very recently constructed and tested. It will doubtless be a matter of general interest to know that the Deane Steam Pump Co., of Holyoke, Mass., have built several hundred machines during the past two or three years expressly for operating without any oil in the steam cylinders. The pumps have been operating successfully and a large number of users report their operation as entirely satisfactory. The pumps referred to are all of them horizontal machines of the duplex type. Yours truly.

The Deane Steam Pump Co.
L. E. Bellows, General Manager.
Holyoke, Mass., Oct. 16, 1896.

Credit for the Johnson Electric Lighting Plant.

Sir: We have read with considerable interest your account of the electric lighting plant at Johnson, Vt., in your issue of Oct. 8. This plant was laid out by our Mr. Almon and it was on his suggestion that incandescent lamps were used rather than arc. We were the contractors for the entire electrical equipment and would have been glad to have had some mention in your article. We have also put in similar plants in Morrisville, Northfield, Bethel and Montpelier, all of which will show up very well in income and operating expenses. Very truly yours.

Almon, Sargent & Conant.
106 Equitable Building, Boston, Mass.

(Our apologies are tendered for the omission. It is the established custom of this journal to give full credit to both engineers and contractors in the description of any piece of engineering work. It was an oversight that it was not done in the above case.—Ed.)

The Weight of the Park Row Building.

Sir: In your issue of Oct. 8, 1896, in speaking of the Park Row Building in your editorial column, you say:

> "Probably the entire weight of the building when completed and occupied is not less than three times the weight of the steel in its framework, or a total of 18,000 tons."

The estimated total weights are as follows:

Weight of building	56,200	tons.
Weight of steel	9,000	"
Total	65,200	"

Yours very truly,
Nathaniel Roberts, M. Am. Soc. C. E.
Jersey City, N. J., Oct. 12, 1896.

(We thank our correspondent for the correction. Our comparison of the weight of the steel framework and the weight of the structure was really only a guess, and was purposely placed at the minimum which we thought possible, and a "slip of the pen" made the figures even less than they should have been. But the correct figures for the weight of the structure given by Mr. Roberts make still more forcible the point which we desired to make, viz.: the immense mass and weight of such a structure compared with the force which the most severe windstorm could exert against it. —Ed.)

Deep Borings for Foundations in New York City.

Sir: It may be of interest to record that a depth of 115 ft. was reached by boring on the site of the Tombs, without reaching rock. Boring was discontinued at this depth, because piling will be used in the foundations of the new prison, and we found satisfactory material for this purpose.

Another hole was driven to 90 ft., and discontinued, no rock being reached, while two others were bored to a depth of 80 ft., and were stopped by the rock. This shows the varying levels of the gneiss rock formation.

The bed of the old pond which existed formerly at this place was reached at from 30 to 40 ft., peat and other vegetable matter being washed up.

The material throughout in all test holes was gravel of a varying coarseness and sand. Particles of the old timber footings of the present prison were met with and washed up, having been cut by the pipe, and the old pine was as fresh as the day it was put in, 60 or 70 years ago.

The depth at which rock was struck in the latter holes (namely 80 ft.), corresponds very closely with the rock level met with in the borings taken not 100 ft. away, on Elm street by Mr. W. B. Parsons, Chief Engineer of the Rapid Transit Commission. This was I think about 84 ft.

Very truly yours,
F. S. Williamson, M. Am. Soc., C. E.
(Engineer to the Architects, Messrs. Withers & Dickson.)
Broadway, New York, Oct. 5, 1896.

Plants for Long Distance Power Transmission.—Correction.

Sir: Referring to your issue of Oct. 8, I find two typographical errors on page 231, in the list of plants in Dr. Duncan's address on "The Present Status of the Distribution and Transmission of Electric Energy." The line-voltage of the Pomona and San Bernardino plant is given as 1,000 volts, whereas it should be 10,000 volts. Again, the plant at Rome is credited with a distance of 188 miles, instead of 18.8 miles. When these corrections are made, the Pomona plant is seen to occupy its true position as the first plant in this country to use such a high pressure as 10,000 volts, and also to transmit power over so great a distance. The Pomona plant owed its origin directly to the success of the experimental plant temporarily put up between Lauffen and Frankfort, and was watched with great interest by engineers and investors as being the first plant in any country to commercially use such a high voltage over such a great distance. The construction and operation of this plant, of which I was engineer in charge, is fully described in the Transactions of the American Institute of Electrical Engineers in my paper on "Long Distance Transmission at 10,000 Volts." read in June, 1895.

Yours truly,
G. H. Winslow.
Lewis Block, Pittsburg, Pa., Oct. 12, 1896.

(The errors referred to were in the copy of Dr. Duncan's paper, furnished to us for reprinting. We may note also that copies of the paper by Mr. Winslow were printed separately from the Electrical Engineers' "Transactions," and we presume can be obtained by any of our readers by addressing him as above.—Ed.)

A Neat Pamphlet Filing Case.

Sir: I send in this mail a pamphlet case for engineers which I designed for my own use and had manufactured by Mr. C. A. Brackett, of this city. It is the result of considerable study, after failing to find anything in the market to suit my ideas. For municipal reports, and as a temporary binder for the Journal, it is just what I want at a moderate price, $3 a dozen, and may be desired by other engineers. Yours truly, Edward P. Adams.
53 State St., Boston, Mass., Oct. 8, 1896.

(The case sent by Mr. Adams is a neat pasteboard box, 7×9⅞×2¾ ins., inside measurement, designed to stand on end, with a flap back cover, opening up, and shutting into the case. The edges are reinforced, and the cover is entirely covered with black cloth. The cover forms the back of the case, and has printed on it in gilt "Engineering and Municipal Reports and Papers," and below, "Vol.," with an enclosed space for the number. A gummed label accompanies the case, which can be used for the volume number, or any other brief designation desired. The construction of the case renders it as nearly dust proof as possible. A number of different styles of cases are made by the Library Bureau, of 280 Broadway, New York, and with offices in Boston, Philadelphia, Chicago and St. Louis. Some of these cases are cheaper, and some more expensive, than the one described above. Most of the cases are made of wood, and thus are more durable than the one sent by Mr. Adams.

We have used for some years past filing cases about 8×10½×4 ins. of ordinary pasteboard, made up with black cloth, and having white paper pasted over the whole back, for titles. These boxes have no covers, and cost only some 5 cts. apiece. Similar ones can be obtained, we suppose, from any manufacturer of paper boxes.—Ed.)

Railway Commissions and the Issue of Stock and Bonds.

Sir: I read with much interest in Engineering News of Sept. 24 your notice and editorial comment on the late hearing of the Maritime Coast Company's application for the approval by the Massachusetts Railway and Harbor Commission of $6,000,000 stock and $6,000,000 bonds.

Your remark that Massachusetts is far in advance of other states in her laws regulating the issue of stocks and the marketing of bonds, while perhaps correct, should have included a notice of the Texas Stock and Bond Law of 1892, which antedates the Massachusetts law by two years, and which, judging by your synopsis of the proceedings referred to, seems to be identical in intention and effect. Texas has been more than generous to railway corporations during the past 25 years, and yet has incurred the pretended ill will of interested promoters and anti-promoters on all sides for her simple and statesmanlike regulation of the issue of bonds by both municipal and railway corporations. Permit me to refer you to your appreciative review of the operation of the latter laws in your issues of March 7, 1895, and April 23, of this year.

Just as ever, opinions depend very greatly on whose ox is being gored. I dare say that the Massachusetts folk consider their law a patriotic advance in statemanship, and yet from that same neighborhood has come the cry against "legislation inimical to capital," which has been alleged, without the slightest foundation in fact, against the fair name of our state.

It is gratifying to see that technical papers of your standing are taking the just position in the public interest which your remarks indicate. "Engineering" takes the same view of the question, and particularly as it relates to our state. The subject was discussed at length in the issue of Feb. 14 of the current year.

Yours respectfully, C. Corner,
Assoc. M. Inst. C. E., Assoc. M. Am. Soc. C. E., Expert Civil Engineer R. R. Com. of Texas.
Austin, Tex., Oct. 3, 1896.

(We owe our apologies to the Railroad Commission of Texas, for our omission to include that state with Massachusetts in the list of those seeking to reform past methods in the issue of stocks and bonds. Our editorial of March 7, 1895, treating of the Texas law and referred to by Mr. Corner, plainly sets forth our position upon the general question.—Ed.)

Experiments on Pumping from Artesian Wells at San Jacinto, Cal.

Sir: The writer was engaged during the winter of 1896 in the construction of a water system at San Jacinto, Cal. The supply was taken from three 7-in. artesian wells, located in the artesian belt which extends from near the mouth of the San Jacinto River canyon northwesterly a distance of several miles. The deepest well was 350 ft. and pierced alternate layers of clay, gravel and sand. The wells were cased with two thicknesses of riveted pipe, and the pipe was cut after the fashion of the region, in all water bearing sand, by a series of gashes, ⅛ to ¼-in. wide by 8 to 12-in. long, four in a ring, and the rings 12 to 16 ins. c. to c. The total thickness of water bearing sand in which the pipe was cut was about 170 ft. in the three wells.

The pump installed was a compound, duplex Worthington, with 12-in. plungers. The wells were about 50 ft. apart, each having a 6-in. suction pipe lowered into it about 30-ft. below the pump, all three being connected to a 10-in. suction main from the pump. A vacuum gage was attached to the vacuum chamber near the pump. At the time the pump was started the water would rise about 5 ft. above the pump and the three wells flowed at the ground surface about 50 gallons per minute. Readings were taken simultaneously of the vacuum gage and the speed of the pump and plotted after adding the head of water above the pump.

The result shows that the yield increased very nearly in proportion to the depth to which the water was lowered below level at rest, until the limit of suction was approached. A similar result was obtained with a centrifugal pump on a single well. The yield of the three wells was about 1,100 gallons per minute, as a maximum, with suction about 23 ft. below the pump.

The effect on nearby wells was noted as follows: A well 200 ft. away was lowered 3.1 ft. after five hours' pumping, the pump taking water 22 ft. by gage. A well 1,800 ft. away, across the drainage lines, fell about 0.1 ft. in one hour and 0.45 ft. in a little over three hours, and the greatest noted difference was 1 ft. after four hours' pumping. A well 700 ft. away, up stream, fell 1.7 ft. after five hours' pumping. A well 3,600 ft. away showed a decrease of flow in about five hours after the pump started, but no measurements were made.

Apparently the water pressure was lowered over a large area and the water slope to the well was very flat. After a day's run the water would stand about 3 ft. lower than at the start, the same as the amount of fall in a well 200 ft. away, and the conclusion reached was that the flow was limited, not by lack of water in the ground, but by want of sufficient entrance area into the pipes or by a clogging by sand near them. A twelve-hours' stop would bring the water back to its former level, save that the general level was falling about 0.5 ft. each month.

E. F. Tabor.
Escondido, Cal., Sept. 30, 1896.

A Schedule for Engineers' Charges.

Sir: I have read with interest the recent discussion concerning "cheap engineers," in your paper, and not wishing to lower the profession by cutting prices below what they should be, I would be glad to see a schedule of prices for some of the more common work which an engineer might be called upon to do, in a city of 7,000 inhabitants.

What would be a fair salary for city engineer in such a town? Sewer work and paving are just commencing. About what is the charge for laying out new additions, for running sidewalk grades and for surveying lots?

What per cent is usually charged for designing and superintending a system of sewers? What on masonry and steel bridges?

What is it worth to design a grade system for a town covering 2 sq. miles of territory with the blocks about 300 ft. square? The town is slightly rolling, with a stream through the center about 20 to 50 ft. below the land on either side.

If you will kindly answer these questions you will confer a great favor upon me, and doubtless upon many other young engineers, who, though they are competent to handle the work they undertake, often do it too cheaply simply because they do not know how much to charge for it.

Very respectfully,
———, Iowa, Oct. 3, 1896. O. E.

(Our correspondent's query is certainly a pertinent one. If cutting prices below what they should be is to be condemned by the profession, it is proper to inquire what prices should be asked for engineering work. There is no schedule of fees in general use by engineers, and the great difference in conditions between the engineer working in a small country town and the engineer working in a large city make the preparation of a schedule that would be of general application difficult or impossible.

In general the engineer in fixing a price for his work should consider two things. First, what is it actually worth to the party for whom it is done? The answer to this question will fix the maximum price that could be asked for the work. Second, what does the work actually cost the engineer, in time, expenses, tools, assistance, etc.? This should fix the minimum. Of course the answer to both these questions will vary greatly in different parts of the country, in places of widely varying population, or when the same piece of work is concerned, the question would be answered differently by engineers of varying experience, reputation and commercial push. If any of our readers can furnish answers which will better meet the needs of our correspondent, we shall be pleased to hear from them.—Ed.)

The Sewerage and Sewage Disposal Systems of Plainfield, N. J.

Sir: Referring to the article entitled "The Sewerage and Sewage Disposal Systems of Plainfield, N. J.," in your issue of Sept. 10, may I ask you or some of your readers the following questions:

(1) If "self-cleansing" means to carry off all solid matter which may enter sewers; is a grade of 1 in 1,200 for a 24-in. sewer, 1 in 900 for an 18-in. sewer, etc., self-cleansing? (2) Are not 6-in. branches for house connections better practice than 4-in. branches? (3) Are not the distances between the manholes, for the size and grade of sewers mentioned, too great?

Being familiar only with the combined system of sewers, the grades and distances between manholes on such small sewers appear strange to me.

Respectfully yours,
South Norwalk, Conn., Oct. 5, 1896. B.

(Familiarity with the combined system, only, doubtless accounts largely for the raising of the above questions, as our correspondent himself suggests. It is explained in the articles that the minimum grades adopted for main sewers were chosen in order to serve as large an area by gravity as possible. The grades were not selected arbitrarily and numerous flush tanks have been provided on the system. To put it strongly, the only reason for making ordinary house connections larger than 4-ins. is to give more leeway for careless servants and householders in the use of the sewerage system for the disposal of garbage, old clothes and waste metal. While larger house connections lessen the danger of stoppages by such matter they increase the deposits of organic matter by reducing the depth of flow in the sewer. Some engineers prefer 6-in. house connections, and a compromise is sometimes made at 5 ins.

The distance between manholes is given in the article as, in general, 400 to 500 ft. on mains and 700 ft. on laterals, with lampholes 200 to 300 ft. apart between the manholes on laterals, but with the important statement that manholes are placed at all junctions, changes of grade and alinement. In a separate sanitary sewerage system, properly designed in other particulars, it would seem that manholes placed as at Plainfield ought to be ample. There should be practically no deposits of organic matter and no foreign matter of sufficient size to make a stoppage should ever reach the sewer. As the stoppages must almost inevitably come from the houses, one advantage in having the house connections small is that it is then possible to determine who is responsible for stoppages, and provide and inflict a punishment to fit the crime.—Ed.)

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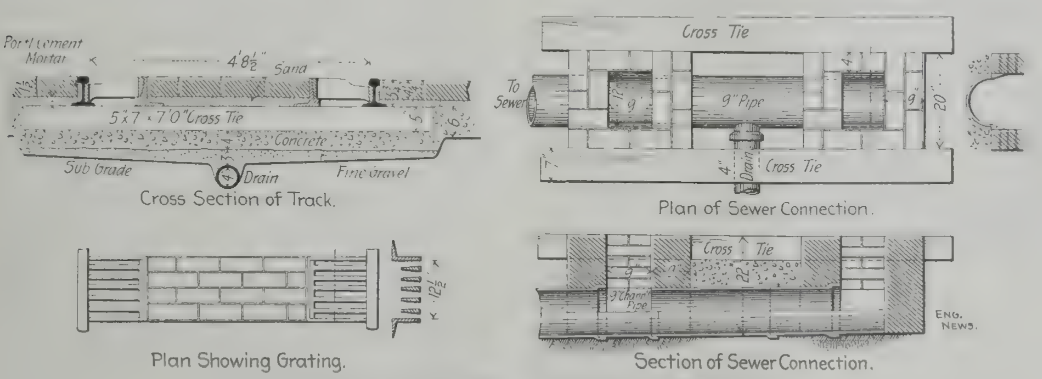
Hydrographic Surveys on the Outer Bar of Brunswick, Ga

Sir: In your issue of Oct. 1 there appears an article entitled "An Experiment in Dredging with Dynamite," in which I am quoted as "an engineer employed by Mr. Goodyear" in such a way as might give the inference that the results of my investigations on Brunswick Bar were on that account prejudiced in favor of the contractor. It appears also that the conclusions reached in the article referred to are the results of an investigation of only a part of the facts. It seems to me, therefore, that it is due to your readers, who I may presume are largely the civil engineers of this country, that you should publish the other side of this matter, and I therefore send you herewith a copy of my report on this subject with the hope that you will deem it of sufficient interest to your readers to publish it in full.

I would also beg to remind you that when this matter was before the River and Harbor Committee during the last session of Congress in which Captain F. V. Abbot was present and attempted to defend the report of the Board against adverse criticisms, it was the unanimous vote of the committee to ask the Honorable Secretary of War to reconvene the Board for the purpose of reconsidering its conclusions. It would, therefore, seem evident that your conclusions in this matter are not the result of a full investigation of all the facts. Very respectfully,

Galveston, Tex., Oct. 6, 1896. H. C. Ripley.

(We certainly did not intend to convey the impression that Mr. Ripley's survey and report on the depth of water on the Brunswick Bar was prejudiced in favor of the contractor. Nor did we intend to enter at all into the differences between the survey made by the Board of Engineers and that made by Mr. Ripley. Our conclusions as stated in the article were reached from a careful examination of a large mass of papers and documents furnished to us by Mr. Goodyear. If there are other facts more favorable to his process than those which he furnished us, we shall be pleased to have them presented to us.



Cross Section of Track.

Plan Showing Grating.

Plan of Sewer Connection.

Section of Sewer Connection.

TRACK DRAINS FOR STREET RAILWAYS; RICHMOND, IND.

The report of the Board of Engineers which made the survey of the bar and the report of Mr. Ripley upon his own survey and in criticism of the methods and results of the Board are very interesting documents but are, we regret to say, too long for reprinting in our columns. We advise any of our readers interested in hydrographic surveying, however, to secure copies of these reports, which we presume they can obtain by addressing Mr. Ripley as above, or Col. C. P. Goodyear, Brunswick, Ga. We may remark, as a matter of interest, that Mr. Ripley enumerates eight common sources of error in making soundings, and discusses the influence of each in the case under consideration.—Ed.)

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A VITRIFIED BRICK PAVEMENT, on McDonough St., in Brooklyn, is to be torn up and replaced by asphalt, in response to continued complaint of the great noise resulting from traffic over this particular street pavement. Other streets in Brooklyn are paved in a similar manner, but are used without the peculiar "roaring sound" complained of by the residents of McDonough St. As these pavements, we understand, are laid on concrete with a sand cushion between the concrete and the brick, there seems to be no evident cause for the noisy quality objected to. It would be interesting to note whether a similar cause of complaint has been found in other cities and we would be pleased to hear from readers having any such experience. Cheapness, smoothness and a practically noiseless roadway, as compared with stone blocks, are the chief advantages claimed for vitrified brick pavements; and for use in thickly-built-up cities the third claim is a very important one.

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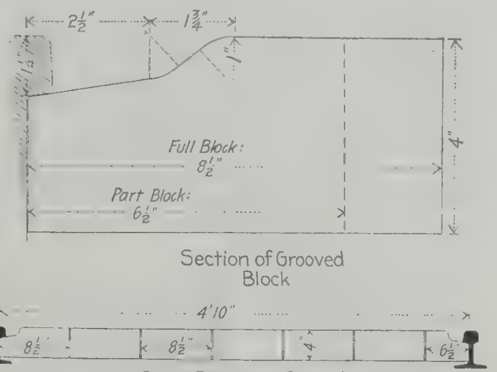
PAVING ALONG STREET RAILWAY TRACKS.

The method of paving a street at Cortland, N. Y., so as to leave a flangeway for the wheels of electric cars running on a track laid with T-rails, was shown in our issue of Sept. 3, and this has brought us some communications on this subject of paving street railway tracks. Mr. H. L. Weber, City Engineer of Richmond, Ind., has sent drawings showing the track construction and special brick or block for T-rail track, as used in that city. The special brick are of different lengths, consequently all joints are broken. On the outside of the rails Portland cement mortar is filled in under the head, so that the paving next to the rail has a full bearing, the same as at the curb. The special blocks form a groove along the rail and if the track work is properly done this is considered as desirable as the grooved head. The street surface is as continuous as it is possible to make it with a railway track upon it. The track drains are placed at intervals of 400 ft. and at points of break of grade.



Section of Grooved Block

Cross Section of Track.

Brick Paving For Street Railway Tracks; Richmond, Ind

Mr. H. P. Jones, of Steelton, Pa., writes as follows, in regard to the article in our issue of Sept. 3:

> The suggestion of the molded brick is excellent, but would be a useless expense to incorporate in the Cortland plan, where every rail chair is in practice a water conductor to the reservoir which in six months' time will be formed under the concrete at the ties, and finally extending under the entire track system. It does not require a scientifically-trained mind to forecast the result when this reservoir becomes frozen solid.
>
> The first intimation to be had that the foundation will give way, will be that the bricks next the gage side of the rails will have a tendency to stand on end; the patrons of the railway will be treated to a very unpleasant sensation while riding, and the stockholders will be wondering why the management is continually purchasing new wheels. The chief advantage of a concrete base for a pavement, over any other kind, is its stability, making maintenance and renewals a minimum cost. When that end is not attained, the money has been thrown away. I do not believe the Cortland plan is based on engineering principles.

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ELECTRIC LOCOMOTIVE ON THE MANHATTAN ELEVATED RAILWAY.

As stated in our issue of Oct. 8, a trial of electricity is being made on the 34th St. branch of the Manhattan Elevated Ry., in New York city. The line is only a few blocks in length, extending from the Third Ave. line to the Long Island Ferry.

The motor car was designed by Mr. J. B. Entz, representing the Storage Battery Co., of Philadelphia. The trucks are from a dummy engine, the drivers being 28 ins. diameter. The body of the car is 18 ft. long, and 8 ft. high, in the center, where the motorman's cab is placed. From the cab the roof slopes in either direction to a height of 3 ft. at the ends. The weight is ten tons. A 400-volt current is supplied from a third rail, of T section, placed on the outside of and at an elevation of about 10 ins. above the track rails. Contact is made by two cast-iron sliding shoes, hanging loosely from the front and rear axle bearings of the trucks. The idea of the two shoes, as explained by Mr. Entz, being to fortify against breaks in the contact, which might occur by the jumping of a single shoe.

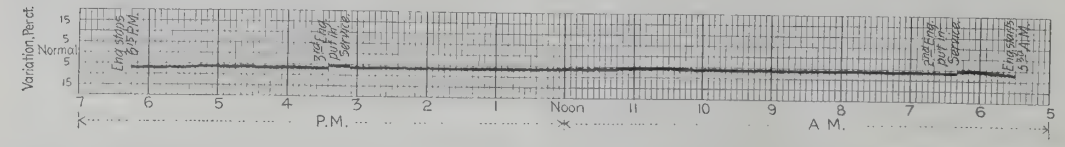
The electrical equipment includes two General Electric motors, each of 125 HP., and storage batteries of 256 cells, weighing 80 lbs. each. These cells are constantly in parallel with the power-house circuit and are intended to equalize the load. When no power is needed, as on a down grade, the current is consumed in charging the batteries; when the load is heavy, the extra current required is supplied from the storage batteries. This has the effect of making the dynamo load more uniform, or of maintaining a constant load on the generators, independent of the variable current required by the locomotive. This permits the use of smaller machines at the central station, and a consequent saving of coal. The location of the batteries in the power-house would in the same way equalize the central station load, but the fluctuations would still be felt in the distributing conductors. By placing the storage battery on the locomotive at the exact point where the sudden fall of potential occurs at the time of heavy demand for power a steady current is maintained in the line conductors; a sudden demand, as in starting, for a large amount of current is supplied by the battery and no additional demand is made upon the current conductor; both pressure and current remaining constant. In the old system of distribution both machines and conductors must be made large enough for the maximum demand; and the drop in voltage, which occurs at a distance from the power-house, causes the motors to work inefficiently just when the demand for power is greatest. By this method the feeders and conductors can be designed to carry the average load. The conductor at a long distance from the power-house could also be made smaller, the small current in the line being reinforced automatically by the battery.

This system also allows the third rail to be discontinued at crossovers, the load at such places being imposed upon the batteries. The batteries alone will supply sufficient power to operate a train for 15 to 20 miles at a speed of 25 miles per hour.

The first cost of the electric locomotive is said to be slightly above that of the steam locomotives now in use.

AN EXAMPLE OF GOOD SPEED REGULATION BY A LARGE ENGINE.

We reproduce herewith, on a reduced scale, a diagram made by the Moscrop speed recorder of a 13 hours' run of the No. 4 engine at the power house of the People's Traction Co., Beach and Green Sts., Philadelphia. The engine is a twin tandem compound, direct coupled, built by the Edward P. Allis Co., of Milwaukee, Wis. The cylinders are 24 and 48 ins. diameter and 60 ins. stroke. The normal speed is 65 revolutions per minute. On the diagram the distance between any two of the horizontal lines is equivalent to a variation of 5% in the speed of the engine. The autographic record shows a practically perfect regulation, the line drawn by the pencil being almost exactly parallel to the horizontal lines of the diagram. There are no noticeable deviations at any point except where additional engines were started or stopped.



SPEED DIAGRAM FROM AN ALLIS 24 × 48 × 60 IN. ENGINE AT THE POWER HOUSE OF THE PHILADELPHIA TRACTION CO., JUNE 1, 1896.

NOTES FROM THE ENGINEERING SCHOOLS.

Columbia University, New York City, entered upon its 143d academic year on Oct. 5. This will probably be the last year that it will occupy the present buildings, as it is likely that in another year the new buildings on the new site on Riverside Drive will be ready for occupancy. Increases in all departments of the University are reported. Mr. Chas. C. Worthington, M. Am. Soc. C. E., has offered to equip a laboratory of hydraulic engineering in the new School of Mechanical Engineering. The gift is to be made in the name of his father, the late Henry R. Worthington. The following additions have been made to the faculty: Adolph Black, tutor in civil engineering; Chas. Durleth, assistant in civil engineering; Heinrich Ries, assistant in mineralogy. A notable change has been made in regard to the old School of Mines, which will hereafter no longer be known by its old name, but by the name of the School of Applied Science, while the School of Chemistry, the School of Architecture, and the School of Engineering will be set apart as distinct schools, all four schools being under the charge of one faculty, known as the faculty of Applied Science. In his address at the opening of the new year President Low declared that the move toward establishing a school of mechanical engineering was a most important one, since the city of New York was the greatest manufacturing center in the country. He said: "I think it may be said that the removal of the University may take place next year as has been proposed. To facilitate our removal we greatly need at once the gift of a building for physics, costing $250,000; a building for engineering, costing $250,000; a gymnasium, costing, with apparatus, $375,000."

The Missouri Military Academy, at Mexico, Mo., was burned to the ground early in the morning of Sept. 24, while 80 cadets were asleep in the building. About twenty of these were more or less severely injured in jumping from the windows. The loss is estimated at $70,000, of which $40,000 is covered by insurance. The Academy was opened in 1890, and the building was one of the most complete in the State. There is a suspicion that the fire was the work of an incendiary.

The Oregon Agricultural College, at Corvallis, Ore., began its year's work on Sept. 17, under the management of a new president, Mr. H. B. Miller, of Grant's Pass, Ore., who succeeded Mr. John M. Bloss, resigned. Prof. F. Birchtold, of the Department of Physics and History, has been appointed Dean of the College, a newly created office. An "Insectory" has been built for the Entomological and Botanical departments, to aid in the study of the habits and life of injurious insects and fungous diseases. The Experiment Station, so far as possible will bend all its energies along one line at a time, all the departments taking up their phase of the same subject. This year "the Prune," Oregon's great industry, will be given special attention. The mechanical course has one young lady taking all the work of the course, and doing work equal to that of any of the young men.

The University of Wisconsin, Madison, Wis., has a College of Mechanics and Engineering, which offers three separate systematic courses, viz.: civil, mechanical and electrical engineering. Special encouragement is given to those students who can afford the time to graduate in a collegiate course before entering the course of engineering. By electing the mathematics required of engineers during the collegiate course the degree in engineering can be obtained in two additional years. Greater satisfaction and profit is gained from the study of engineering when the student has already acquired a broad and thorough general training. The staff of instruction in the engineering college, including professors, assistants and special lecturers, numbers over forty. Dr. Chas. Kendall Adams, LL. D., is president of the University.

The Newark, N. J., Technical School, which has been in successful operation for some years, will not open until some time in November, owing to delay in the construction of its new building. The school year will be extended later in the spring of 1897, to make up for the loss of time at the beginning. Prof. Chas. A. Colton, E. M., is director. Mr. Maurice A. Miller, instructor in mechanical drawing and mechanical engraving for the last few years will also give instruction in descriptive geometry, taking the place of Mr. A. W. Jacobi, resigned.

The Department of Engineering of the University of Michigan, Ann Arbor, Mich., has issued an annual Announcement and Register of Alumni for 1896-7. The Register contains a list of Alumni, dating back to 1860.

The University of Nebraska, Lincoln, Neb., issues a brief Announcement of its School of Mechanic Arts, with photographic illustrations of the exterior and interior of its mechanical and electrical laboratory. Primarily the school is intended for those young men who expect to enter some one of the mechanical trades, although it is hoped that the stimulus given by this school will, in many cases, be such that a collegiate course in one of the engineering groups will be pursued. Tuition in the school is free, and other expenses are remarkably low. Prof. C. R. Richards is the director of the school.

Brown University, Providence, R. I.—The annual report of the President, together with the reports of professors in charge of the departments, have been published in a pamphlet of 80 pages. From the President's report we learn that increased expenditures for needed improvements and apparatus caused a financial deficit in the past year, to make up for which it has been necessary to reduce salaries and to discontinue the services of four professors in the departments of Germanic Languages and Literature, Biology, Philology, and Architecture. There are 35 students in the University pursuing courses in mechanical engineering and 38 in civil engineering. Mr. Edward C. Burnham, B. S., formerly instructor in mechanical drawing and engineering, has been made Associate Professor of Mechanical Engineering.

The Michigan State Agricultural College boasts of being the oldest agricultural college in the country, having been established in 1857, or five years before the passage of the Morrill Land Grant Act, by the U. S. Congress, which brought about the establishment of most of the agricultural colleges. The college is steadily increasing in prosperity and in influence. Five years ago a mechanical engineering department was established, which is under the direction of Prof. Chas. L. Weil, with Prof. P. M. Chamberlain as assistant in charge of shops. It is equipped with foundry, machine pattern and forge shops. The college receives a good income from the investment, the proceeds of its land grant; and an annual appropriation from the state.

From Rensselaer Polytechnic Institute we learn that Prof. James McGiffert, Jr., C. E., Assistant in Mathematics, has obtained leave of absence for one year in order to study pure mathematics at Harvard University, and to obtain the degree of Ph. D. His place has been filled by William E. Whitney, C. E. Benedict Papot, professor of French, has resigned, and Arthur de Pierpont has been appointed in his place.

At the New Hampshire College of Agriculture and the Mechanic Arts, Durham, N. H., recent new appointments to the faculty are: Joseph H. Hawes, instructor in free-hand drawing; George H. Furbish, foreman of woodwork; Clement S. Morris, actuary and purchasing agent.

At the Polytechnic Institute, Brooklyn, N. Y., the Institute course in civil engineering, the graduates from which have received the degree of B. S., has been extended by a year of post graduate work, and those completing the course will receive the degree of C. E. This work will be under the direction of Profs. Plympton and Kimball, assisted by Richard L. Russell, B. S., who, since his graduation, has been employed in the city Board of Public Works. The graduates of the civil engineering course have so far taken the positions in every civil service examination held in Brooklyn, over all competitors.

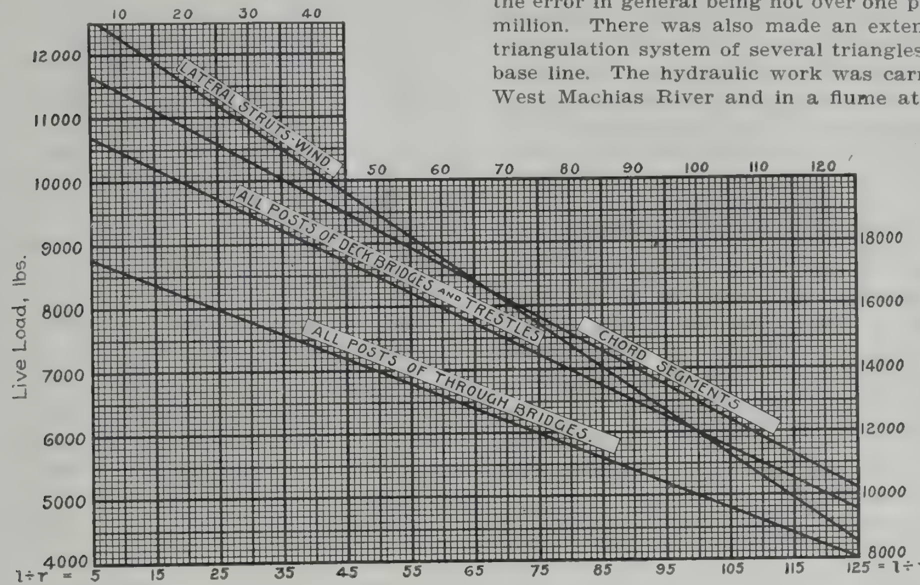
The Florida State Agricultural College, Lake City, Fla., is prospering under the management of its president, Oscar Clute, who was formerly president of the Michigan Agricultural College. The department of mechanics, while not having as complete an equipment as many of the Northern schools, is yet doing good and efficient work, both in theory and practice. During the vacation two of the graduates have set up without any outside help a complete electric plant, with a 100-HP. engine and two 1,000-light dynamos. Mr. N. H. Cox, one of the graduates of the school, has been elected assistant in mechanics. Prof. H. C. Powers is in charge of the mechanical department.

At the Michigan Mining School, Houghton, Mich., the following appointments have been made for the year 1896-7; Louis M. Hardenburgh, A. B., E. M., instructor in chemistry; Albert J. Houle, E. M., instructor in civil and mining engineering; Mr. George Wass, instructor in pattern shop; and Mr. Nathan S. Osborne, assistant in the physical laboratory. The school opens this fall with a large attendance. In September, 1895, the change from the rigid course to the elective system was made after much deliberation, and good results have followed. The entering class this year is larger than at any time since the organization of the school, ten years ago. The standard of work required has not been lowered, but the student is allowed freedom of choice to take the work best suited to his needs. An interesting paper on the "Elective System in Engineering Colleges," was read before the last meeting of the Society for the Promotion of Engineering Education, by M. E. Wadsworth, Ph. D., Director of the School, who perfected the system as used in the mining school.

At the Massachusetts Institute of Technology, the following is the provisional list of appointments for 1896-7; Associate Prof. C. Frank Allen has been appointed Professor of Railroad Engineering; Associate Prof. A. E. Burton, Professor of Topographical Engineering; Associate Prof. Dwight Porter, Professor of Hydraulic Engineering; Associate Prof. Peter Schwamb, Professor of Mechanism and Director of the Workshops; Assistant Prof. Linus Faunce, Associate Professor of Drawing; Mr. W. H. Lawrence, Assistant Professor of Architecture; Mr. A. G. Robbins, Assistant Professor of Highway Engineering; Dr. J. J. Skinner, Assistant Professor of Mathematics; Mr. G. H. Barton, Assistant Professor of Geology.

The school year opened on the 30th of September, and the preliminary registration shows a slight increase over the registration at the same period in 1895. Should the final registration bear the same relation to the preliminary this year as it did last year, the number of students will slightly exceed 1,200.

The increase in the number of students taking the course in Organic Chemistry has rendered imperative an increase in the floor space devoted to this laboratory. The necessary accommodations have been obtained by the removal of the chemical library from the fourth to the third floor of the Walker Building, and the conversion of this room into laboratories.



UNIT STRESSES ALLOWED IN COMPRESSION MEMBERS OF MEDIUM STEEL BY COOPER'S 1896 SPECIFICATIONS FOR HIGHWAY BRIDGES.

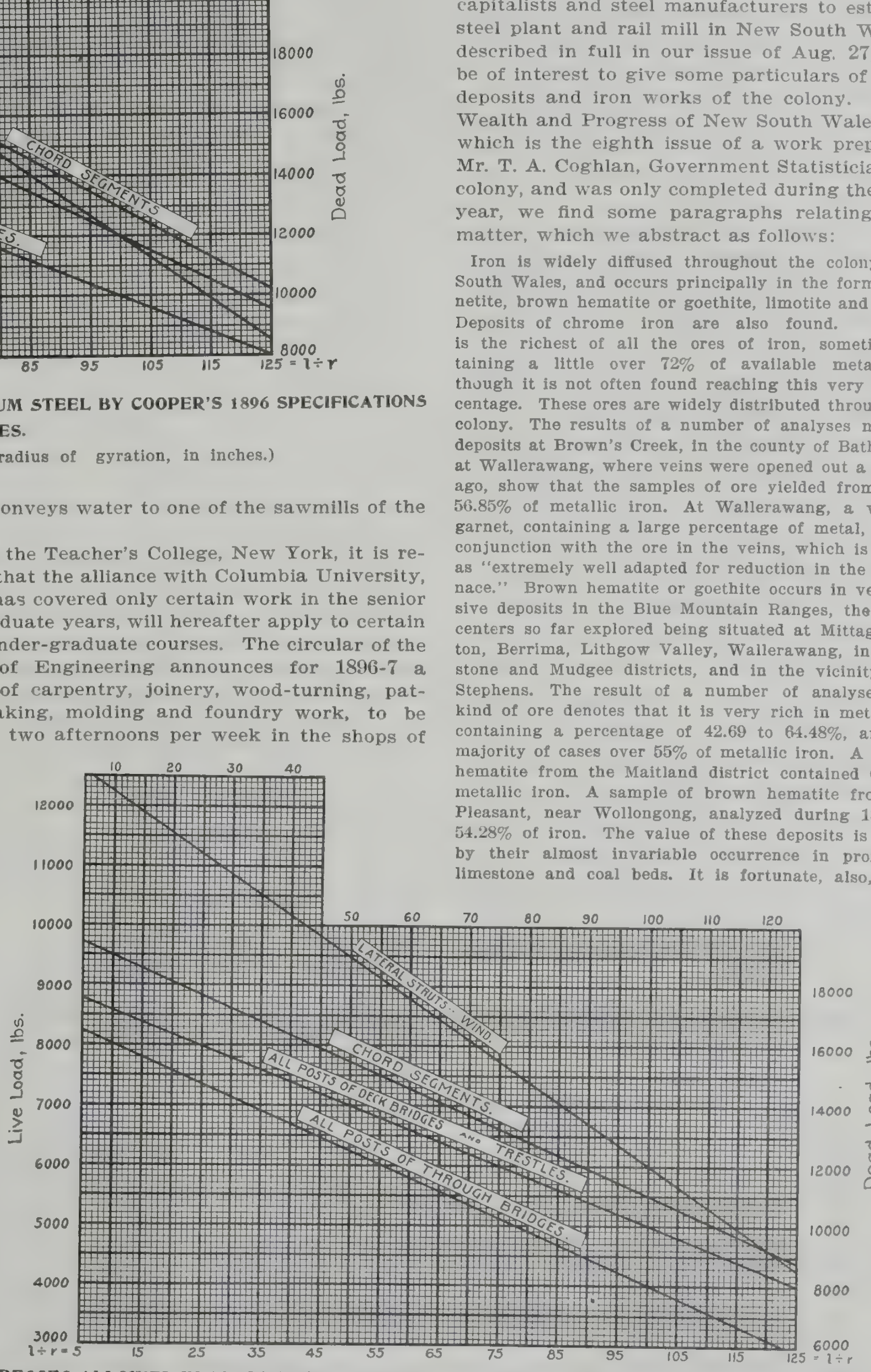
(l = length of member, in inches; r = least radius of gyration, in inches.)

The Department of Architecture has recently secured an important addition to its collection of lantern slides. During the stay of the summer school, in London and Paris, Professer Homer selected 2,600 views of buildings and cities in Europe, Russia and the East. These views will supplement the present collection of the department, and will materially assist the illustration of the lectures given by its instructors. The views of Spanish, Russian, Indian and Chinese architecture are particularly valuable as they include a large amount of material at present not available in any other form.

The season of 1896-7 of the Society of Arts, opened on Oct. 8, with a meeting in the Rogers' Building. Prof. Sedgwick called attention to certain serious practical difficulties which beset the problem of supplying large communities with wholesome milk. The recent occurrence of numerous epidemics of typhoid fever in Massachusetts and elsewhere, which have been traced directly to infected milk, has led Prof. Sedgwick, who has personally investigated several of these epidemics, to propose a reconsideration of the whole question of milk supply of cities, with reference to the sources of danger and the means of removing them. At the same meeting a notable development of the biological work of the Institute on the technicological side was brought to the attention of the society. Mr. S. C. Prescott, Instructor in Biology, and Mr. Lyman Underwood, have, for some months, been closely engaged in a study of the causes of spoiling of canned clams and lobsters. This evil has become so common as to command the earnest attention of the trade. Not only is the outright loss considerable; but the offence given by the spoiled goods is of a kind seriously to affect the market. Messrs, Prescott and Underwood, in the course of their investigation, have found that under certain conditions imperfect sterilization occurs in the ordinary processes of canning clams and lobsters, resulting occasionally in the blackening and spoiling of the entire contents. They have identified certain micro-organisms in the spoiled cans, which are peculiarly resistant to the processes of sterilization, requiring the application of exceptional means to overcome the difficulty and to insure the safety of the foods in question.

The Institute's Summer School of Civil Engineering was held at Machias, Me., during the month of June. The members of the institute faculty in charge were Professors Alfred E. Burton, Dwight Porter and A. G. Robbins, and they were aided by Mr. H. K. Barrows, assistant in the department. Fourteen students of the third year made up the rest of the party. The work of the school is of an advanced nature, and only students who have finished the third year are admitted. The work was entirely in the field, and was in three parts, topographical, geodetic and hydraulic. In the geodetic work, a base line over half a mile in length was measured, with extreme accuracy, the error in general being not over one part in one million. There was also made an extension of a triangulation system of several triangles from the base line. The hydraulic work was carried on in West Machias River and in a flume at Machias, which conveys water to one of the sawmills of the town.

From the Teacher's College, New York, it is reported that the alliance with Columbia University, which has covered only certain work in the senior and graduate years, will hereafter apply to certain other under-graduate courses. The circular of the School of Engineering announces for 1896-7 a course of carpentry, joinery, wood-turning, pattern-making, molding and foundry work, to be held on two afternoons per week in the shops of Teachers' College under the instruction of members of Teachers' College staff.



UNIT STRESSES ALLOWED IN COMPRESSION MEMBERS OF MEDIUM STEEL BY COOPER'S 1896 SPECIFICATIONS FOR RAILWAY BRIDGES.

(l = length of member, in inches; r = least radius of gyration, in inches.)

At the University of New York, Mr. Collins P. Bliss, recently assistant engineer in the Globe Iron Works, of Cleveland, has been apointed instructor in the engineering school. Mr. Bliss is a graduate of Princeton in the class of 1888, and of the Columbia School of Mines in 1891. His special work is to be laboratory courses in steam engineering and practical hydraulics.

A GRAPHICAL METHOD OF FINDING ALLOWABLE STRESS IN COMPRESSION MEMBERS.

The accompanying diagrams show the unit stresses in compression members of both highway and railway bridges, allowed by Mr. Theodore Cooper's 1896 Specifications. The diagrams were plotted by Mr. A. Lincoln Hyde, Assoc. M. Am. Soc. C. E., New England Building, Cleveland, O., and we are indebted to his courtesy for the privilege of reproducing them here. The diagrams explain themselves, and will, we believe, be found exceedingly convenient by those engaged in the design of structural work.

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IRON IN NEW SOUTH WALES.

In view of the opportunity offered to American capitalists and steel manufacturers to establish a steel plant and rail mill in New South Wales, as described in full in our issue of Aug. 27, it may be of interest to give some particulars of the iron deposits and iron works of the colony. In "The Wealth and Progress of New South Wales, 1894." which is the eighth issue of a work prepared by Mr. T. A. Coghlan, Government Statistician of the colony, and was only completed during the present year, we find some paragraphs relating to this matter, which we abstract as follows:

> Iron is widely diffused throughout the colony of New South Wales, and occurs principally in the form of magnetite, brown hematite or goethite, limotite and bog-iron. Deposits of chrome iron are also found. Magnetite is the richest of all the ores of iron, sometimes containing a little over 72% of available metallic iron, though it is not often found reaching this very high percentage. These ores are widely distributed throughout the colony. The results of a number of analyses made from deposits at Brown's Creek, in the county of Bathurst, and at Wallerawang, where veins were opened out a few years ago, show that the samples of ore yielded from 40.89 to 56.85% of metallic iron. At Wallerawang, a variety of garnet, containing a large percentage of metal, occurs in conjunction with the ore in the veins, which is described as "extremely well adapted for reduction in the blast furnace." Brown hematite or goethite occurs in very extensive deposits in the Blue Mountain Ranges, the principal centers so far explored being situated at Mittagong, Picton, Berrima, Lithgow Valley, Wallerawang, in the Rylstone and Mudgee districts, and in the vicinity of Port Stephens. The result of a number of analyses of this kind of ore denotes that it is very rich in metallic iron, containing a percentage of 42.69 to 64.48%, and in the majority of cases over 55% of metallic iron. A sample of hematite from the Maitland district contained 60.83% of metallic iron. A sample of brown hematite from Mount Pleasant, near Wollongong, analyzed during 1891, gave 54.28% of iron. The value of these deposits is enhanced by their almost invariable occurrence in proximity to limestone and coal beds. It is fortunate, also, that the main lines of railway pass through the region where the deposits are most easily worked.
>
> Limonite (a variety of brown hematite) principally occurs at Lithgow, Eskbank and Bowenfels, in the Blue Mountains; in several parts of the Hunter River coal field; and at Bulli, in the Illawarra District. This ore is usually found very rich in metal, and contains an average of over 50% of iron; while the English clay bands, which are mostly carbonates, only contain about 30% of metallic substance. It occurs in lenticular layers of no great extent, in the coal measures. Bog-iron ore, which is impure

limonite, is principally found at Mittagong, and assays of this ore gave a percentage of metal equal to an average of over 45%.

No other colony of Australia possesses deposits of iron ore approaching in extent or richness those of New South Wales; it is, therefore, probable that at some future time this colony will become the great seat of the iron industry of Australia. As illustrating the present extent of the supply required, the value of all descriptions of iron, machinery and iron manufactures imported into New South Wales in 1894 was $5,946,245. The average yearly import for the four years 1890-1893 amounts to $13,134,755 for New South Wales, and $32,507,230 for Australasia; and the quantity of pig-iron required to produce the material represented by these values is approximately 190,000 tons and 480,000 tons per annum for New South Wales and the whole group of colonies respectively.

In a report, dated January, 1891, by the late Mr. C. S. Wilkinson, Government Geologist, it is stated that the iron deposits in the districts of Mittagong, Wallerawang and Rylstone contained in sight 12,944,000 tons of ore, estimated to yield 5,853,000 tons of metallic iron. These districts are most favorably situated for the establishment of smelting works. Some years ago public attention in England was drawn to the possibility of manufacturing iron within the colony and a mining expert was sent out from that colony to inspect the iron, lime and coal deposits and to report upon the probable cost of establishing the industry in the colony; but so far the visit has been without result.

The principal works for the manufacture of iron from the ore are situated at Eskbanks, near Lithgow, where red siliceous ore, averaging 22%, and brown hematite, yielding 50% metallic iron, have been successfully treated. Abundance of coal and limestone are found in the neighborhood. The establishment, however, has for some time abandoned the manufacture of pig-iron for which it was originally built. The work now carried on consists of the re-rolling of old rails, and the manufacture of iron bars, rods and nails and of ordinary castings. The quantity manufactured from scrap during 1894 was 2,368 tons, valued at $85,850. A successful attempt has been made at Mittagong to make gas pipes, etc., from iron smelted from the ore, and taken direct to the mold, without first making it into pig-iron. Some years ago the iron smelting works at Fitzroy, Mittagong, were established, but after producing a considerable quantity of pig-iron the operations were discontinued. Some samples of ore, coal and limestone obtained in this district, with pig-iron and castings manufactured therefrom, were exhibited at the late mining exhibition at London, and obtained a first award. In the Broken Hill district, 254 tons of iron ore, valued at $1,280, were raised during 1894, chiefly for the purpose of flux.

Deposits of manganese ore have been discovered in various parts of New South Wales. Pyrolusite, in the form of black oxide and manganese, dioxide, occurs principally in the Bathurst districts and at Bendemeer. Wide veins have also been found in the Glen Innes district, near the Newton-Boyd road. Some of the specimens analyzed have yielded a very high percentage of metal; but the demand for manganese in the colony is very trifling, and until a foreign market is found, or local manufactories requiring the metal spring up, the rich deposits of this ore will remain comparatively untouched. The ore is found extensively in conjunction with iron in coal and limestone country, and often contains a small percentage of cobalt.

DIRECT CONNECTED ENGINES FOR ELECTRIC POWER STATIONS IN GERMANY.

(With inset.)

Our inset this week illustrates three steam engines, recently installed in electric power stations in Germany, which will be interesting to American engineers in showing that the trend of practice in Germany is like that in America, toward vertical compound or triple expansion engines of short stroke, connected directly to the dynamos, while the German construction is notable for greater complexity of details and variety of forms of valves as compared with the usual simplicity of American designs. The American engine-builder is usually compelled by the high price of skilled labor and by intense competition to build an engine which has the smallest possible number of parts, and to so design these parts that they can be made in quantities by machinery with a minimum expenditure of labor. The German builder seems to be subject to no such restrictions and is able to give freer scope to his ideas in designing. The result he obtains is apt to be, as shown in these illustrations, an engine which is admirable as a piece of workmanship, fairly durable and highly economical, but one which is not apt to be copied by American builders, on account of the restrictions to which they are subjected. Among the features especially noticeable in these German engines are massiveness of frames, large extent of bearing surfaces, and comparatively low speed, the highest piston speed figured from the data given below being 512 ft. per minute. In all three engines the expansion or cut-off valve of the high pressure cylinder is separated from the main valve, and is driven by a separate eccentric, and in the two larger engines separate expansion valves are also provided for the intermediate cylinders. In the triple-expansion engine two separate admission slide valves are provided, each with means for varying the travel by hand. This would be quite unusual in an American engine as small as 700 HP. The following description of these engines, from the "Zeitschrift des Vereines Deutscher Ingenieure," has been translated by Mr. O. J. Marstrand, Assoc. M. Am. Soc. C. E.

The first engine described in the following paragraphs is installed at the electric station of New-Bydzow, Bohemia, and forms part of a plant designed for a total output of 160 kilowatts, but capable of future extension. At the present time, however, there are two of these vertical compound condensing engines of 90 HP. each, with dynamos coupled directly to the main shaft. The diameter of the high pressure cylinder is 300 mm. (11.8 ins.); that of the low pressure 470 mm. (18.5 ins.), and their stroke 350 mm. (13.8 ins.) at 220 revolutions per minute.

The high pressure cylinder is controlled by two piston valves, the main valve being made in two parts, connected by an iron pipe. It is provided with double inlet passages, and fits closely, without any packing in the bushing, which latter is held in place by three set screws. Its weight is balanced in the usual manner, by increasing the diameter of the upper part. The expansion or cut-off valve, which is made in one piece, and weighs only 5 kilos. (11 lbs.) is also fitted into the main valve without any packing. The length of these valves is reduced as much as possible. The expansion valve is operated directly, while the main valve is operated by means of an intermediate rod, which may be readily removed. The hub of the fly-wheel forms the eccentric for working both valves. The weight of the expansion valve, rods and eccentric ring, and the reduced weight of the turning eccentric are balanced by a vertical plunger, moving in the top of the steam chest. The maximum reaction on the governor becomes 2½ times as great for unbalanced as for balanced weights.

The low pressure cylinder is controlled by only one valve, which is made in two parts as above. It has a Trick passage* and is provided with packing rings on both exhaust sides.

The air pump is driven by cast-iron rods and levers, connected to the cross-head pin of the low pressure cylinder, and works noiselessly in spite of the rather high number of revolutions. The necessary steam is provided by three fire-tube boilers with 110 sq. m. (1,184 sq. ft.) heating surface, one or two of these being in use at a time, as required.

The second and third engines illustrated have lately been placed in an extension of the electric light and power station at Munich. The original station was used for the purpose of street lighting only; it was, however, recently decided to increase its capacity, and to use the increased power for the operation of a street railway. The main dimensions of the smaller engines are: Diameter of high-pressure cylinder, 510 mm. (20 ins.); diameter of low pressure cylinder, 760 mm. (30 ins.); stroke, 480 mm. (18.9 ins.) with 150 revolutions per minute. They are vertical compound engines, having the dynamo coupled directly to the main shaft. The main valve of the high-pressure cylinder is a balanced slide valve, while the expansion valve is cylindrical; the low pressure cylinder has a balanced slide valve. The engines work at an initial pressure of 9 atmospheres (132 lbs. per sq. in.), and are condensing; they can, however at any time, be changed to exhaust into the atmosphere. The normal rating is 250 HP., maximum 350 HP. Under normal loading and a steam pressure of 9 atmospheres, a consumption of 7.25 kilos. (16 lbs.) steam per HP. hour with condensation, and 12 kilos. (26.5 lbs.) without condensation is guaranteed. The diameter of the fly-wheel is 2.8 m. (10 ft. 2 ins.) and it weighs about 6,900 kilos. (15,200 lbs.). The Hartung spring governor acting upon the expansion valve, controls the speed with a maximum variation of 1% for a change of load of 25%. The coefficient of fluctuation during a uniform loading is 1-250.

The third engine is also directly coupled to its dynamo, and is a vertical triple-expansion engine, controlled by a Hartung spring governor; the piston valve of the intermediate cylinder has a Meyer cut-off, with hand adjustment, and the low pressure cylinder has two balanced slide valves, as shown in the plan, also adjustable by hand. The engines are operated at a pressure of 12 atmospheres (176 lbs. per sq. in.), and can be run as condensing or non-condensing. Their principal dimensions are: Diameter of high-pressure cylinder, 490 mm. (19.3 ins.); diameter of mean-pressure cylinder, 800 mm. (31.5 ins.); diameter of low-pressure cylinder, 1,180 mm. (46.5 ins.); stroke, 600 mm. (23.6 in.), with 120 revolutions per minute. The normal rating is 500 HP., maximum 700 HP. The steam consumption per HP. hour is guaranteed at 6.5 kilos. (14.3 lbs.) and 10 kilos. (22 lbs.), with or without condensation, respectively. The diameter of the fly-wheel is 3.5 m. (11 ft.), and it weighs 8,600 kilos. (18,900 lbs.).

Special attention was paid in the Munich engines, which were designed by Engineer Hammel, to making all the principal parts easily accessible. Their massive construction will be particularly noticed, as also the fact of the bed plates being made in one piece, and of such a depth as not to require the stone foundation to rise above the floor level. The cross-head slides on the smaller engines are made plane surfaces to allow for the expansion of the two cylinders on a single base-plate. In the larger engines the three cylinders are independent of each other, and have cylindrical cross-head slides.

The injector condensers are placed below the engines; as are also the air pumps, of which there is one to each of the compound engines, and two for the triple expansion engines; they are operated by levers, extending from the cross-heads.

Three steam boilers provide the necessary steam; the heating surface of each boiler is 180 sq. m. (19,400 sq. ft.), its grate surface 3.7 sq. m. (40 sq. ft.).

The piping is all in duplicate; the diameter of the pipes at the boilers, and as long as they run separately, is 150 mm. (5.9 in.), while they join into pipes of 250 mm. (9.8 in.) diameter. Provision is made for expansion and contraction at the joints and elbows. The boilers are supplied with about 187,000 lbs. of water per hour. The feed pipes, and the steam pipes for the feed pumps, are built in a circuit, so as to make it possible to feed either boiler by either pump.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

The Use of Sand on Track.

It is for the jury to say whether it was negligence not to have had sand on an electric car for stopping in emergencies, though it was a season when the rails were dry and dusty, where the evidence showed that the streets had been sprinkled shortly before the accident, and that the rails were slippery with thin mud; that in such cases the wheels of the car will slide, making it very difficult to stop; and that if there had been sand on the car it could have been stopped more easily than it was.—Penny v. Rochester Ry. Co. (Sup. Ct. App. Div.), 40 N. Y. Supp. Rep., 172.

Contributory Negligence of Passenger.

The Supreme Court of Minnesota holds that where a party falls and is injured by reason of getting off the car while it is slowing down for the purpose of stopping, he cannot recover, as he is guilty of contributory negligence.—Defoe v. St. Paul City Ry. Co., 68 Northwestern Reporter, 35.

Running a Dummy Engine Backward.

The running of a dummy engine, says the Supreme Court of Alabama, backward at a greater degree of speed than that prescribed by the city ordinance is a violation of same, though the speed was within the limitation for running forward, and it was safer to run backward than forward. —Highland Ave. & B. R. Co. v. Sampson, 20 Southern Reporter, 566.

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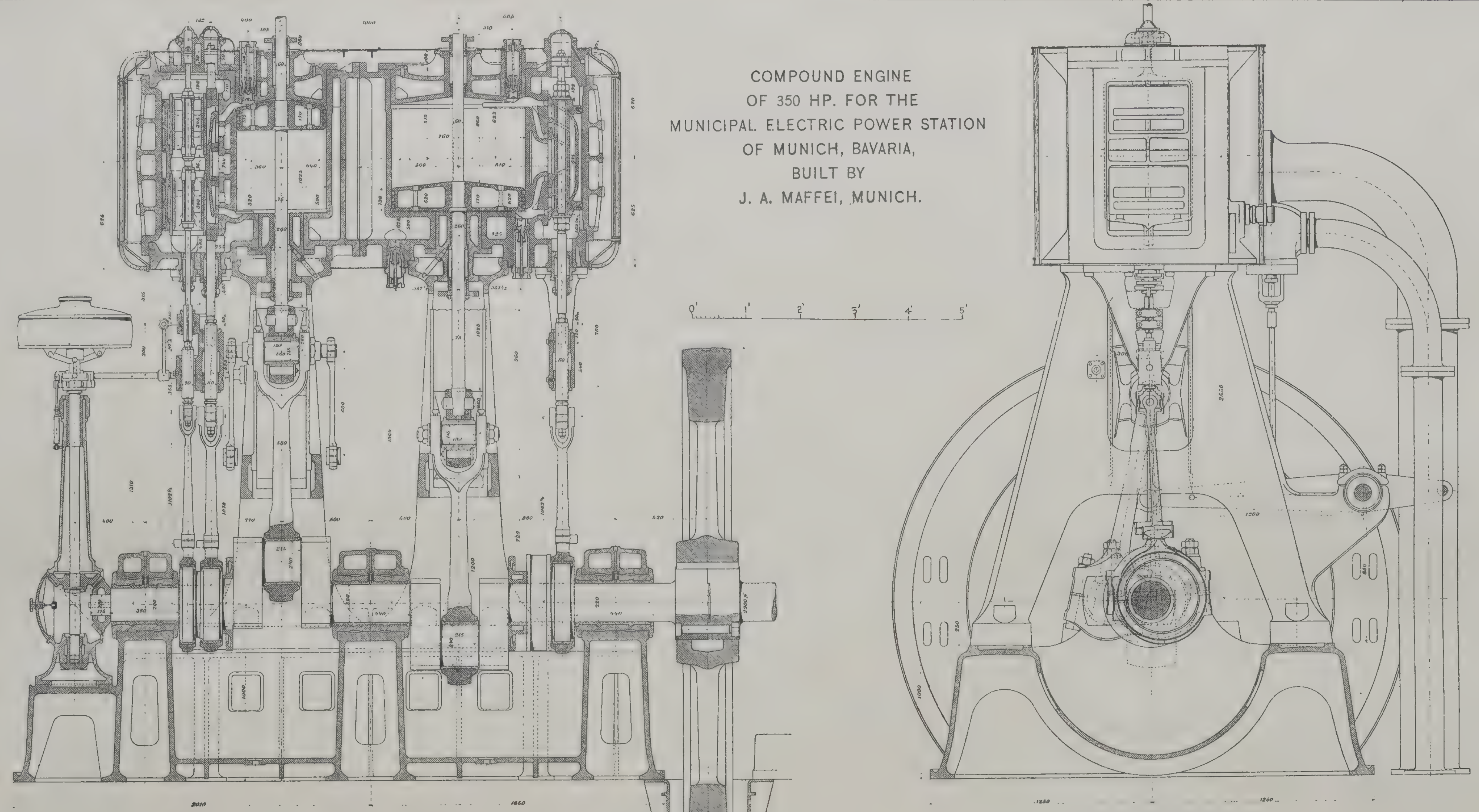
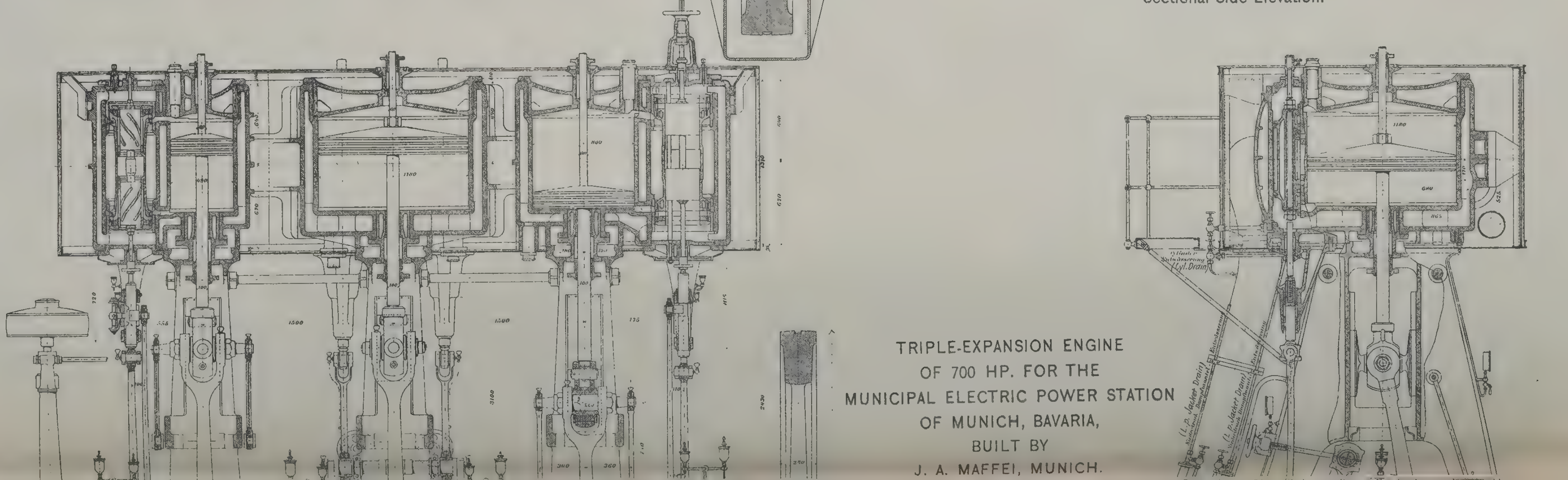
*A passage through the body of the valve which provides a double inlet for the steam, making what is commonly known as the Allen valve in America, and as the Trick valve in Europe.



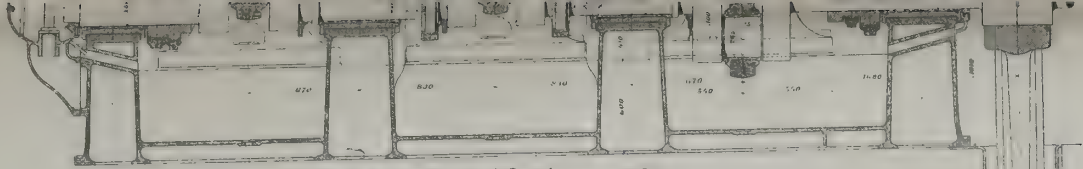
COMPOUND ENGINE
OF 350 HP. FOR THE
MUNICIPAL ELECTRIC POWER STATION
OF MUNICH, BAVARIA,
BUILT BY
J. A. MAFFEI, MUNICH.

Vertical Section.

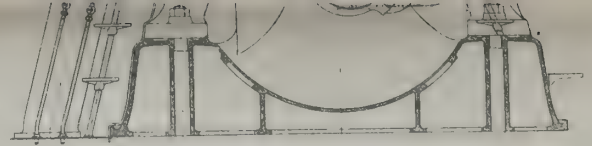
Sectional Side Elevation.



TRIPLE-EXPANSION ENGINE
OF 700 HP. FOR THE
MUNICIPAL ELECTRIC POWER STATION
OF MUNICH, BAVARIA,
BUILT BY
J. A. MAFFEI, MUNICH.



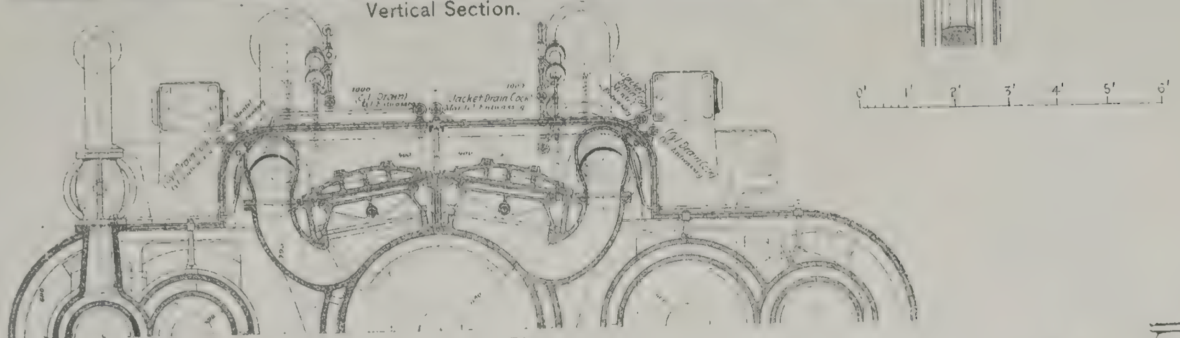
Vertical Section.



Sectional Side Elevation.

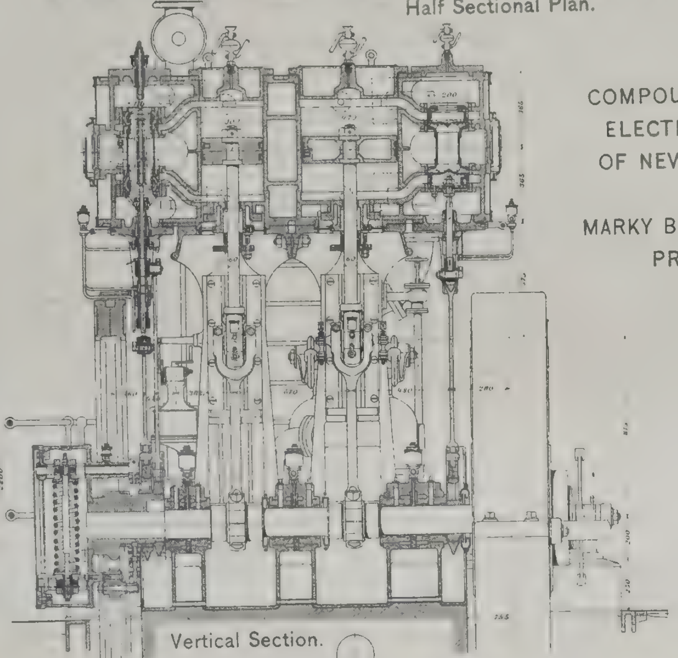
ENGINES
FOR
ELECTRIC POWER STATIONS,
IN
MUNICH, BAVARIA,
AND
NEW BYDZOW, BOHEMIA.

(Reprinted from the
Journal of the Society
of German Engineers.)

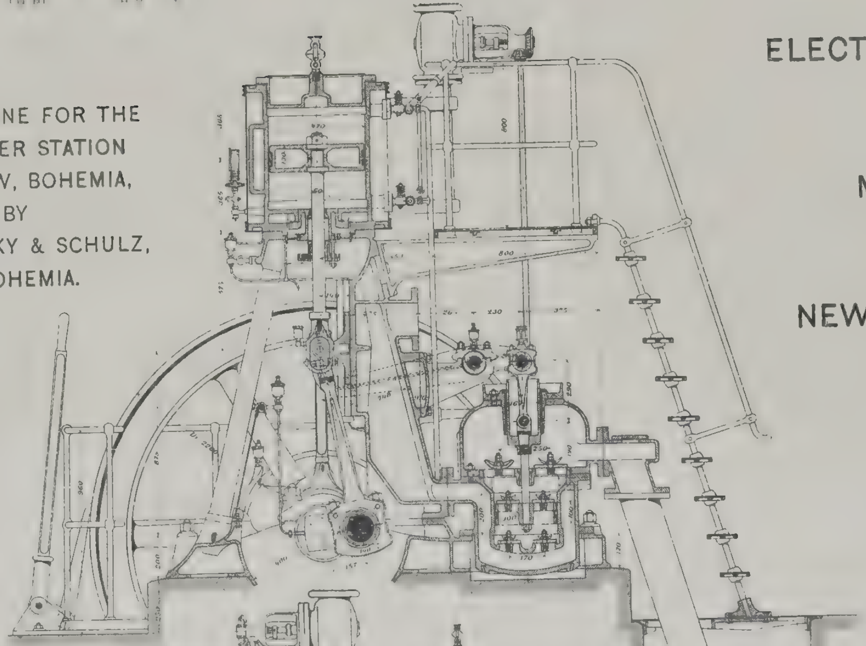


Half Sectional Plan.

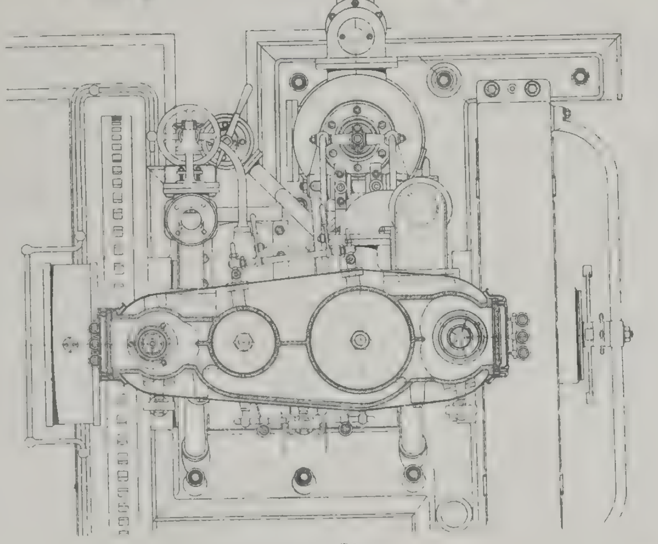
COMPOUND ENGINE FOR THE
ELECTRIC POWER STATION
OF NEW BYDZOW, BOHEMIA,
BUILT BY
MARKY BROMOVSKY & SCHULZ,
PRAGUE, BOHEMIA.



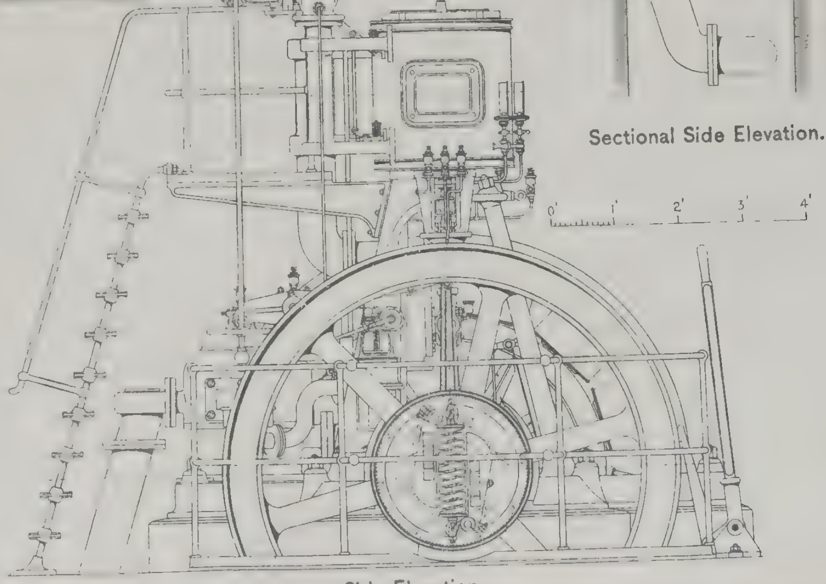
Vertical Section.



Sectional Side Elevation.



Part Sectional Plan.



Side Elevation.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

Negligence of Sub-Contractor.

Where a street car company, authorized by charter to build a car line, lets a contract for construction to an independent contractor, without any agreement as to the particular manner in which the work shall be done, it is not liable for injuries caused by a wire stretched across the road by such contractor in the course of the work.—Sanford v. Pawtucket St. Ry. Co. (Sup. Ct. R. I.), 35 Atlantic Rep. 67.

Power of Railways to Adjust their Rates.

Subject to the two leading prohibitions, that their charges shall not be unjust or unreasonable, and that they shall not unjustly discriminate so as to give undue preference or disadvantage, the laws of the United States leaves common carriers, as they were at common law, free to make special contracts looking to the increase of their business, to classify their traffic, to adjust and apportion their rates so as to meet the necessities of commerce, and, generally, to manage their important interests upon the same principles as are regarded sound and adopted in other trades and pursuits.—Interstate Commerce Commission v. Ala. Midland Ry. Co. (U. S. Cir. Ct. App.), 74 Federal Reporter, 715.

Mining: Rule of Safe Place.

The United States Circuit Court of Appeals recently said: It is a positive duty which the owner of a mine owes to his employees, after the mine is opened and timbered, to use reasonable care and diligence to see that the timbers are properly set, and to keep them in proper condition and repair, and for this purpose to provide a competent mine boss or foreman, to make timely inspection of the timbers, walls, and roof of the mine. —Western Coal & Mining Co. v. Ingraham, 70 Fed. Rep., 219.

◆

CIVIL SERVICE EXAMINATIONS for engineering positions will be held shortly in New York and Washington. On Thursday, Oct. 22, the New York City Civil Service Commission will hold an examination for Building Inspectors, who must be either "architects, civil engineers, masons, carpenters or iron workers who shall have served at least ten years as such." On Friday, Oct. 23, an examination will be held for Inspectors of Iron and Steel, who are required to have had ten years' experience. Applications for these examinations may be procured from S. William Briscoe, Secretary of the Civil Service Commission, New Criminal Court Building, New York city. On Oct. 28, 29, 30 and 31 the U. S. Civil Service Commission, Washington, D. C., will hold examinations for positions in the office of the Supervising Architect, Treasury Department, as follows: Senior architectural draftsman (6 years' experience required, salary $1,600 to $2,000 per year); architectural draftsman (4 years, $1,200 to $1,400); junior architectural draftsman (no experience, $600 to $1,000); structural iron draftsman (2 years, $1,600); heating and ventilating draftsman (2 years, $1,200); computer (no experience, $1,200 to $1,800). Applicants must file with their applications certificates or letters from present or former employers to show that they have had the required practical office experience with some reputable firm of architects or engineers.

◆

THE EIGHT-HOUR LAW lately brought about an absurd suit in Providence, R. I., in connection with the government work on the new mortar battery at Fort Adams. The contractor for that work was sued by the Newport Trades Council for working men nine hours a day, and thus violating the United States Statute prohibiting government contractors from working their men more than eight hours per day. In the trial before U. S. Commissioner Blodgett, the charge was admitted in the case of the men named; but it was shown that it was an emergency case caused by springs breaking out in the foundation excavation. It was also pointed out that the statute provided that the law was not to apply in such cases, and the complaint was dismissed upon the ground that there was no proof of wilful intent to disregard the law, and because the time clause in the contract required extraordinary activity on the part of the contractor.

◆

A METEOROGRAPHIC KITE was sent to an altitude of 9,385 ft. above sea level, at the Blue Hill Observatory on Oct. 8, thus breaking all previous kite altitude records. This "kite" was made up of seven Eddy and two Hargrave kites, from 6 to 9 ft. in diameter, exerting a pull of from 50 to 95 lbs. upon the piano-wire employed. More than three miles of wire were paid out. The kites carried a meteorograph making its record in ink. This record showed a temperature of 46° F. at the ground and 20° F. at an altitude of 8,750 ft. The kites remained at an altitude of over one mile for three hours.

◆

THE PEARY ARCTIC EXPEDITION has returned to North Sydney, N. B., from its summer trip. The party was made up of representatives from Cornell University, the U. S. Coast Survey and the Massachusetts Institute of Technology. They bring back valuable botanical and other collections, and the U. S. Coast Survey party made a series of pendulum and magnetic observations. Lieut. Peary, who returns with the party, writes to the New York "Sun" that the result of the Nansen and Jackson expeditions proves that Greenland is the only land base for an expedition to the North Pole, and he outlines a proposed line of advance towards that point. He says that Lockwood and himself sighted the most northerly land known, extending certainly to 84° or 85° North. Lieut. Peary proposes to organize another Arctic expedition next season, associating with him the leading American geological and archaeological societies. In his absence the interior tableland of Greenland, traversed by him, has been named Peary's Land, by the American and European geographical societies.

◆

A NEW ARMOR STEEL has been invented by Samuel Maxim, a brother of Hiram Maxim, of machine-gun fame. Mr. Maxim, according to the Philadelphia "Record," claims to have simplified the process of manufacturing the famed Wootz steel of India, still made by laborious crucible methods in that country. He submits specimens which are said to cut glass with ease and says he can, by his process, much increase the resistance of armor plate while greatly reducing the thickness and weight.

◆

THE WALRAND-LEGENISEL STEEL PROCESS is meeting with considerable success in Europe, according to a paper read by Mr. George J. Snelus at the recent meeting of the Iron and Steel Institute of Great Britain. It has been adopted by two firms in France, two in Germany, two in St. Petersburg, Russia, one in Spain and one in Glasgow, Scotland, one in Erith, England (Fraser & Chalmers) and one in the United States (Potter & Hollis, Chicago). The size of the converters range from 350 kilos to 1 ton. The principal field for the process is for steel castings, which are made solid and very true to pattern, the melted metal being unusually fluid. It is also applicable to the manufacture of special steels which are required in smaller quantities than can be conveniently produced in the ordinary converter or in the open-hearth. A description of the process was given in our issue of March 19, 1896. It differs from the ordinary Bessemer process in the addition of ferro-silicon to the metal in the converter at approximately the time of flame-drop, and making an after-blow. The rapid combustion of the silicon raises the temperature most notably, and finishes the process by burning silicon to a solid (slag) instead of carbon to a gas.

◆

THE SELECTION OF THE SAVAGE RIFLE by the New York state commission appointed to test guns presented by different manufacturers and to report which one was the best for the use of the state militia, has led to a protest by the Winchester Arms Co., of New Haven, Conn., one of the rivals of the Savage Gun Co. A hearing of the protest and of the reply was held by Governor Morton on Oct. 7, and his decision in the matter is reserved. Statements have been made in the daily papers that collusion between the Savage Gun Co. and some members of the commission was charged, but in the argument before the Governor by Gen. Tracy, representing the Winchester Arms Co., he expressly disclaimed any such charge, and claimed only that the commission was not composed of either trained army officers or gun experts, and that the commissioners were not competent judges of firearms.

◆

A HEAVY EXPRESS ENGINE of the Columbia type has been built by the Baldwin Locomotive Works, of Philadelphia, Pa., for the "Black Diamond" express of the Lehigh Valley R. R., the engine having been designed by Mr. S. Higgins, Superintendent of Motive Power of that road. The engine has four driving wheels (the rear pair being the main drivers), a four-wheel leading truck and a pair of trailing wheels. It has the Wootten firebox, cast-steel driving wheel centers, steel engine and tender wheels, rods of I-section, metallic packing, and all the latest improvements in boiler fittings, etc. The boiler jacket is of steel, painted black. The general dimensions are as follows:

Driving wheels (4)	6 ft. 4 ins.
Truck wheels (4)	3 " 0 "
Trailing wheels (2)	4 " 6 "
Tender wheels (8)	3 " 0 "
Driving axle journals	8½ × 11 ins.
Wheelbase, driving	13 ft. 0 ins.
Wheelbase, total	24 " 0 "
Weight on driving wheels	81,800 lbs.
" on truck	29,100 "
" on trailing wheels	30,050 "
" total of engine	140,950 "
" tender	85,000 "
Cylinders	19 × 26 ins.
Steam ports	1⅜ × 19 "
Exhaust ports	3¼ × 19 "
Valves (Richardson balanced), travel	5¾ "
Boiler, diameter of barrel (outside)	5 ft. 1 in.
Boiler pressure	180 lbs.
Tubes (steel), 265, diameter	2 ins.
" length	15 ft. 0 "
Firebox (radial stay), length	9 " 6 "
" width	6 " 8 "
" depth, front and back	3 ft. 10¼ "
Grate area	63.97 sq. ft.
Heating surface, tubes	2,081.24 " "
" " firebox	148.98 " "
" " total	2,230.22 " "
Smokestack (taper), height of top from rail	14 ft. 10 ins.
Capacity of tender tank	4,000 gallons.
Brake fittings	Westinghouse driving-wheel brake.

◆

THE SIBERIAN RAILWAY may be built across Northern Manchuria, according to a Pekin cable despatch, which states that the Chinese government has granted right of way under the condition that China can purchase this line 30 years after completion. The same despatch says that permission to build a branch line across Southern Manchuria was refused by the Chinese. The original location of the Trans-Siberian railway departed from the present line at Lake Baikal and cut across Northern Manchuria, directly to Vladivostock, instead of following the more northerly and crooked Amoor River. The saving in distance by the southern line would be about 500 miles between Lake Baikal and Vladivostock. This is apparently the right of way referred to as granted. What Russia wants, and will doubtless somehow obtain in the near future, is a branch from this line, at about Petung, south to the Gulf of Pechili, and to a port open at all seasons. The distance from Petung to Port Arthur is only about 500 miles, or about 150 miles more than from that point to Vladivostock. This is doubtless the branch through Southern Manchuria which the Chinese refuse, for the present.

◆

THE TENNESSEE CENTENNIAL EXHIBITION, which is to be held in Nashville from May 1 to Nov. 1, 1897, has opened an Eastern headquarters at No. 229 Broadway, New York, under the direction of Mr. Algar M. Wheeler, Commissioner for the Eastern States, where intending exhibitors may obtain all necessary information. A handsome illustrated circular has been printed by the management, giving views and descriptions of the buildings, and the "Centennial News Bulletin," a finely printed four-page sheet, is issued regularly from Nashville by Mr. Leland Rankin, chief of the Bureau of Promotion and Publicity. The illustrations in the "News" of Sept. 10 show the condition at that date of a number of the principal buildings. From the appearances of the photographs we should judge it likely that the promise made by the management to the effect that all the buildings will be completed three months before the opening day will be kept. The exterior of some of the buildings is practically completed already. The most remarkable building of the exhibition will be the Fine Arts Building, which is a reproduction of the Parthenon in Athens. It will occupy the "Acropolis" of the exhibition, and the other buildings will be grouped around it.

◆

THE NEW MOGUL FREIGHT LOCOMOTIVES built by the Schenectady Locomotive Works, Schenectady, N. Y., for the New York, New Haven & Hartford R. R., are particularly noticeable for the great length of cylinder stroke (28 ins.) and the great boiler capacity, the huge wagon-top end extending nearly to the smokebox. The general dimensions are as follows:

Driving wheels	5 ft. 3 ins.
Truck wheels	2 " 9 "
Driving axle journals	9 × 12 ins.
Driving wheel base	15 ft. 2 ins.
Total wheel base	23 " 3 "
Weight on drivers	124,400 lbs.
Weight, total	144,200 "
Cylinders	20 × 28 ins.
Steam ports	1[illegible] × 20 "
Exhaust ports	3 × 20 "
Boiler, diameter of first ring	5 ft. 2[illegible] "
Boiler pressure	190 lbs.
Firebox, length	9 ft. 0⅛ in.
" width	3 " 4¼ "
Grate area	30.22 sq. ft.
Tubes; number, 312; diameter	2 ins.
" length	12 ft. 0 "
Heating surface, tubes	1,946.72 sq. ft.
" " firebox	164.38 " "
" " total	2,111.10 " "
Capacity of tender tank	4,500 gallons.
Capacity of coal space	20,000 lbs.

◆

AN ELECTRICAL OSCILLATOR has just been patented by Nikola Tesla for transforming either direct or alternating currents into electrical vibrations of very high frequency. A number of inventors have been at work along this line chiefly because a high frequency current is believed to be the main requirement necessary to make vacuum tubes of practical use in electric lighting. There are also other uses to which a successful high frequency machine can be put, such as the production of ozone and of Roentgen phenomena, and all purposes for which a Ruhmkorff coil is now employed. The "Electrical Review" publishes an interview with Mr. Tesla in which he states that the invention is for use with ordinary electric lighting circuits and that the machine is simple in construction and can be manufactured at small cost.

◆

A NEW CLASSIFICATION OF THE EARTH'S SURface has been devised by Prof. Hermann Wagner, of Gottingen, one of the most prominent of the geographers of Germany. He divides the total area of the surface of the globe, above and below sea level, into five regions, which may be tabulated as follows, using sea level as the datum:

Regions.	From.	To.	Mean elevation or depres'n, ft.	Percentage of total area.
Culminating, above	+ 3280	......	+ 7.200	6.
Continental plateau	+ 3280	— 656	+ 800	28.3
Continental slope	— 656	— 7544	— 4300	9.
Oceanic plateau	— 7544	— 16.400	— 13.500	57.3
Depressed area, below.	......	— 16.400	— 20.000	3.

He places the mean elevation of the earth's crust at a depth of 7,500 ft. below the actual sea level; and he figures that of the total area land occupies 28.3% and the sea 71.7%; or a ratio of 1 land to 2.54 water.

STEEL PORTABLE VOTING BOOTHS have been used in New York city for the last three years. They are owned by the Buffalo Steel House Co. and rented for $90 per annum; the company has to move and store the houses, keep them clean and to do all the heating and lighting. These booths measure 12 x 28 ft., weigh about 3,000 lbs. each, and have six voting compartments with all the necessary room for transacting business. They replace the old wooden booths and have given general satisfaction.

A SAMPLE WAREHOUSE, for exhibiting American products of various kinds, is to be opened at Caracas, Venezuela, under the auspices of the National Association of Manufacturers of the United States. The concession obtained from the Venezuelan government permits the entry of goods for exhibit free of duty, with the dues to be paid only in case of actual sale. The Association, with its headquarters at 1751 North Fourth St., Philadelphia, issues a circular of information describing the building proposed for the permanent exhibition, with a plan of the spaces allotted for goods; and this circular also briefly sets forth the population, area and products of Venezuela, and the possibilities of trade with that country.

THE SMOKE NUISANCE is now being attacked by the cities of Buffalo and Kansas City. In Buffalo the aldermen passed an ordinance which the mayor has vetoed on the ground that it is not effective for the purpose for which it is framed, and that it will put undue burdens upon manufacturers. He recommends that a new ordinance be framed which will better meet the requirements of the situation. In Kansas City the matter is being taken hold of by a "Smoke Abatement Association," which has framed an ordinance for consideration by the city council. It is modeled after the one now in operation in St. Louis, which has proved to be very efficacious in diminishing the smoke from large chimneys.

THE PRODUCTION OF COAL IN OHIO in the year 1895, according to the annual report of Hon. R. M. Haseltine, Inspector of Mines, showed a substantial increase over that of 1894. The report gives the year's production as 13,683,879 tons, an increase over the preceding year of 1,773,660 tons. The increase in lump coal is 1,349,231 tons; in nut coal 113,755, and in pea and slack 310,674 tons. The unusual percentage of gain in lump coal is ascribed to the increased use of mining machines and the adoption of improved methods in mining. Of the year's production, 3,120,456 tons were mined by machinery, an increase of 564,990 tons as compared with 1894.

The average time worked is given at 156 days as against 132 days during the preceding year. Four hundred and forty-seven hands were employed in operating the machines and 3,374 hands in blasting down and loading the coal after it has been undermined by the machines.

There are 1,187 mines in the State—424 employ ten men and upward and 763 employ a less number. Of the entire number of mines, 1,097 were in operation during the year. The number of persons that found employment in and about the mines during the year was 22,416 miners and 6,582 day hands, as against 25,163 miners and 6,330 day hands during 1894. Deducting from the whole number of miners employed those who were engaged in operating mining machines, there were 18,645 miners employed as pick miners, a decrease of 3,863 as compared with 1894.

BOOK REVIEWS.

A TEXT BOOK ON SHADES AND SHADOWS AND PERSPECTIVE.—Prepared for the use of Students in Technical Schools. By John E. Hill, M. S., M. C. E., Associate Professor of Civil Engineering, Brown University. Second edition, revised and enlarged. New York, John Wiley & Sons; London, Chapman & Hall, Ltd. 1896. 8vo; cloth; pp. 101, with 12 folding plates. $2.

This text book is designed to furnish a short course in shades and shadows, and one-plane perspective, for students who have studied the elements of descriptive geometry. Prominence is given to the fact that the subjects treated are branches or applications of descriptive geometry, and follow that subject in logical sequence. For this second edition the book has been thoroughly revised and in the main re-written. We believe it will be found a very satisfactory text book for technical schools. The author's style of treatment is very clear and concise, and the 52 illustrations in the folding plates are well executed.

WEALTH AND PROGRESS OF NEW SOUTH WALES, 1894.—By T. A. Coghlan, Government Statistician. Eighth Issue. Sydney, N. S. W., Charles Potter, Government Printer. 8vo.; 1,021 pp.

This document briefly sketches the history, physical geography, geology, fauna and flora, and the political, financial and commercial growth of New South Wales. The list of contents also covers mineral, agricultural, industrial and educational statistics, together with much other matter relating to progress of this section of the world. The period covered by the tables is limited to ten years; but the reader is referred to the "Statistical Register" for more detailed figures.

MATHEMATICAL TABLES.—Consisting of Logarithms of Numbers, 1 to 10,800, trigometrical, nautical and other tables. Edited by James Pryde, F. E. I. S. New Edition. New York, D. van Nostrand Co. 8vo.; 454 pp. $1.75.

This edition is greatly enlarged and the tables of logarithms of numbers, logarithmic sines, tangents and secants, and those of natural sines, cosines, versed sines and chords, tangents and cotangents, secants and cosecants, and of circular arcs, have been carried to seven decimal places and rearranged so as to be more convenient for use. The greatest care has been observed in making these tables accurate, and to secure this end they have been collated with six of the best sets of tables known. The price remains the same as for the old edition.

A DICTIONARY OF GEOGRAPHIC POSITIONS.—Bulletin No. 123, U. S. Geological Survey. By Henry Gannett, Chief Topographer, Washington, D. C., Department of the Interior, U. S. Geological Survey. 8vo.; 183 pp. $0.15.

This will be found an exceedingly useful book of reference to many engineers and land surveyors. For some years past the Division of Topography in the U. S. Geological Survey has been engaged in compiling positions determined within the United States which are believed to be sufficiently accurate for use in preparing its maps. It is placed before the public at the very modest price stated, and the list covers nearly 10,000 positions, with the latitude and longitude expressed to hundredths of a second, together with the authority. These positions are arranged by states, and within states by "square degrees," or the quadrilateral limited by consecutive parallels and meridians. But an alphabetical index covering all the positions noted enables any one to readily find those marked. A short sketch of the several authorities used in the compilating of the list is given. A dictionary of altitudes has also been compiled by Mr. Gannett, and is issued as Bulletin No. 76, and sold for 25 cents by the Geological Survey.

DES INGENIEURS TASCHENBUCH.—Herausgegeben vom Akademischen Verein "Huette." 16th edition. Berlin, 1896. Wilhelm Ernst & Sohn. 2 vols., 7 x 4½ ins.; pp. 984 and 618. Price in Germany, bound in leather, 16 marks = $4.

The standard German engineers' "pocket-book" has now grown too large for one pocket, and it has been divided into two volumes. "Huette" differs from the American engineers' pocket-books, not only in being larger, but in its methods of treatment. It devotes considerable space to descriptions of apparatus, the chapter on steam boilers, for instance, covering 103 pages, and including cuts of all the principal styles used in Germany. It is less elementary than the American books, assuming a considerable amount of mathematical knowledge on the part of the user. The subject of mechanics begins with velocity and acceleration, instead of with force, and equations involving a knowledge of the differential calculus are employed in its discussion. The second volume is chiefly devoted to engineering practice in the departments of railways, buildings, bridges, steam vessels, furnaces, flour mills, paper making, etc. The work is an invaluable reference book to any engineer who has an acquaintance with the German language.

UNIVERSAL DIRECTORY OF RAILWAY OFFICIALS, 1896.—Compiled from Official Sources by S. Richardson Blundstone, Editor of the "Railway Engineer." Directory Publishing Co., 8 Catharine St., Strand, London, England. Cloth; 8vo.; pp. 375; 10 shillings ($2.50).

This is the second edition of the directory which was reviewed in our issue of Nov. 28, 1895, and it is stated that about 150 railways and 32 pages of matter have been added in this edition. Some of the omissions and inaccuracies noted in the review of the former edition reappear now, Colombia being credited only with the Girardot Ry., and no mention being made of the newer and more important lines. Even the Panama Railway is again omitted. One of the weak points in this, as in the first edition, is the treatment of the railways of the United States, and it is difficult to understand what system of selection has been employed, several small lines being included, to the exclusion of some of the great trunk lines. It also mixes up the Knoxville & Ohio (65 miles) with the Southern Ry. (4,649 miles), by which it is leased, and gives the former little line a long list of officers of the latter line. These defects are doubtless due to a lack of knowledge of the railway systems of this country, but they greatly detract from the usefulness of the work, in fact the directory of American railway officers would be of little use in this country, where several much cheaper and far more complete and accurate directories are regularly issued. The information respecting the railways of Great Britain, the British colonies and European countries is naturally pretty complete, and in the whole the book is probably as complete and accurate as could be expected, with the exception of the United States section, the omissions in which are glaring and inexcusable. The volume is well and clearly printed on a good quality of paper (though the arrangement and type are somewhat confused in style), and it is strongly and compactly bound.

IRON MAKING IN ALABAMA.—By William B. Phillips, Ph. D. Published by the Alabama Geological Survey, Eugene Allen Smith, Ph. D., Director, Montgomery, Ala. 1896. Pamph.; 8vo.; pp. 164.

The development of iron making in Alabama in the ten years from 1880 to 1890 was one of the most remarkable events in the history of the iron trade. Not less remarkable has been the progress of the last three years in cheapening the cost of production to such a point that it has been possible when freight rates were favorable to ship a portion, although a small one, of the product of the state to England and other foreign countries to compete with English iron. The pamphlet before us was written by Dr. Phillips for distribution by the Geological Survey, and it gives a very complete account of the present status of the industry chiefly from the standpoint of the miner of the raw materials used in iron making. The growth of the manufacture of coke pig iron in the state is well shown in the following figures: Tons of 2,240 lbs.—1876, 1,262 tons; 1880, 35,232 tons; 1885, 133,808 tons; 1890, 718,383 tons; 1892, 835,840 tons; 1894, 556,314 tons; 1895, 835,851 tons. The production is now about 10% of the total iron production of the United States. The pamphlet is largely devoted to a description of the ores, fuels and fluxes found in the state, then follows a directory of the furnaces, rolling mills, etc., with a brief description of each, and a number of short papers by different writers on the grading of Southern pig iron, the market for Alabama pig, etc. The papers on the grading of pig iron should be read by all who are interested in the purchase or use of pig irons for foundry purposes. Dr. Phillips shows clearly the troubles which arise from the present method of having eleven different grades for Southern pig irons, and recommends that they be reduced to six, having chemical analyses as follows:

	Silicon.	Combined Carbon.	Sulphur.
Silvery irons.. ..	5 to 6	0.10 to 0.30	0.01 to 0.04
Soft irons..	3 to 5	0.20 to 0.60	0.01 to 0.05
Foundry irons ..	2 to 3	0.30 to 0.90	0.01 to 0.07
Gray forge..	1 to 2	0.40 to 1.25	0.04 to 0.09
Mottled..	0.6 to 1	0.50 to 1.80	0.06 to 0.11
White..	0.1 to 0.6	1.00 to 2.50	0.08 to 0.30

He strongly favors, of course, the grading of irons by analysis and condemns the old method of grading by fracture.

METALLIC STRUCTURES, CORROSION AND FOULING AND THEIR PREVENTION.—A Practical Aid-Book to the Safety of Works in Iron and Steel, and of Ships; and to the Selection of Paints for Them. By John Newman, Assoc. M. Inst. C. E. London, E. & F. N. Spon; New York, Spon & Chamberlain. 12mo.; pp. 374. $3.50.

The author appears to be a professional book-maker rather than an engineer. The title page gives the names of five other books which he has written, one of which has a rather taking title, "Scamping Tricks and Odd Knowledge Occasionally Practised upon Public Works;" the others being on earthwork slips, concrete, cylinder bridge piers, and foundations. What special qualification the author has for writing a book on the subject of corrosion is not apparent, except in the following note from the preface.

> The author, having had his attention specially directed during many years, to the subject of corrosion and fouling and their prevention, has placed his experiences on record, and that of others in all parts of the world, to whom he offers his acknowledgments, and also to the editors of the various technical journals mentioned.

From an examination of the book itself it would appear that the author's method of book-making is to have a box or drawer into which for several years he puts clippings or notes of the subject upon which it is his intention to write, and then in due time to arrange the matter into shape for publication in the best way that he can, with the least labor possible in studying the subject or in arranging the matter in logical and literary form. There is a "long-felt want" for a good book on the subject of corrosion; the author has recognized the want, and attempts to fill it with a "pot-boiler." Of course the book contains a great quantity of useful information, clipped from various sources, but the useful matter is so hidden amongst a mass of imperfectly digested, if not useless, stuff that a great effort is required to find it. For instance, in searching to find what is the author's opinion on the subject of the relative corrosibility of different grades of wrought iron, on page 31, we find:

> The greater the purity, homogeneousness and freedom from foreign matters of the metal, other conditions being similar and in accordance with specified requirements relating to strength, the less will be the corrosion.

On p. 34 we find what appears to be a contradiction of the above:

> Hard and crystalline irons are generally considered to be less oxidable than ductile or fibrous irons.

The following sentences, also from p. 34, are examples of the characteristic style of the author:

> In steel, uniformity can be approached more than in iron; however, the cinder in iron and the scale of steel are different. The former is a dielectric glassy substance and has no corrosive influence, while the scale produced in rolling steel has a very deteriorating effect, as it is a magnetic oxide negative to the steel, and therefore corrosion is rapid, as also if such scale is rolled into steel plates. Professor Kick, of Prague, after many experiments, which he only regards as indicating the probable general rule, not as proving it, with nitric, sulphuric and hydrochloric acids and their cerubinations, with mordants composed of the salts of copper, etc., found that soft and fibrous iron of good quality, also fine grained iron, when attacked by the acid, is uniformly so, and with a limited elimination of the carbon, the surface retaining a dull lustre, a few incised specks and cinder-like holes being only observable. Coarse-grained iron and hot-short iron were found to be more powerfully attacked.

ENGINEERING NEWS
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THE AMERICAN TRANS-CONTINENTAL ARC, as surveyed by the U. S. Coast and Geodetic Survey, has been completed. It lies along the 39th parallel, north latitude, and extends from a point near Cape May, on the Atlantic, to a point above San Francisco, on the Pacific coast. According to the measurements made the distance, reduced to sea-level, is 2,625.8 miles; and from these measurements the radius of the 39th parallel is yet to be determined. While this survey has cost about $1,000,000 in the aggregate, the longest base-line heretofore run is that across India, about 1,000 miles long. As compared with the radius of the 39th parallel, as given by Bessel, of Germany, this arc as measured is 111 ft. in error; and according to the figures of Andrew Clarke, of Glasgow University, it is 98½ ft. in error. But the Bureau claims that these variations are due to errors in previously established standards.

COMPRESSED AIR FOR OPERATING WAR-SHIPS is an innovation; but the U. S. Monitor "Terror" is so equipped and is said to be the only war-ship in the world that uses this power for turning its turrets, working the guns and steering the ship. Compressed air has been substituted for steam, or hydraulic power, because a leak in the pipes is not dangerous, and no exhaust pipes are required, as with both of the others. The "Terror" has two air-compressing engines, which can, singly or together, supply sufficient air at a pressure of 125 lbs. per sq. in. to operate both turrets. The air is carried to engines in each turret having 8-in. cylinders and 14-in. stroke, of about 40 HP. each. The shell-hoist is operated by another pneumatic cylinder, and the ramming is done by the same power. Compressed air also elevates or depresses the gun, and two pneumatic cylinders control the recoil. A similar engine is connected with the steering-gear, though a 5 HP. electric engine is also fitted for the same purpose. The "Terror" has passed her trial stage and the machinery operated by the compressed air has been found to work satisfactorily.

THE USE OF ELECTRICITY ON THE "FRAM," Nansen's exploring ship, is noted by the "Elektroteknish Tidsskuft," of Christiania. The dynamo was operated by a windmill and every puff of wind was utilized to load the accumulators. The current generated was used for incandescent and arc-lamps, and for firing the mining shots in clearing the "Fram" from ice. In extremely cold weather the solution used in connection with the accumulators froze solid, but the acid-blended ice was still useful in operating the accumulators and the cells were used until the cog-gearing in the windmill wore out.

THE WAR DEPARTMENT ESTIMATES, for the next fiscal year aggregate $52,875,638. The chief items in this estimate are as follows: Pay of army, $13,522,880; army subsistence, $1,659,837; quarter-masters' supplies, $2,200,000; army transportations, $2,500,000; clothing, $1,100,000; ordnance department, $1,131,000; military posts, national cemeteries and national parks, $1,558,380; national soldiers' homes, $3,443,214; rivers and harbors, $5,349,000. In regard to coast-defences, Secretary Lamont reports as follows: Within the last four years, 17 out of 21 12-in. emplacements, 55 out of 60 10-in. emplacements, 20 out of 25 8-in. emplacements, 14 out of 16 rapid-fire gun emplacements, and 92 out of 156 12-in. mortar emplacements, have been entirely provided for; while much work has also been done in the same time on those previously provided for. As nearly as can be gathered from the report, the government has now completed, or under construction, 71 12-in., 112 10-in. and 88 8-in. modern breech-loading rifled guns, and 109 12-in. rifled mortars, besides smaller guns. The all important question of gun-carriages has been practically settled and disappearing and non-disappearing carriages of an acceptable type are being furnished.

A SWORD FISH pierced 13 ins. of Oregon pine, forming part of the hull of the brigantine "Irmgard," on the late passage of that ship from Honolulu with a cargo of sugar. The sword passed through the 5-in. planking on the port bow and the 8-in. skin planking behind it, protruding 1 in. into the hold of the vessel. The planks were split for about 1 ft. each way, causing a leak. We give the above on the authority of the San Francisco "Examiner."

STEEL FERRY-BOATS, with twin-screws at both ends, are being built for the Pennsylvania R. R., to ply on the North River, from Jersey City to 23d St., New York city. The first of these boats, the "Pittsburgh," was launched from the Cramp shipyard on Oct. 17. The dimensions are—length over all, 206 ft. and 184 ft. between rudder-posts; moulded beam, 46 ft., and over guards, 65 ft.; average depth of hold, 15 ft. The hulls are made of steel with water-tight compartments, and there are two 3-cylinder compound engines with cylinders of 20, 32 and 32 ins. diameter and 24-in. stroke. Each engine will operate two screws 8 ft. 3 ins. in diameter on a continuous shaft. Water-tube boilers are used, with a working pressure of 200 lbs. A sister boat, the "St. Louis," will soon be launched from the yard of B. Hillman & Co., in Philadelphia.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision of passenger trains on the Florida Central & Peninsular R. R., at Swansea, Ga., Oct. 14. The southbound train had orders to pass the northbound train at Swansea, but the engineman read this as Sweden, a station 30 miles beyond. When the conductor found the train was running past Swansea he started to signal the engineman, but just at that time the collision occurred. Both engines were wrecked and the combination mail and baggage car of the southbound train was overturned and set on fire. The baggage master and mail clerk were burned to death and a brakeman who was crushed between the cars was also burned to death.—— In a collision between a locomotive and an electric car at Hazleton, Pa., Oct. 14, three men were killed and nearly 30 injured, some fatally.

THE LOSS OF THE STEAMER "ARAGO" occurred Oct. 20 at the entrance to the harbor of Coos Bay, Oregon, during a heavy fog, and 12 persons (passengers and crew) were drowned. The vessel was owned by the Oregon Coal & Navigation Co., and was a steel steamer built by the Union Works, of San Francisco. It was 200 ft. long, 30 ft. beam, 16 ft. deep, of 947 tons gross tonnage.

THE FALL OF A CONCRETE DOME ROOF at the University of Virginia, Charlottesville, Va., on Oct. 19, resulted in the death of two men and the serious injuring of three others. The roof was a new one and the men were removing the falsework.

THE COLLAPSE OF A BRIDGE under a 15-ton steam roller occurred Oct. 14 at Watertown, N. Y. The engine was crossing the Knowlton bridge over Black River, when the bridge broke and the engine fell 30 ft. to the ground below, killing the engineman.

THE FLOOD PROTECTION DIKE at Corning, N. Y., has proved its efficiency during the recent freshet in the Chemung River. There were three unfinished places in the dike, but the Ferguson Contracting Co. kept gangs of men at work all night to fill the gaps. It is said that this is the first time that the Fifth Ward has not been flooded in time of high water.

EXCESSIVE SPEED OF ELECTRIC CARS is causing trouble at Hartford, Conn., and the Hartford Street Ry. Co. has been notified of the following results of an investigation made by Mr. A. W. Gilbert, City Electrician:

	No. of Readings.	Per cent of total No.
Under 8 miles per hour..................	5	3.0
8 to 10 " " "	14	8.6
10 to 12 " " "	47	29.0
12 to 14 " " "	35	21.6
14 to 16 " " " "	36	22.2
16 to 20 " " "	17	10.5
Over 20 " " "	8	4.9

THE BOSTON SUBWAY is to be leased to the West End Street Ry. Co., at an annual rental of 4.75% on its cost, which is not to exceed $7,000,000, the lease extending for 20 years. As the city pays a considerably less rate of interest (between 3 and 3½%) the difference between rentals and interest charges will constitute a sinking fund which will eventually pay off the capital borrowed by the city for the subway construction.

THE POWER OF LABOR UNIONS over public officials has recently been shown in Detroit. The board of supervisors is about to erect a new county building, and it received a letter from Mr. Garland, president of the Amalgamated Association of Iron and Steel Workers, asking that the contract for the iron and steel work be kept from the Carnegie Steel Co. In his letter he says:

> Since the memorable struggle with the company they have been cutting wages of the men in their employ and the market price of the material, and thereby making it harder for us to secure fair wages from union manufacturers. Even now they have demanded a reduction of their men, to take effect January 1. At the same time they are enjoying the benefits of a trust and holding up the price to $4 over a normal profit.

There appears to be a contradiction between the two statements that the company "is cutting the market price of the material" and that it is "holding up the price to $4 over a normal profit," but if so the supervisors seem to have overlooked it and they passed a resolution to the effect that none but union-made iron and steel work be used in the county building.

EIGHT DYNAMOS OF 560 K-W. each have been erected and started in the power-house of the Niagara Falls Hydraulic Power & Mfg. Co. in the gorge below the Falls. A description of this plant was given in our issue of March 26, 1896. The eight dynamos are driven by four Leffel turbines. The company expects to deliver power to the new aluminum works of the Pittsburg Reduction Co. in about two weeks.

BELGIAN PAVING BLOCKS to the number of about 15,000 have been imported by the New York Department of Public Works for use upon some streets of heavy traffic. The claim is made that they are more homogeneous in structure and wear better than blocks of native stone.

SEWER FLUSHING AT ROCHESTER, N. Y., has been discontinued. It seems that the work was at one time done by the Board of Health, which for some reason discontinued it. The Executive Board then took up the work, although not coming within its domain. Money for the work not being provided by the Common Council the Board has been obliged to discontinue the flushing.

LIMITATIONS OF THE CITY ENGINEER of Providence, R. I., are being considered by the Board of Aldermen of that city. It is proposed to restrict the engineer from doing outside work. The matter has been laid over until the last of October.

THE DRAWBAUGH TELEPHONE AND TELEGRAPH Company has applied to the Board of Electrical Control, of New York city, for a franchise to establish a telephone system. This company, of which Mr. J. R. Bartlett is president, contested for years the validity of the claims of Alexander Graham Bell as the inventor of the telephone and it is still engaged in legal controversy. As all attempts failed to establish Daniel Drawbaugh as the prior inventor, a bill is now before Congress, but not yet passed, asking that the Drawbaugh Company be permitted to use similar appliances to those now claimed by the Bell Company. It is in the hope that this bill will be favorably acted upon that the present company was incorporated on July 25, 1895.

INCRUSTATIONS IN WATER-PIPE, says "Le Genie Civil," were recently removed by fire, at Setif, as follows: Three pipes had been reduced in diameter from 1½ to 2¾ ins. by incrustation, and immersion in a bath of diluted hydrochloric acid had failed in useful result. Finally two lengths of pipe were placed on the ground parallel to each other, and 6½ ft. apart, and on these layers of 15 pipes were placed, each layer at right angles to the one below it, until there were 7 or 8 layers. Combustible material was filled in between the pipes and fired; and when the pipes were cooled they were easily scraped out and cleaned. Out of 137 pipes only 6 developed defects causing their rejection after the firing process, and the cost was about 3 cts. per lineal foot of pipe.

AROUND THE WORLD IN 33 DAYS is the possible pace set by Prince Hilkoff, the Russian Imperial Minister of Ways and Communication, now officially studying American railway methods. To make the circuit in this time modern fast ships and railway trains are alone considered; but with these available on the routes specified he gives the time as follows: New York to Bremen, 7 days; Bremen to St. Petersburgh by rail, 1½ days; St. Petersburgh to Vladivostock, by rail at 30 miles per hour, 10 days; Vladivostock to San Francisco, via Hakodate Straits, 10 days; San Francisco to New York, 4½ days. The present shortest time for circuiting the globe is given as follows: New York to Southampton, 6 days; Southampton to Brindisi, via Paris, 3½ days; Brindisi to Yokohama, via Suez, 42 days; Yokohama to San Francisco, 10 days, and San Francisco to New York, 4½ days, or 66 days in all.

THE WATER SUPPLY SYSTEM OF SALT LAKE CITY, UTAH.

By W. P. Hardesty, C. E.

(With inset.)

Salt Lake City is exceptionally well situated to secure a good supply of pure water at moderate cost. The Wasatch Range of mountains lies close to the city on the east, and all along its western slope issue streams of pure mountain water, well fed by the snow, which lies on the highest peaks of the range till far into the summer. The creeks immediately contiguous to the city, and which were naturally first turned to for water, are:

(1) City Creek, which comes in from the northeast and enters the city and flows through the north side. (2) Emigration Creek, which comes in from the east. (3) Parley's Creek, which issues from the mountains southeast of the city. These creeks flow naturally westward through the city, emptying into the Jordan River, but their channels have been greatly changed and converted into irrigation canals, flumes, etc.

The water from all these creeks can, within a short distance from the town, be diverted so as to secure an all-gravity supply with an almost unlimited pressure. On account of the range of elevation, the north central, northeast and east central parts of the city naturally compose a zone for a high-line system, while the remainder can be covered by a low-line supply.

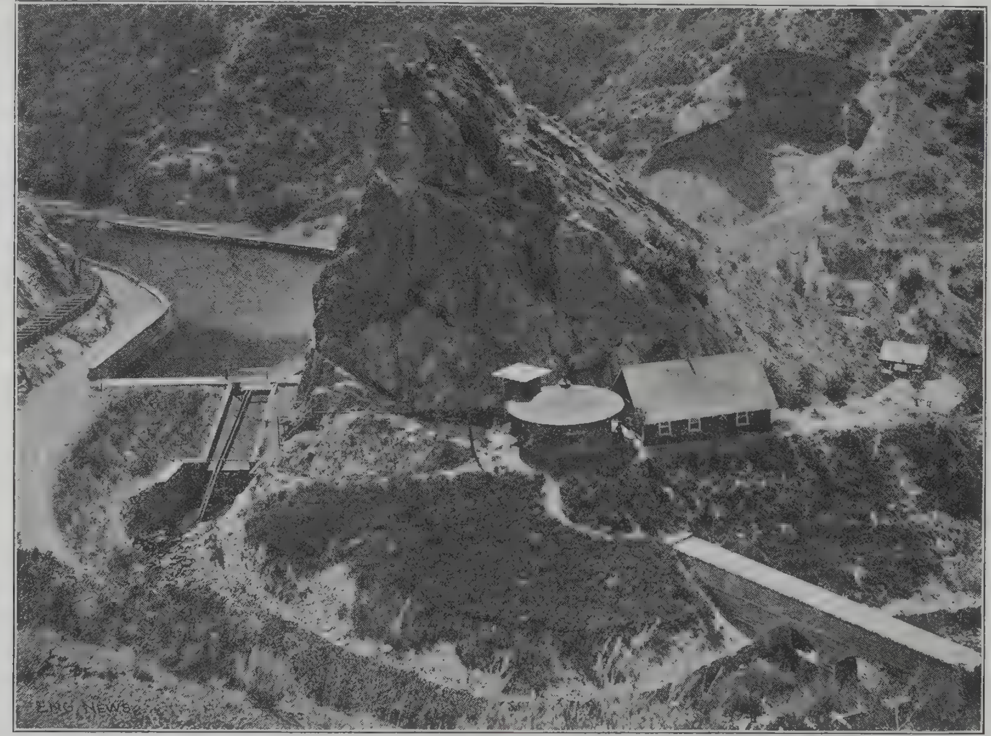

FIG. 1.—VIEW OF DAM, SCREENING TANK AND CULVERT AT HEAD OF PARLEY'S CREEK CONDUIT, SALT LAKE CITY.
A. F. Doremus, M. Am. Soc. C. E., Engineer.

The water supply system has always been owned by the city. The population of Salt Lake City increased from 20,768 in 1880 to 44,843 in 1890, and is now estimated at 50,000.

City Creek Supply System.

This creek, being much the nearest and most available stream, was naturally turned to first for water for irrigation as well as domestic use. Indeed, the Mormons tapped this creek with a small irrigating ditch on the very day they arrived in Salt Lake Valley, July 24, 1847. All water brought by the city for domestic use came through open ditches, or from wells, until about the year 1872, when the creek was tapped by a pipe line. Wooden pipe was proposed at first, but cast-iron was soon substituted. This cost, then, about $100 per ton delivered in Salt Lake City. A 20-in. pipe was used for 1,900 ft., and a 16-in. pipe for 1,450 ft. more, which brought the line to the center of the city, no water being then drawn from it on the way down. In 1888, a line was taken out nearly one-half mile farther up the stream. The water is diverted by a weir, and after passing through screens for excluding leaves and drift is passed by a short tunnel through a projecting ridge in the valley to a brick tank on the creek below, used for a settling basin. This tank is divided into two compartments, so that either can have the water drawn off and be cleaned when necessary. It has a capacity of 220,000 gallons. From the tank a pipe line leads down the canyon to connect with the first pipe line. About 100 ft. of this pipe is 30-in. and the rest 24-in., reducing to 20 and 16 ins. in the first line.

It is told as a fact that Brigham Young and his lieutenants gave the pipe this diminishing size, from 30 to 16 ins., with the firm opinion that the momentum of the water (it was to gradually increase in velocity) would permit of this reduction in pipe cross-section.

In 1889 the 20th Ward pipe line was built. This takes water at about 130 ft. higher elevation than the low line. It consists of a 12-in. wooden pipe, wound spirally with flat bands and well tarred. On leaving the canyon bed, the pipe is changed from 12-in. wood to a 6-in. cast-iron (which climbs the side hills and runs east on 6th St.), and to an 8-in. kalameine pipe. This pipe line supplies the district between South Temple St. and 6th St., and from State St. east.

The high line supply from City Creek is taken out about 2½ miles above and nearly 500 ft. higher than the low line, and supplies the highest part of Salt Lake. The main is of 12-in. cast-iron, and just below the brick tank of the low-line system a Y is put in and a branch run up each side of the canyon onto the high ground. The branch on the east supplies the 13th St. system, which includes the district between 6th and 13th Sts., and between State and O Sts.

The only reservoir completed and now in use on the City Creek system is the one on Capitol Hill, on the west side of the canyon, fed by the west branch of the high line. This is 100 × 200 × 14 ft., is lined with concrete and cement; cost over $20,000 and holds 2,050,000 gallons.

The capacity of the pipes taking water from City Creek is about 14,000,000 gallons daily. The average minimum flow of the creek is about 7,000,000 gallons daily, with 4,000,000 gallons as the least flow recorded, in 1889. The natural flow has been much increased since then by tunneling and developing the springs and underflow.

Great care is taken in the canyon of this stream to guard against pollution. During the summer season the creek is regularly patrolled by watchmen in the employ of the city. The creek channel has been greatly improved by straightening and by rip-rapping its banks with stone. In this manner most of the vegetable matter and the debris have been excluded from the stream. The drift that does get into the stream is regularly cleaned out each season. The water, however, is hard, on account of the carbonates of lime and magnesia, which also cause concretions, particularly in dead ends of pipes. Some of the very small mains used in this system are at an extreme disadvantage on account of these incrustations, being often nearly closed.

Emigration Creek Supply.

This creek was tapped after the city had grown beyond the capacity of the City Creek supply. In 1890 a 12 and 14-in. kalamein iron pipe was laid from the creek just above the mouth of the canyon to a relief tank on the east bench in the city. This line is over three miles long and has a fall of about 300 ft. A trench 10 ft. wide and nearly 200 ft. long was dug across the bottom of the canyon with the intention of putting in a submerged dam and raising the water to the surface. It was found that the bed-rock in the lowest part was much deeper than was expected, and after going down 27 ft. the water had increased so fast that three pumps could not handle it, so this plan was abandoned.

A supply of about 800,000 gallons daily is obtained from that portion of the underflow reaching this trench that rises to the level of the inlet to the pipe here, near the top of the trench.

The natural summer flow of this creek is quite small and is rendered impure by the many flocks of sheep driven through the canyon. As a means of increasing the flow a tunnel was driven into the hill on the south side of the canyon at this same site. This tunnel is about 4½ ft. wide by 6 ft. high, and reaches in 306 ft. It cost about $5 per lin. ft. A flow of excellent water, estimated at 800,000 gallons daily, was thus developed. To secure the underflow it is proposed to start a tunnel about one-half mile down the canyon, at the mouth, and run up the canyon to the site of the dam. A ledge of rock extends diagonally across the valley here, though rather deeply buried in the center. It is believed that by constructing the tunnel with the head on the upper side of this ledge and at a sufficient distance below its top, that the ledge, acting as a submerged dam, will collect all the water needed to be drawn off through the tunnel. Some borings have been made to define the profile of this ledge and ascertain the best location for the tunnel.

The conduit constructed is of 14-in. pipe, except about one mile of 12-in., used where the hydraulic grade is heavier. The crossing of Red Butte Creek (a small stream north of Emigration Creek) is made by laying the pipe in a box 16 ins. square inside. This box is very strongly built, and is packed with sawdust around the pipe. It spans the creek, having a mud sill as support at each end. The sides of the box are single, 8 × 16-in. pieces. The capacity of this pipe-line is about 3,000,000 gallons daily. It was built in 1890 and cost $51,000, of which the pipe and fittings cost about two-thirds, at the factory.

Parley's Creek System.

It was in 1889 that Salt Lake City took on a new growth—a genuine western boom, and it was soon seen that the water supply was totally insufficient. Both Emigration and Parley's Creeks were suggested as new sources of supply, and the construction of the former in 1890 was followed by that of the latter in 1891-92. The mouth of Parley's Creek is over two miles south of that of Emigration Creek, and as the supply lines from both run northwest to the same point, the waters could just as well be united opposite the mouth of Emigration Creek canyon, making one line serve for both from that point to the city. This was not done for the reason that there was immediate need for more water, which could be secured quickly and cheaply by constructing the Emigration Creek line, and also for the reason that it was thought that this supply would be sufficient for a while, which, however, was not the case.

The Parley's Creek conduit has a length of over five miles, and it was made of sufficient size to

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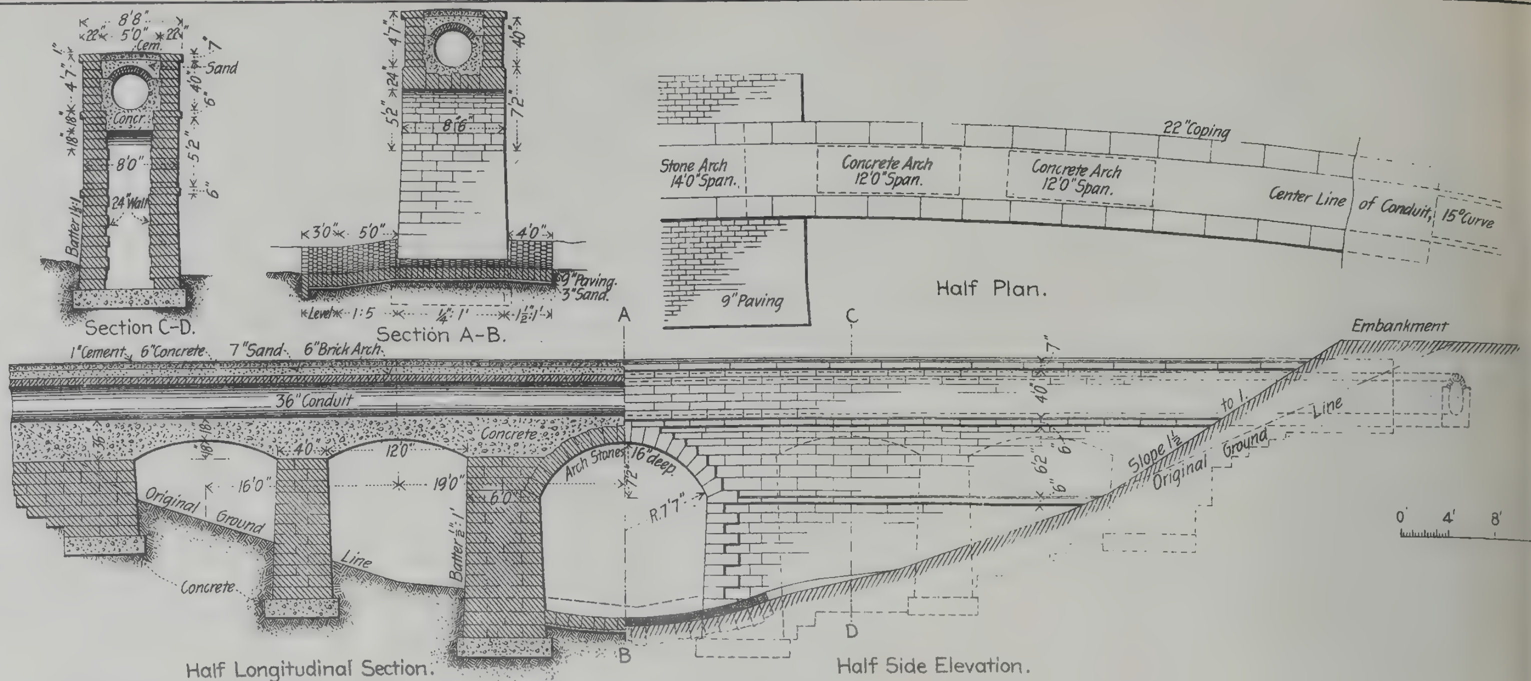
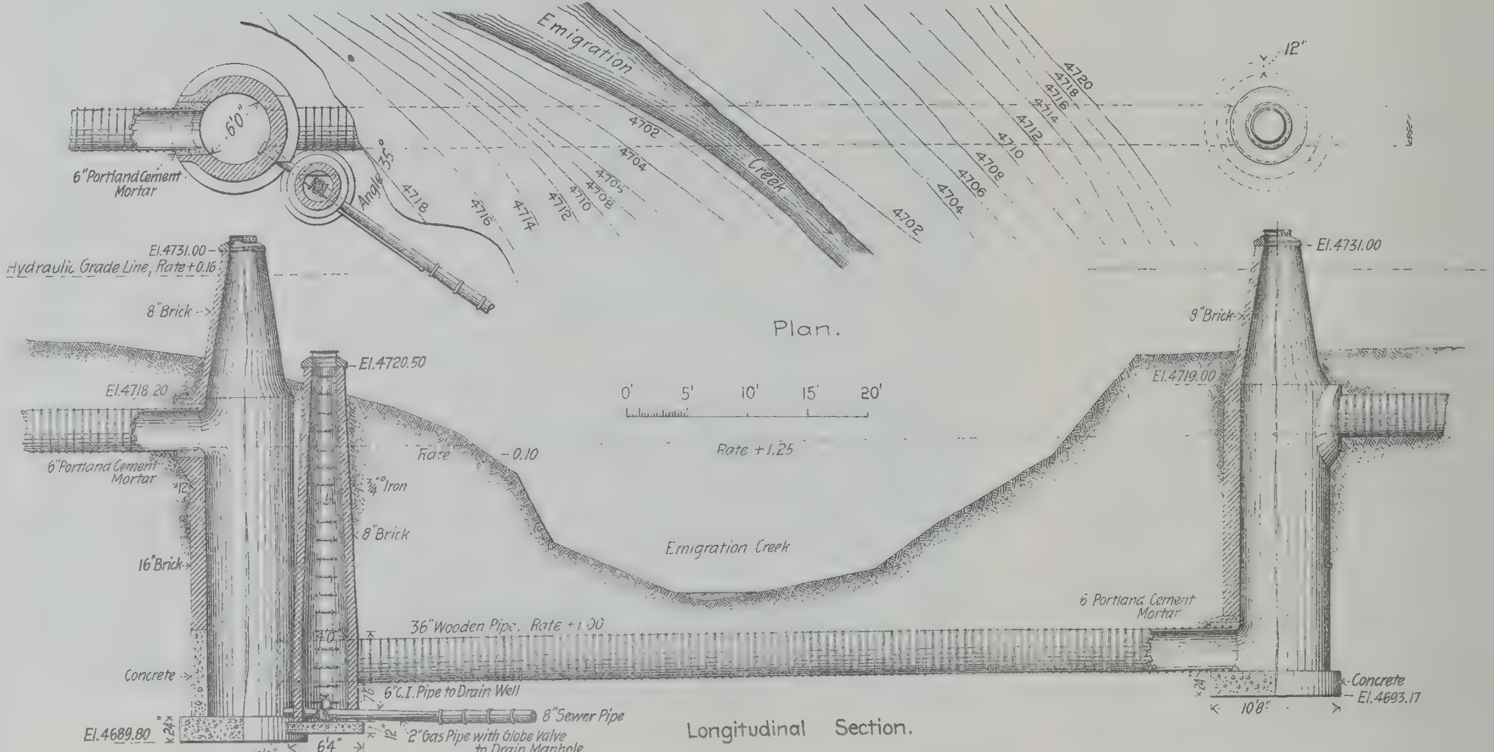


Half Longitudinal Section.

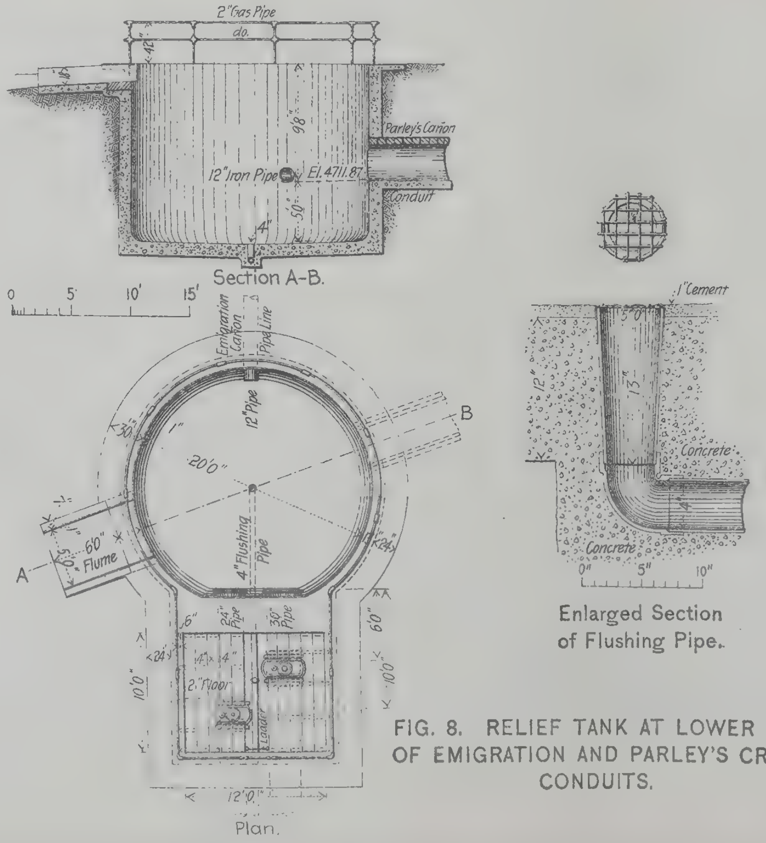
Half Side Elevation.

FIG. 6. CULVERT AT DUDLER'S GULCH.



Longitudinal Section.

FIG. 7. SIPHON UNDER EMIGRATION CREEK.



Enlarged Section of Flushing Pipe.

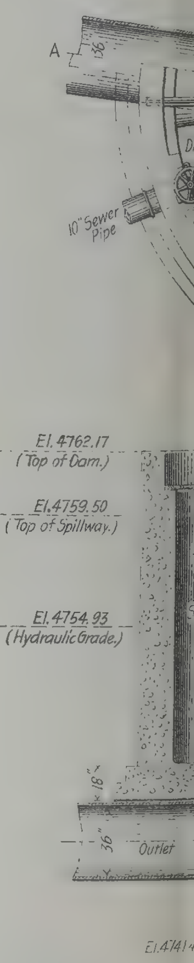
FIG. 8. RELIEF TANK AT LOWER END OF EMIGRATION AND PARLEY'S CREEK CONDUITS.

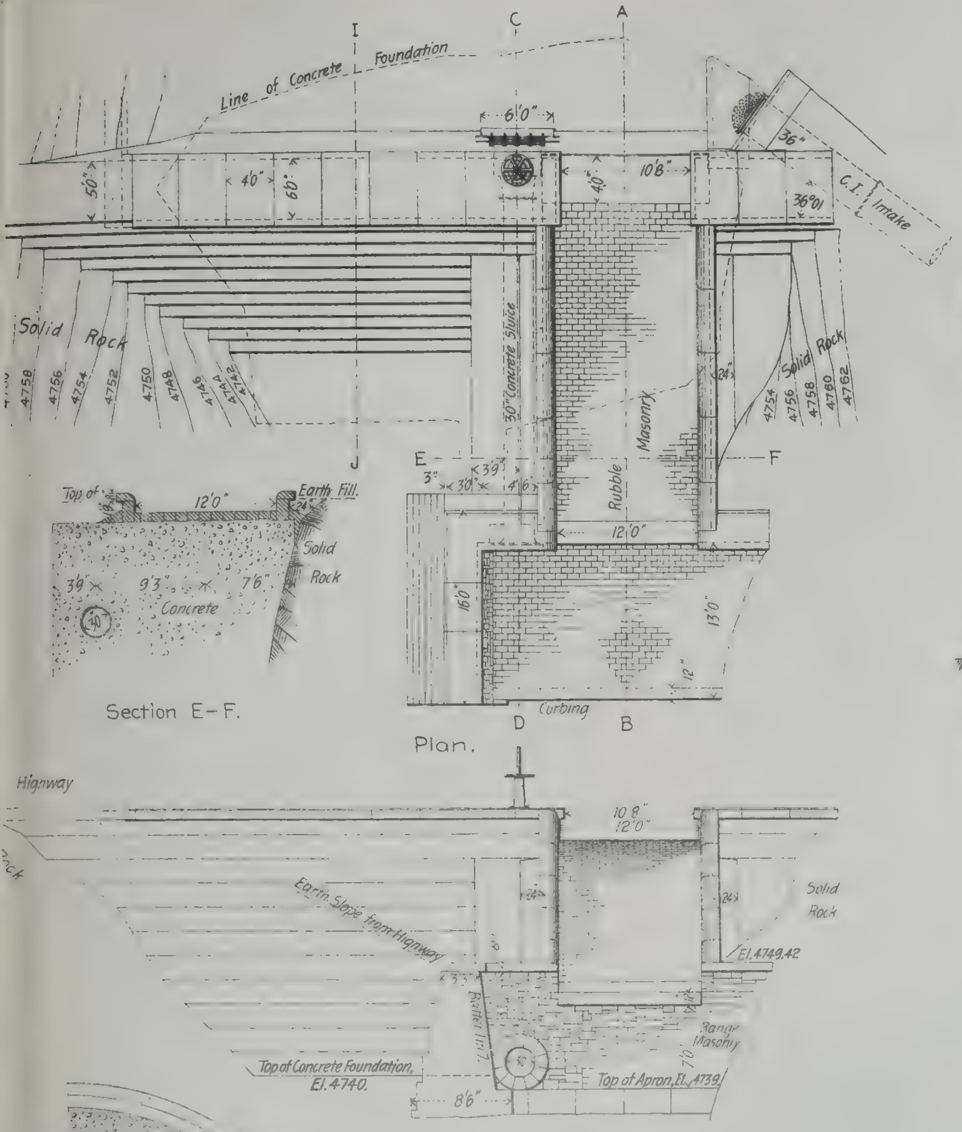
THE
WATER SUPPLY
SYSTEM
OF
SALT LAKE CITY,
UTAH.

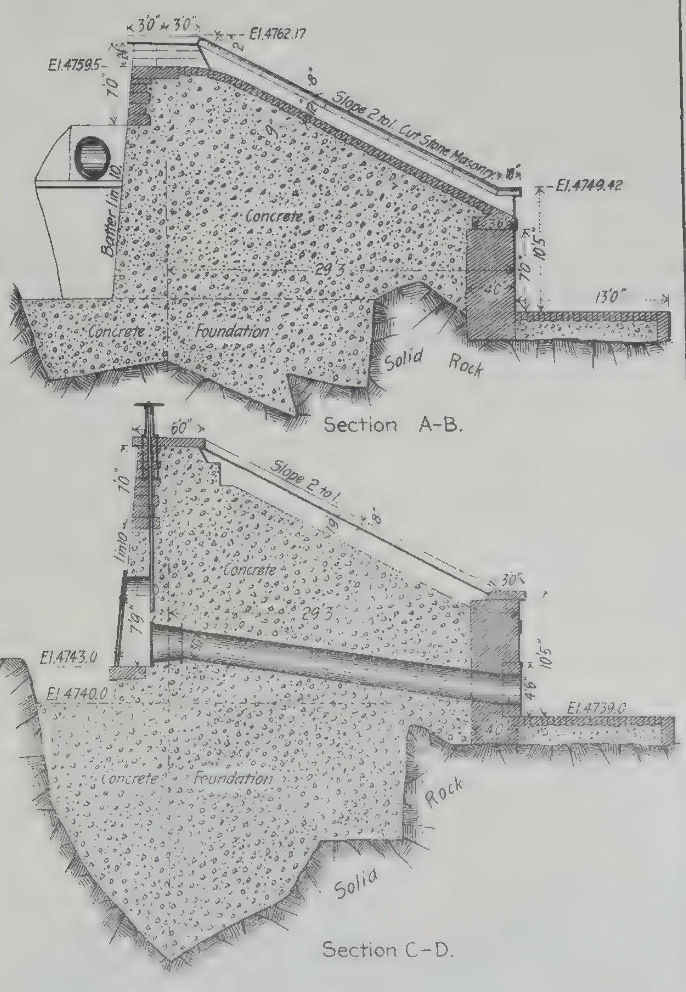
A. F. Doremus,

M. Am. Soc. C. E.,

City Engineer.


A
10" Sewer Pipe
El. 4762.17 (Top of Dam.)
El. 4759.50 (Top of Spillway.)
El. 4754.93 (Hydraulic Grade.)
Outlet





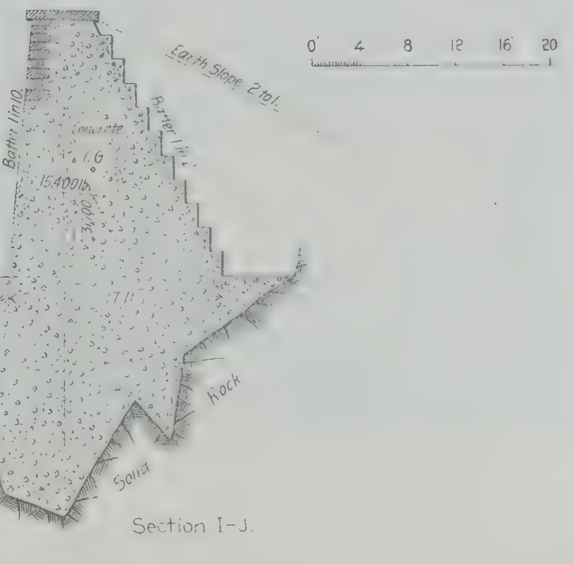
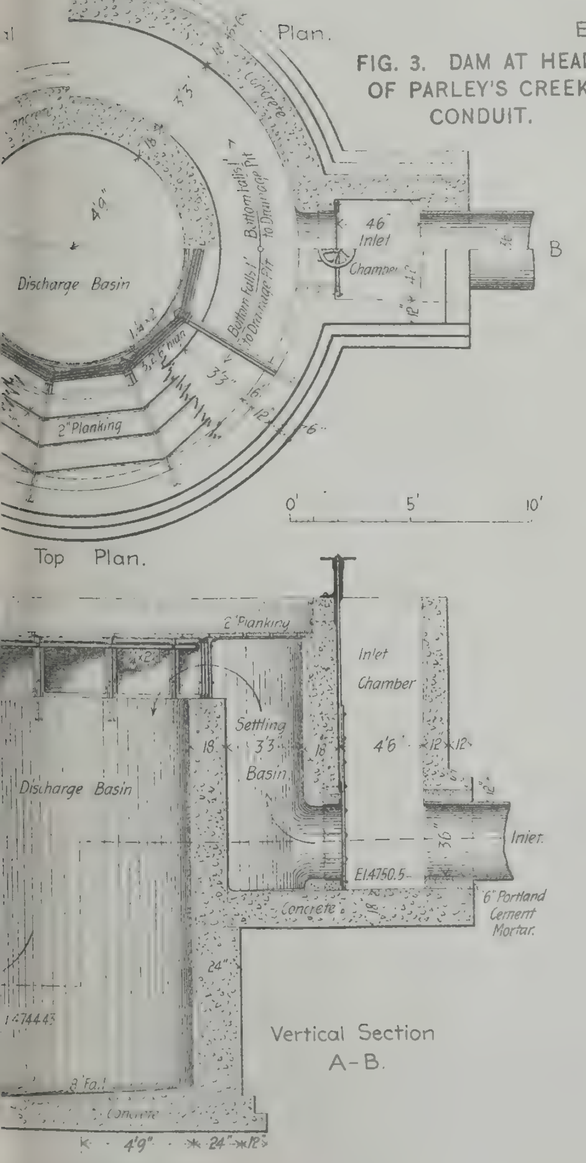
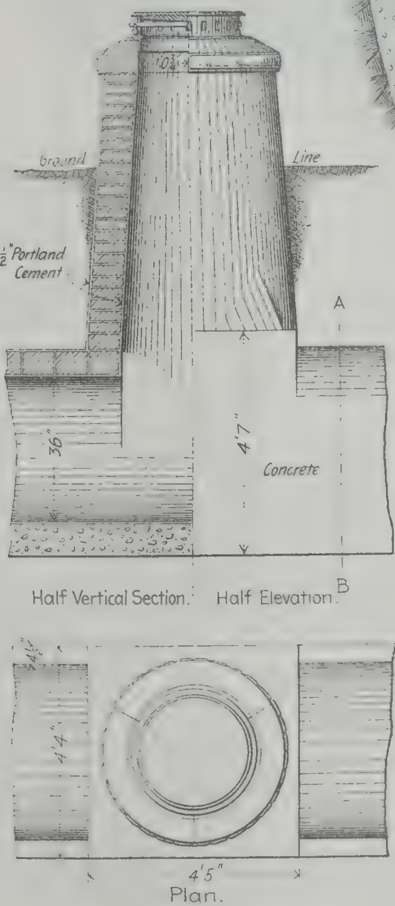


FIG. 3. DAM AT HEAD OF PARLEY'S CREEK CONDUIT.



4. SCREENING TANK.



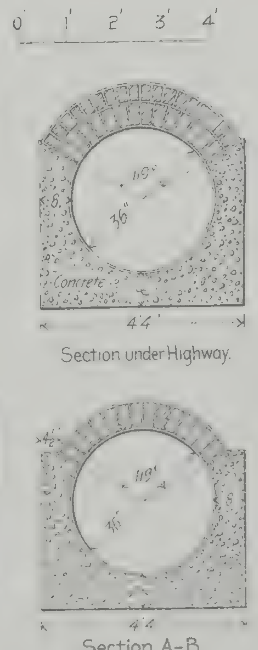


FIG. 5. SECTIONS OF CONDUITS AND MANHOLE.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

carry the waters of Mill Creek, the next creek south of Parley's, The conduit can be extended on to this creek with an additional length of about two miles. This will probably be done when necessary. Parley's Creek is tapped at the mouth of the canyon, at Sentinel Rock, where the opposite walls approach and make a natural damsite. The head-works are shown by the two views, Figs. 1 and 2. The system consists of a settling basin, a stone dam, screen house and over five miles of 36-in. conduit. The conduit has a fall (of hydraulic grade line) of 0.16 ft. per 100, with a daily carrying capacity of 18,000,000 gallons.

The dam shown in detail by Fig. 3, on the inset sheet, is of concrete, with rubble masonry facing and cut stone coping, Portland cement being used. It has a water-way over its top and a 30-in. sluice underneath for passing surplus water. The crest of the spillway is 19½ ft. above the top of the foundation; its clear width is 12 ft., and the fall to the toe of the dam on the lower side is 20½ ft. Of this fall, 12½ ft. is down a 2 to 1 slope, and the balance of 8 ft. is a vertical drop, the water falling on an apron 13 ft. wide. The dam is 70 ft. long on top and the greatest width at the bottom is 34 ft., this being under the spillway.

The 30-in. sluice discharges the water near the bottom, and is controlled by a gate at the upper end. The upper side of the dam next to the spillway has a batter of 1 in 10, and the lower side of 1 in 2. The bottom width here is 18 ft., and the height, 22 ft.

The water is conveyed in a 36-in. cast-iron pipe, laid in a tunnel about 100 ft. long, and on the south side of the creek, from the upper side of the dam to the screening tank, both being at the foot of Sentinel Rock.

The tank, Fig. 4, consists of an annular settling basin, 3¼ ft. wide and 12½ ft. interior diameter, the water falling over the top of this into the circular discharge basin inside of it, the two basins being separated by an 18-in. wall, of an extra strong concrete, the parts being 1, 2 and 3. On top of this wall are the screens, through which all the water passes. This discharge basin is 9½ ft. by 16 ft. deep, and near its bottom the 36-in. outlet starts. The bottoms of both the settling and discharge basins slope in one direction toward a discharge pit, from which a 10-in. pipe leads for discharging sediment back into the creek. This pipe has a gate between the discharge basin and the pit. and one at the outlet to the latter. The screening tank is enclosed within a neat brick building.

From the discharge basin a 36-in. cast-iron pipe leads. The creek is crossed at once from south to north by a double stone culvert with 12-ft. arches, shown at the right of the view, Fig. 1. The pipe rests on concrete, which is carried halfway up its sides, the stone coping being all that is placed over its top. This pipe extends from the tank to the first manhole, a distance of 450 ft., and has a uniform ascending grade of 0.5% until the creek is crossed and then a grade of 3% to the manhole. This up grade is partly for the purpose of allowing sediment carried through the screens to deposit in the pipe, and when the inlet to the tank is closed and the discharge gate opened, the backward flow of the water in this pipe carries much sediment with it to be flushed out.

At the manhole begins the main conduit. This is a combination structure of concrete and brickwork, as shown by Fig. 5. The lower two-thirds is of concrete and the top one-third is of brickwork.

A special arch brick is used, having a depth of 6 ins., and but one ring is used. Where the conduit passes under a highway, an extra ring of common-sized brick is used over the 6-in. ring, to give added strength. The contract called for native cement for all the conduit, but after about ¾ mile had been built an agreement was made by which Portland cement was used for the concrete at the same price, the proportions of 1, 2 and 3 of the former being changed to 1, 4 and 5 of the latter. The bottom of the conduit, however, was still made with the native cement. Native cement, mostly Milwaukee or Utica, was used for all brickwork. The inside of the conduit is plastered with ½-in. of mortar of equal parts of sand and Portland cement. The maximum curvature for the conduit in the difficult work in the valley is 15°, while 3° and 4° curves are mostly used on the open ground.

Seven tunnels are used through the valley, ranging from 70 to 770 ft. in length, and with an aggregate length of 2,000 ft. These are used to go through the points of ridges. The material encountered was all earth. The summits above the tunnels range from 20 to 40 ft. The excavation was made 6 ft. high and wide enough to work in. Light cast-iron pipe is used through the two longer tunnels, amounting to 1,300 ft. in length, and the earth was backfilled around the pipe. It was deemed unsafe to use the concrete conduit here on account of a glacial movement of the earth, caused by its composition and by its being kept wet by seepage water.

Nearly one-half mile below the head is Dudler's gulch, which is crossed by a five-span arch culvert, shown by Fig. 6. Four of these are "blind" arches, and are of concrete with 12 ft. span, the arches being blinded with stone walls, while the center arch is of stone, of 14 ft. span and is open to pass the drainage.

The concrete arches are each 16 ins., and the stone arch 24 ins. thick on top, below the bottom of the conduit. The width of the blind arches is 18 ft.; the stone walls are each 2 ft. thick, leaving a 4-ft. open space between, which was filled with earth and stone spalls, well packed. The piers between arches are solid. The standard construction of conduit is used, but 18-in. stone walls are used on the sides in addition, while over the brick arch is a regular pavement of sand, concrete and cement.

The arch of the center opening, the belt courses and coping are of cut stone, the rest of the masonry of coursed ashlar, quarry-faced. Portland cement is used in all these extra structures, except for the brickwork. The conduit here is on a 15° curve. A 9-in. stone pavement is used under the center opening for the drainage.

At about three miles from the head, Emigration Creek is crossed, by an inverted siphon, shown in detail by Fig. 7. This is a 36-in. redwood stave pipe, with steel bands. It is 546 ft. long, 313 ft. of this length being under a head of 12 to 15 ft., while the crossing of the creek bed proper is under a head of 33 ft. for a distance of 87 ft. At each end of this latter crossing is a deep brick well, giving a vertical drop in the siphon of over 19 ft. Adjoining the well at the north end is a valve pit, with an outlet pipe, by means of which the well and thereby the siphon is drained off when desired. This siphon pipe is buried about 3 ft. under the bed of the creek. Red Butte Creek is crossed with a 6-ft. open arch culvert, with a grade 6 ft. above the creek, and with two 8-ft. blind arches.

At the intersection with 5th, 7th, 9th and 10th South Sts. the conduit is connected by lengths of 12-in. pipe with valve boxes, to be used for direct connection with the city pipe system when needed. The average cut made in open ground for this conduit was 8 ft., and 3 ft. is the least depth of covering over the top.

Brick manholes are placed every 800 ft. along the conduit. These have ventilators under the edges of the covers and a screen with ¼-in. meshes is placed below the cover of each manhole to prevent any large object that may get through the ventilators from falling into the conduit. The covers are provided with locks.

The ordinary sections of conduit cost $2.70 per lin. ft., while the contract price for wooden pipe, wrought-iron pipe and light cast-iron pipe were $3.45, $6.95 and $11.68, respectively, showing conclusively the economy of using the conduit in this case, to say nothing of its superior durability.

The Parley Creek conduit system was designed and built under the supervision of Mr. A. F. Doremus, M. Am. Soc. C. E., who was the city engineer from 1890 to 1894. Dubois & Williams, of Denver, Colo., were the contractors for all the work, except excavation and backfilling. In design and in the excellent and substantial character of construction, this system will compare favorably with any to be found in this country.

The entire cost of this system was $181,000, of which $34,000 went to contractors for excavation, etc., $117,000 for the masonry and constructed parts of the system, including pipes; $10,000 for engineering and $4,000 for inspection; right of way and additional work by other parties on the conduit taking up the balance.

The water from the conduit, and from the Emigration Creek pipe line, can be discharged into the relief tank, Fig. 8, on the east bench on the line of 1st South St. The pressure from the latter line must be relieved here before being turned into the low line system, as there is a fall of nearly 300 ft. from its head. The tank is 20 ft. in diameter and 14⅔ ft. deep. From the west side are projected two pipe lines, one of 24-in., leading to the 20th Ward pipe system, the other of 30-in., leading to 13th East St. reservoir, from there to be conducted into the low line supply system of the city. At present, however, water from the Emigration Creek line is not discharged into the relief tank at all, but is continued on past it and west on 1st South St. to supply the district between 8th and 13th East Sts. without relieving the pressure. An overflow pipe leads from the tank at a higher elevation than the

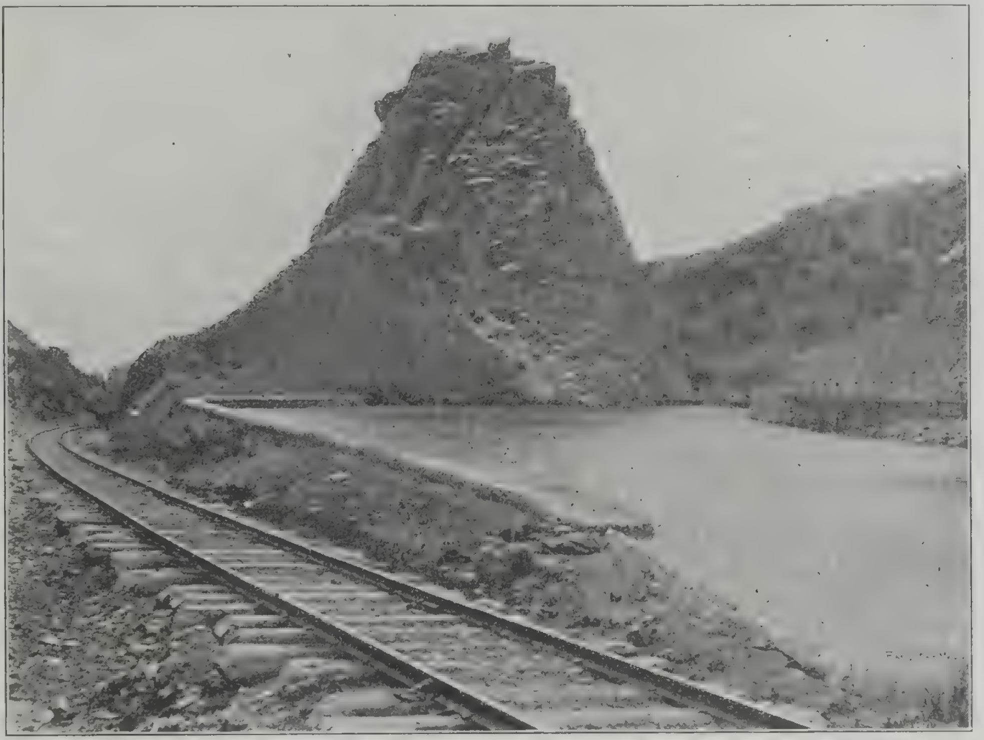


FIG. 2.—VIEW OF PARLEY'S CREEK HEAD-WORKS FROM UP-STREAM SIDE.

other pipe, for discharging surplus water into the city irrigation system, near by. The tank and valve chambers are enclosed within a neat and substantial brick house.

The 13th East St. reservoir is only partly completed. It has yet to be lined before being of any service, and it will then hold about 6,000,000 gallons. It is located about 1,000 ft. west of the relief tank and is about 130 ft. lower. The water from the 30-in. pipe from the tank discharges through an 18-in. pipe and a flume into a wooden tank set within the reservoir and with its overflow at the same elevation as the overflow of the brick tank for the low line supply in City Creek canyon. They thus do not interfere with one another by discharging into the same pipe system. The relief tank is at the same elevation as the tank house in City Creek canyon, where water is taken out for the 20th Ward, so water from these two tanks can be turned into the same system without interference.

A 20-in. main leads from the reservoir west on 1st South St., being soon reduced to 18 ins., and then to 16 ins. at 8th East St., and extending to West Temple St., or over two miles.

The water of Parley's Creek is often very muddy during fall and winter, after rain or cloud bursts, and always so in the spring. On this account it is regularly used only in the summer season, when it is more clear and when the other creeks cannot supply the demand.

Distribution System.

The greatest fault with the distribution system is the insufficient size of the mains and sub-mains. This was caused partly through ignorance of the city councils and partly because the system was built up piecemeal as the increased demand made necessary, not being planned broadly enough at the start.

On numerous streets the mains laid were only 3 and 4 ins., and from one of these as a trunk the laterals or branches would be laid. These were laid with dead ends, the system resembling a tree with projecting branches, only with the branches often larger than the parent trunk. There were 4 and 6-in. hydrants, and in one place a 6-in. hydrant was connected with a 2-in. main, the hydrant, of course, being of no use. These faults have been largely remedied during the last few years by putting in larger mains and by connecting the pipe so as to do away with dead ends as much as possible. In the 20th Ward system the mains are still mostly 3-in., and about 33,500 ft. here need to be replaced by 6-in pipe. The business part of town comes under the low line system, which supplies about two-thirds of all the water used. Following is a summary in round numbers of different sizes of pipe in the ground at this time:

Size, ins.	No. ft.	Size, ins.	No. ft.
30	110	10	3,500
24	2,620	8	33,000
20	2,400	6	341,000
18	3,700	4	138,000
16	9,100	3	61,000
14	11,900		
12	38,000	Total	644,330

or about 122 miles. Besides this there have been over 7,000 ft. of 1½ and 2-in. pipe discontinued or abandoned. There have been placed about 1,425 valves and nearly 900 hydrants. The hydrants used are the Howe, Galvin and Ludlow. The Howe is an old type of hydrant that was made in Salt Lake. Nearly all of this make have been remodeled so as to make them effective. Those of 4-in. size are single and of 6-in. are triple nozzle. The Ludlow hydrants are 6 and 4-in., and are nearly all triple nozzles. The gates or valves used are the Boston, Ludlow and Galvin. The service pipes are all of lead, and are mostly ½ in., with ⅝-in. and ¾-in. for the larger houses.

The static pressure on Main St., in the business center of town, is 100 to 110 lbs. per sq. in. With a heavy draft during the summer the pressure often reduces to 60 to 65 lbs., while 90 to 100 is the average. By turning water from the 20th Ward system into the low-line here, the pressure is increased by 50 lbs. An ample supply with a strong fire pressure is thus secured. The Emigration or City Creek high-line system would increase the pressure to 250 lbs., entirely beyond the strength of the down-town pipes to withstand.

About 5,000 acres is reached by the supply system, thus taking in not less than 80% of the inhabitants. During the summer, when there is a large amount of water used for lawn and street sprinkling, the consumption reaches over 12,000,000 gallons daily, or 250 gallons per capita. During the winter the consumption does not reach over 8,000,000 gallons, daily, and the water of Parley's Creek is not then used. A very large amount of the water of the three creeks named was formerly used for irrigation, both for public irrigation of shade trees in the city and by private parties. In order to secure a supply to meet the demand for this irrigation water the city has for several years brought water through a large canal from the Jordan River, near Utah Lake, which is the source of this river and is about 30 miles south of the city. This water is used to supply irrigators in exchange for their water rights on Parley's Creek, and for the city's own uses. The lake will in time probably be the key to the solution of the problem of an increased water supply for domestic purposes, as water from it will have to be exchanged with pure water from the other mountain streams, these already being appropriated by farmers and millers. The minimum flow from the three creeks used occurred in 1889, when it fell to 8,000,000 gallons. The flow has been much increased by development of springs and other underground sources since then.

Considering all the possibilities in the way of supply, Salt Lake City should never have any serious trouble in obtaining sufficient water, even with a population of 500,000 or more. The value of the present water supply system, as an asset to Salt Lake City, has been variously estimated at $1,000,000 to $3,000,000; $2,000,000 is probably a safe figure to put it at, and it is doubtful if it could be bought for this, even if the constitution of the state did not prohibit it, as the people are violently opposed to any private corporation ever obtaining control of it. The actual cost of the plant has been but a fraction of this, though large sums have been spent on it at one time and another; but the water-rights and privileges and the ownership of much of the land in the valleys of the creeks are of the highest value.

U. S. IMPORTS AND EXPORTS FOR 1893-1896.

U. S. imports and exports for 1893-96, inclusive, are reported upon, as follows, by the U. S. Department of Agriculture: During the ten years ending June 30, 1896, the United States exported domestic merchandise to the value of $8,207,292,566, and it re-exported articles of foreign origin to the amount of $149,785,038, making our total exports in that decade, $8,357,077,604. Our imports during the same period were valued at $7,656,127,784; and the total commerce of the United States, for the ten years 1887-1896, was thus $16,013,205,388, or a yearly average of more than $1,600,000,000. The total exports for 1896 show an increase of $75,068,773 over 1895, and the imports an increase of $47,754,709, or an increase in total commerce of $122,823,482 over 1895, or about 8%. The figures for the present fiscal year also show an upward tendency, though this is not quite so marked as was the gain in the last fiscal year.

The exports of domestic merchandise, grouped by sources of production, are given for the years 1892-1896, inclusive, together with percentages of each group, as follows:

Year.	Agriculture.	Manufactures.	Mining.	Forest.	Fisheries.	Miscellaneous.	Total for year.
1891	$642,751,344	$168,927,315	$22,054,970	$28,715,713	$6,208,577	$3,612,364	$872,270,283
Per cent.	73.69	19.37	2.53	3.29	0.71	0.41	
1892	799,328,232	158,510,937	20,692,885	27,957,423	5,403,587	3,838,947	1,015,732,011
Per cent.	78.69	15.61	2.04	2.75	0.53	0.38	
1893	615,382,986	158,023,118	20,020,026	28,127,113	5,541,378	3,936,164	831,030,785
Per cent.	74.05	19.02	2.41	3.38	0.67	0.47	
1894	628,363,038	183,728,808	20,449,508	28,000,629	4,261,020	4,400,944	869,204,937
Per cent.	72.28	21.14	2.35	3.22	0.49	0.52	
1895	553,210,026	183,595,743	18,509,814	28,576,235	5,328,807	4,171,974	793,392,599
Per cent.	69.73	23.14	2.33	3.61	0.67	0.52	
1896	569,841,714	228,480,893	20,412,153	33,718,204	6,585,814	4,152,709	863,200,487
Per cent.	66.02	26.47	2.37	3.91	0.76	0.47	

These figures show that in the fiscal year which ended last June, American farmers sold to foreign nations nearly $570,000,000 worth of their products, or about $17,000,000 more than in the preceding year. The sale of our manufactured products abroad grew faster still and their percentage of the total value of exports is now greater than for any year in the list; the gain of 1896 over 1895 being nearly $44,000,000.

The United Kingdom of Great Britain leads all other countries in exchanges with the United States. During the year ending June 30, 1896, we sold to the English speaking people of Europe merchandise valued at $406,000,000, or 46% of our total exports, and we bought from these people goods to the value of $170,000,000, or 22% of our total imports. Taking all parts of the British Empire in all continents, we find that they bought from us 58% of our last year's imports, aggregating in value $512,000,000. Next to England as purchasers come Germany, Canada, Italy, British Australia, British India, Japan, Russia and China, in about the order named. Our exports to Cuba have declined from $24,000,000 in 1893 to $7,500,000 in 1896, or only 31% of the value of the imports of 1893.

The value of imports for these six years, under the heads of dutiable and free, is thus given:

Year.	Dutiable.	Free.	Total Imports.	Total customs collected.	Per cent of free.
1891	$478,674,844	$366,241,352	$844,916,196	$219,522,205	43.3
1892	369,402,804	457,999,658	827,402.462	177,452,964	55.4
1893	421,856,711	444,544,211	866,400,922	203,355,017	51.3
1894	275,199,086	379,795,536	654,994,622	131,818.531	58.0
1895	368,736,170	363,233,795	731,969.965	152,158,617	49.6
1896	409,967,204	369,757,470	779,724,674	160,534,351	47.4

These figures show, for the year ending June 30, 1896, a gain of about $48,000,000 over 1895, and $125,000,000 over 1894, in the value of total imports. The articles that most contributed to the gain in imports last year were sugar, raw and manufactured wool, unmanufactured silk, wood and its manufactures, hides, tobacco, earthen, stone and chinaware, etc. We import most from England. As before stated we bought from her in 1896, goods to the value of $170,000,000; to this must be added the value of imports from her colonies, the aggregate being $259,000,000, or 33% of our total imports. After the United Kingdom comes Germany, Brazil, France, Canada, Cuba, Japan, China and British India, in the order named. Our imports from Cuba shrank from $79,000,000 in 1893 to $40,000,000 in 1896, and those from Mexico dropped in the same time from $34,000,000 to $17,000,000.

MOMENTUM FRICTION BRAKE FOR ELECTRIC CARS.

The design of an efficient and simple momentum brake for electric cars, such as has been used on cable cars, possesses several features of difficulty, the chief of which, perhaps, has been the limited axle space left available by the motor casings. Only about 5 or 6 ins. of the car axle is ordinarily left clear by the casing, and this affords a very contracted space in which to apply suitable mechanism, and practically excludes the screw on the axle, such as, for instance, the Johnson brake for cable cars has. In a recent invention by Mr. W. G. Price, of the Chicago City Ry. Co., of Chicago, Ill., however, the difficulty is overcome, if a successful operation of six months in actual service is a good criterion from which to draw conclusions. Through the courtesy of the inventor we are able to present illustrations of this brake, which is called a momentum friction brake.

Fig. 1 is a plan and section of a four-wheel electric car truck, showing the location of the friction mechanism and brake rigging. A friction disk A, with a suitable hub runs loose on a sleeve keyed to the car axle close to the wheel, which is of special construction, having a disk on the inside, against which the friction disk bears, as is clearly shown by Fig. 2. In the 2-in. annular recess in the friction disk hub are inserted the bifurcated ends of the levers, Fig. 3. These levers are located on the car as shown at B, Fig. 1. The operating rods C, Fig. 1, from the levers on the car platforms attach to the arm D, Fig. 1, shown in detail by Fig. 3—and this arm by its swing operates the screw, Fig. 3, so as to spread apart the lever ends resting in the annular recess, in a manner obvious from the drawing, Fig. 3. This spreading of the levers forces the friction disk, A, against the wheel, so that it turns with the wheel and winds up the chain E, Fig. 1, operating the wheel brakes, through the rigging, shown in Fig. 1.

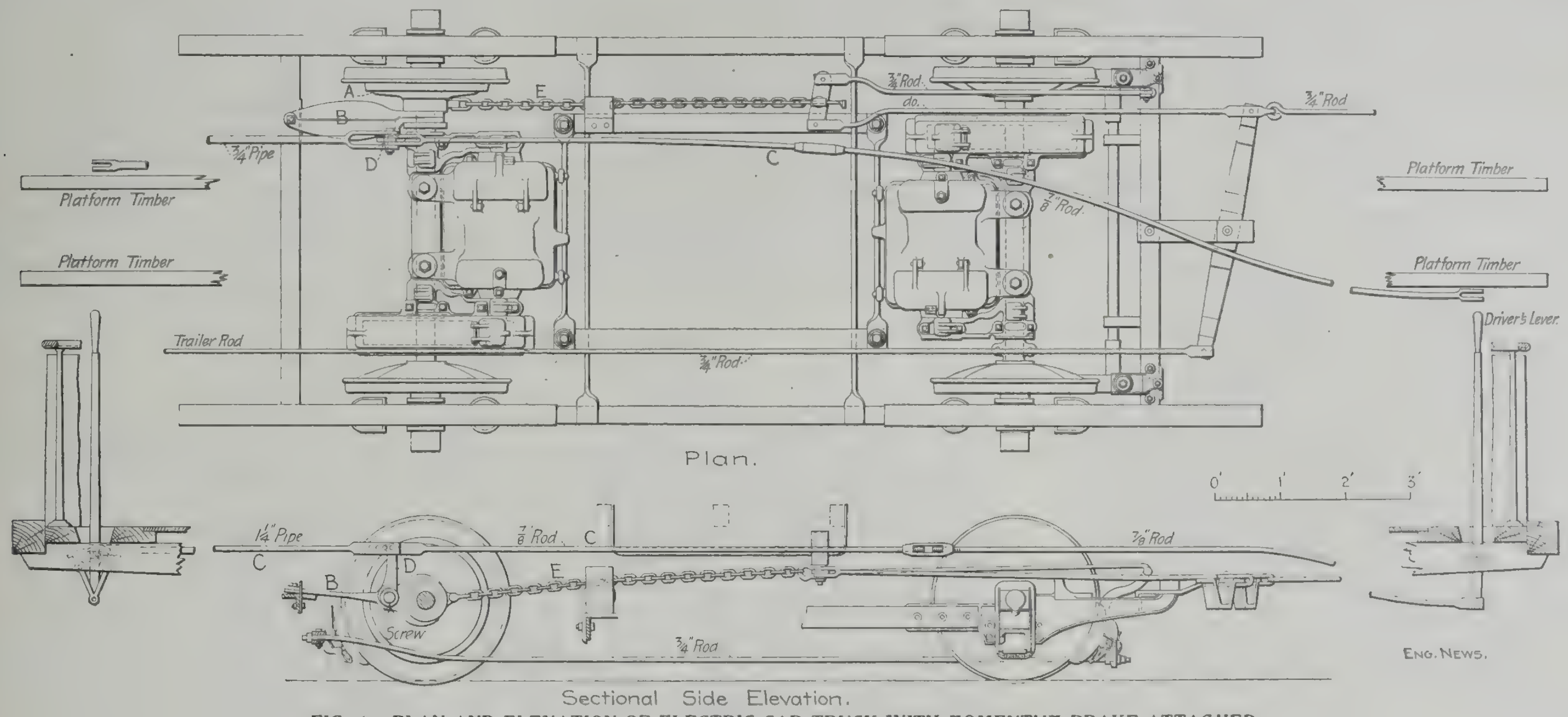


FIG. 1.—PLAN AND ELEVATION OF ELECTRIC CAR TRUCK WITH MOMENTUM BRAKE ATTACHED.
Used by Chicago City Ry. Co. Designed by Wm. G. Price.

When applying the brake the motorman pulls the lever a few inches toward him, and to release the brake he pushes it back again close to the dash of the car. When the brake shoes are properly adjusted a movement of the car of 18 ins. applies the brakes. It is adjusted by means of a ratchet on the head of the screw, and this adjustment can be done by the motorman in five minutes' time. The brake is oiled by means of an attached oil cup, which requires filling only once a week. Mr. Price states that the brake can be applied as quickly as an air brake, and works fully as smoothly by using the bend in the lever rods, as shown. Its release is instantaneous.

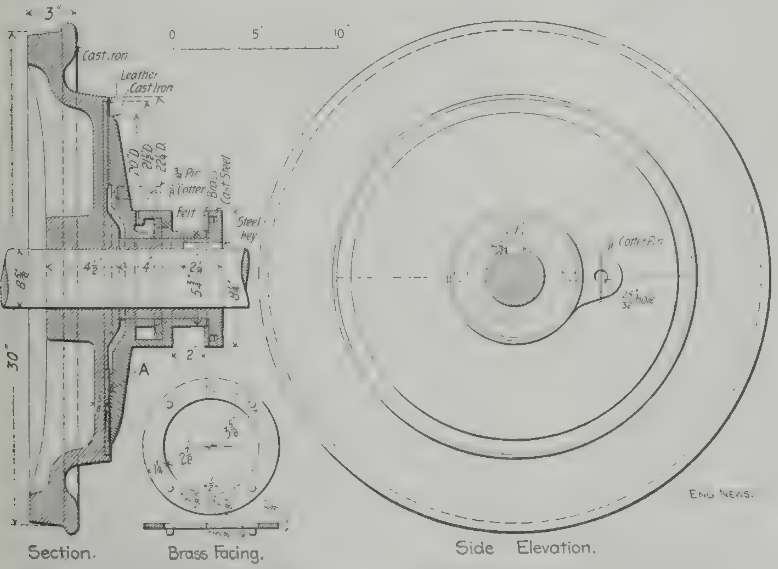


FIG. 2.—SECTIONS THROUGH CAR AXLE SHOWING FRICTION CLUTCH OF MOMENTUM BRAKE.

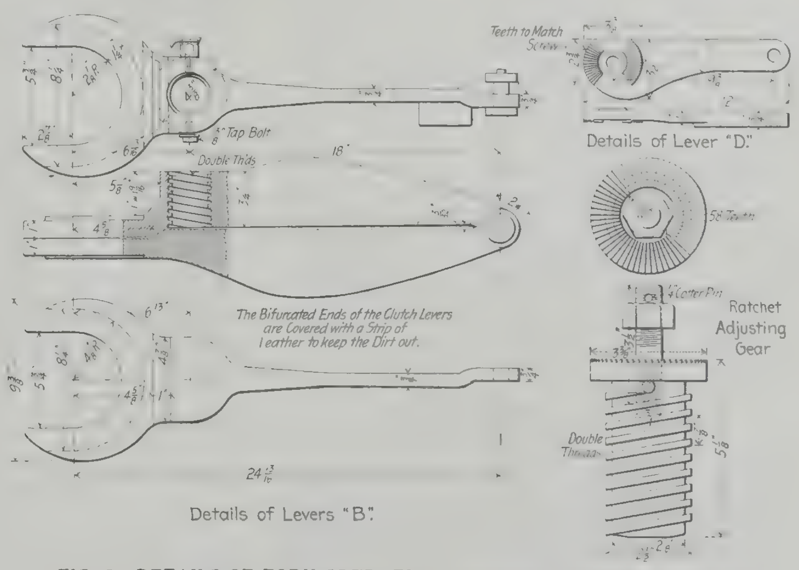


FIG. 3.—DETAILS OF FORK OPERATING CLUTCH OF MOMENTUM CAR BRAKE.

This brake has been in operation on several cars running on the Chicago City Ry. Co.'s lines for six months, and has proved so successful that it will be placed on many other cars during the winter. One of its principal advantages is the reduced physical labor required of the motorman in braking, and the reduced mental strain since he has much less fear of accidents. It is also expected to reduce the number of "slid-flat" wheels.

* * *

THE BATES THERMIC ENGINE CO.

Public announcement was made in the Philadelphia daily papers about Oct. 1, of the great success of a wonderful new engine, which, it was claimed, would save 80% of the fuel consumed by ordinary steam engines, and invitations were given to the public to see the engine in operation at No. 1040 Ridge Ave. The Bates Thermic Engine Co., 652 Philadelphia Bourse, at about the same time issued a pamphlet advertising the engine, and a circular "Prospectus," headed "A Revolution in Motive Power," "Consumption of Coal 80% less than with Steam Engines," etc. According to this prospectus the company is chartered under the laws of West Virginia; capital stock, $5,000,000; shares, 100,000 at $50 each, of which 15,000 shares are now offered for sale at $10 per share. The company owns the exclusive rights to manufacture, use and sell the Thermic engines in the State of Pennsylvania, in the State of Delaware, and in the State of New Jersey, south and including Trenton. The officers of the company are Russell Thayer, President; A. E. Kennelly, vice-president; Wm. J. Elliott, secretary and treasurer. The directors are James McManes, Edwin J. Houston, Allen B. Rorke, Henry Clay, David S. B. Chew and Geo. H. Holgate. Some of these names are well known to engineers. Mr. Thayer is a Member of the American Society of Civil Engineers and is Chief Engineer and Superintendent of Fairmount Park. Mr. A. E. Kennelly is an Associate Member of the American Institute of Electrical Engineers and one of the managers of that society. Prof. E. J. Houston is a Member and Past-President of the American Institute of Electrical Engineers, and is a scientist and an authority on electrical subjects whose fame is world-wide.

Certainly the fact that engineers of such eminence are the managing officers of a new engineering enterprise ought to be a good guarantee of its soundness from an engineering standpoint, and should therefore strongly recommend it to investors. We often hear of inventions which are to generate power with a fraction of the fuel used by the steam engine; but it is seldom that any of these new inventions are vouched for by such an array of names as that above noted.

With this in mind, we deemed it well worth while to undertake an investigation of the new motor, for which such large claims were made, and a member of the staff of this journal visited Philadelphia, examined the engine in operation and secured all the information available concerning the new motor and the company formed to exploit it.

According to the pamphlet issued by the company, the history of the motor is given as follows: M. Gardie, of Nantes, France, patented a gas engine in 1889, and assigned his patent to the "Societie Anonyme des Moteurs Thermiques Gardie." After M. Gardie's death, experiments were continued by the society for five years, under the direction of Maurice Lorois, who succeeded in perfecting the system, and patented the present engine in 1894. The Bates Thermic Engine Co., of Philadelphia, was organized, and purchased the exclusive rights under these patents for the states of Pennsylvania, Delaware and part of New Jersey, as above noted. It then made patterns from the original drawings furnished by the French company. The engine was then built by Mr. A. Falkenau, whose machine shop is at 11th St. and Ridge Ave., Philadelphia, in the basement of which the engine is now running.

We have secured from the patent office copies of the U. S. patents of M. Lorois, of which one is for a process of manufacturing gas, No. 529,453, and the other for a gas motor, No. 529,452, both dated Nov. 20, 1894. The latter patent gives a very complete description of the engine and its operation, from which we condense the following: Fig. 1 is a diagrammatic view of the engine with its appurtenances, and Fig. 2 is a front view, partly in section, of the engine.

An air pump or compressor P compresses atmospheric air to a pressure of 43 lbs. per sq. in. and upwards, into an air reservoir Z, where the water is separated from the compressed air. The compressed air passes from this reservoir through a pipe and branch pipes and into two heat interchangers or regenerators R R′, in which it is heated by the spent gases of combustion exhausted from the power cylinders C C of the engine. The heated compressed air passes from the interchanger R′ by a pipe x to the gas producer G, constructed as a cupola furnace. At the same time superheated steam is introduced to this producer as hereinafter explained, and commingling with the air flows through a mass of incandescent fuel in the producer, whereby is generated the combustible gas. This gas, being produced under the same pressure as that initially given by the air pump, passes out from the producer by a pipe and enters a dust separator N, which disengages any dust or ashes from the gas and then flows through the pipe Q′ to the inlet ports of the power cylinders C C. The compressed air which is heated in the interchanger R passes therefrom by a pipe which has branches leading to the air inlet ports of the power cylinders.

The operation of the engine is as follows: On the opening of the inlet valves the heated compressed air and hot compressed gas which until now have been separate, and which are both at the initial pressure given them by the pump P, flow in suitably regulated proportions into the cylinder, entering it at the commencement of the stroke of the piston and being ignited by contact with the walls of the cylinder and piston, which thus serve as the igniter. The gas and air being mixed in the proportion necessary to complete combustion, burn in the cylinder. The gases continue to enter while the piston moves through a portion of its stroke and up to the instant when the inlet valves are closed. Up to this time the pressure continues the same as the initial pressure given by the compressor, and which is maintained in the gas producer and all the apparatus. From this moment the expansion of the gases commences, and as the piston recedes the pressure falls, while in acting against the piston the gases develop mechanical energy, and in consequence undergo a considerable reduction in temperature. At the end of the working stroke of the piston the exhaust valve is opened, and during the return stroke the products of combustion are expelled from the cylinder and ultimately escape into the atmosphere. The pistons of the two cylinders work alternately, each developing power on its working stroke, and being driven by the other on its return stroke. The hot spent gases of combustion expelled from the respective cylinders are conducted through pipes to the two heat interchangers R and R′, through which the flow, giving up their heat to the compressed air which is flowing oppositely through these interchangers, and the spent gases being finally discharged through a pipe into the atmosphere, producing neither noise or smoke, and having given up nearly all of their heat. At the same time water is forced by a pump p, through a pipe t″, which divides into two branches, conducting the water into jackets h′ surrounding the lower portions of the power cylinders, from which jackets the water passes by pipes t‴ into jackets h surrounding the upper portions of the cylinders, these upper jackets constituting steam generators wherein by the heat disengaged in the cylinders the water first heated in the lower jackets is converted into steam, and the steam flows through a pipe s^2 to the gas producer, wherein the pipe is formed into a coil or superheater s exposed to the intense heat of the newly generated gas, whereby the steam is highly superheated, after which it is conducted through a passage s′ down through the heated brick work or lining of the producer, and commingled at the lower part thereof with the heated compressed air introduced through the pipe x.

The gas producer G is constructed to resist pressure. It has a strong outer casing or jacket of sheet steel, within which is built a fire-brick lining. It is provided with a feeding hopper on top having a tight closing lid and a delivery valve. By closing the valve and opening the lid, the hopper can be filled with fuel, whereupon by tightly closing the lid and opening the valve this fuel falls into the producer.

The operation of the gas producer under pressure in connection with the pre-heating of the air, and the superheating of the steam, enables a much higher temperature to be maintained in the gas producer than has ever been possible heretofore. The result is to furnish a gas having a high calorific power, and completely free from tar and ammonia.

A partial combustion occurs in the gas producer which is sufficient to maintain it at the high interior temperature required. The gas being free from all impurities which would necessitate the use of condensers and purifiers, permits complete suppression of such purifying apparatus with their attendant necessity of cooling the gas. The rate of production of the gas can be varied from time to time in accordance with the varying requirements of the engine, so as to allow of the complete suppression of a gasometer between the gas producer and the engine. As the fuel in the gas producer is consumed it settles to the bottom and the resulting ashes or slags may be removed from time to time through an orifice by opening a tightly closed lid or door.

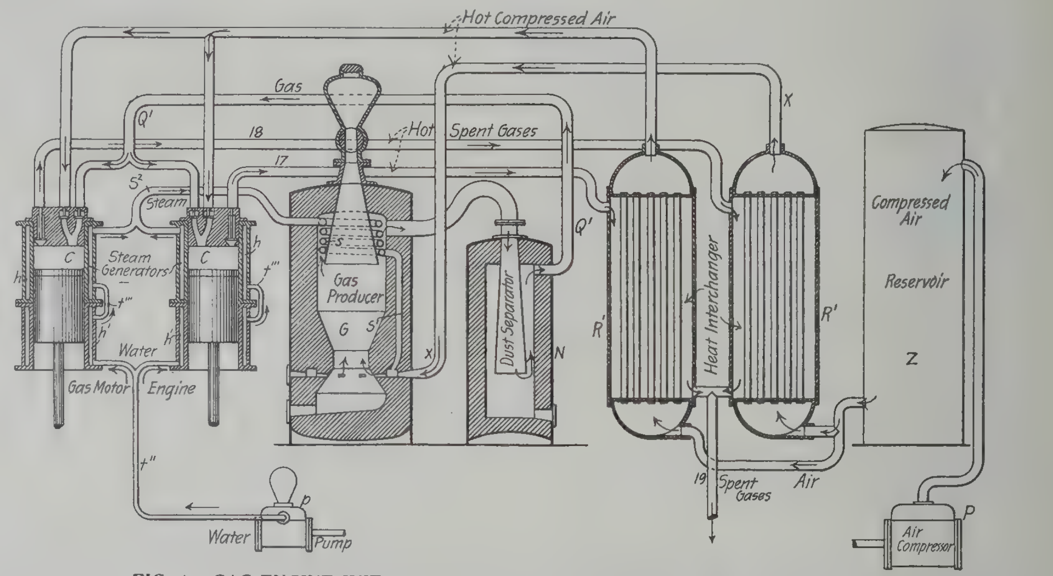


FIG. 1.—GAS ENGINE WITH GAS PRODUCER WORKING UNDER PRESSURE.
Patented by M. Lorois, Nov. 20, 1894.

The dust separator N has a strong outer shell which is protected by a refractory non-conducting lining as shown.

The heat interchangers RR′ are each constructed with an upright cylinder of sheet metal, having at top and bottom two cast domes, between which are extended numerous tubes fixed at their ends in two metallic tube sheets. The whole construction is surrounded by an independent cast jacket.

The two motor cylinders C are alike, each being single-acting. Each cylinder is divided into two parts, the upper or hotter section being made larger than the piston or plunger, while the lower or cooler section is made to fit with the piston. The upper section is provided with a non-conducting substance, and with a plate i of a suitable heat-retaining metal adapted to maintain a sufficiently high temperature for automatically igniting the gases. The piston is of considerable height, its lower part which never leaves the cooled lower section of the cylinder being provided with packing rings K. For lubricating the cylinder, oil is contained in a collar l, into which the lower flange of the piston dips. The lubrication of the piston is made possible since the temperature of the lower portion of the cylinder does not reach 60° C. The lower section of the cylinder is cooled by the circulation of cold water in the jacket h′.

The top of the piston P′ is also provided with a plate i′ of a suitable heat retaining metal insulated by asbestos. Nickel is a suitable metal for the plates i and i′. As the plates are always red hot, the combustible gas and heated air introduced through the gas and air inlet ports, mixing in the cylinder in contact with these plates, is ignited and burns without explosion while being introduced, remaining at the initial pressure of 3 kilos. per sq. cm. or upward (this pressure once determined upon remaining constant).

The diagrammatic view of Fig. 1 is a very fair representation of the system used in the engine as installed in Philadelphia. The arrangement of the parts, however, is somewhat different, thus the two heat interchangers are located so as to adjoin the two power cylinders, and the ground plan of the whole is arranged so that all the apparatus is contained inside of a floor area about 16 ft. square. The cylinders of the Philadelphia engine are each 15¾ ins. diameter and 15¾ ins. stroke.

The engine being constructed as above described, the next question likely to be asked is, what results have been obtained from it? To answer this we have recourse to the pamphlet issued by the company. It contains a report by Mr. Thomas Pray, Jr., who adds to his name the initials C. C. and M. E. These letters, we understand, do not mean that Mr. Pray is a graduate of any engineering school or a member of any society of engineers, as some readers may imagine, but they are simply an abbreviation of the words "Consulting, Constructing and Mechanical Engineer," which appear at the top of his report. Mr. Pray's report is a literary as well as an engineering curiosity, as will be seen by the extracts which we quote from it below. It is not remarkable for its brevity, covering some 28 duodecimo pages, and we have even had some difficulty in finding out from the report what economy the engine actually showed under his test. On this subject, in fact, Mr. Pray makes a charming variety of statements, some of which we quote "verbatim et literatim," as follows:

> P. 5. Your engine burns less than 1 lb. of coal per I. HP., and when delivering 100 HP. at its belt will consume less than 1.2 lbs. per HP. per hour from the data of present actual tests made.
>
> P. 9. Economy of fuel consumption for large marine engine.—This engine in large powers can undoubtedly produce its indicated HP. at less than 0.9 lb. of coal, including the power for air compressors, and the required auxiliary steam.
>
> P. 14. When the engine is in full motion doing 81.9 HP., not varying two revolutions per minute and the load running from the one just mentioned to 82.9, we have to put a hod of poor quality of PEA size coal into the gascogen once in 24 minutes.
>
> P. 19. The coal now in use is a "pea size anthracite," costing in the coal bin, $3.75 per ton, and from picking it contains 2 lbs. 5 oz. of slate in a hod of 28 lbs., or 8.3% of refuse before it goes into the gascogen for use, or we buy 91.69% of real coal, and 8.3% of waste, and from this coal the past week we find that with an indicated horsepower of slightly more than 82, that in regular operation it calls for .85367 lbs. of coal for 1 I. HP., one hour, not making any consideration of the loss of over 8% of the coal in worthless slate, but which is paid for and counted as used; if we figure the performance of the engine as we do that of the steam engine, by allowing the refuse of the coal, the result will be changed to in the last amount of .78319 lbs. of coal for 1 HP. for one hour.
>
> The amounts stated above are from the total load of the engine as it was running yesterday, September 4th, but as it is intended to not consider the air compressor as "power" and it is intended to consider the engine as indicating about 140 HP. in order to take off 100 HP. from a belt, I have estimated that "as intended" taking the actual load as above, and the results stated as actual, with a "commercial result" of taking the first actual amount of .85367 lbs. for one hour of 1 HP. and suppose your engine does its work only as efficiently as it has in the four days of this week, and your slate is as good as COAL, and 40 HP. is actually done in compressed air, and the coal is counted to do that 40 HP. but in your figuring you say the 40 HP. is not power, and call your load 100 HP. then your engine would use in one hour 119.52 lbs. of coal, which was actually 8.3104% slate, it would indicate 140 HP., but you don't credit it as power only for 100 HP., as all you get on a belt, and all this would cost you 119.52 lbs. coal.
>
> PERHAPS SOME OF YOUR BOARD KNOW OF STEAM ENGINES DOING THAT? I DON'T; and now as we are in a speculative mood we go one step farther, and take

> out the slate; and call the 40 HP., not commercial, actually indicate 140 HP., but only figure 100 as transmitted to your machinery, and we shall have for THAT train of conditions, the using up of 109.64 lbs. of coal each hour to furnish you "business men" with 100 HP. to run your looms, or spindles, electric cars, or any other purpose you may choose, and as you are figuring now, you get 100 HP., 109.64 lbs. of coal, with NO slate in it, and still get your air pumped for nothing with which to make gas.
>
> Now, in either case you will give me credit for not deducting anything for ashes, or for moisture in the coal, and the basis I have taken is that your engine has only 58% of its rated load, and you are almost at ONE pound of poor coal for 1 HP. one hour.

The above extracts give fair examples of Mr. Pray's lucid literary style, and from them we glean after considerable study that the engine has actually given one indicated horse-power for 1 lb. of coal, that it may be expected to give a brake horse-power for 1.2 lbs., and that it is believed it will show still better economy when built in larger sizes than 100 HP. An engineer reading these figures would naturally inquire, How much better is this result than the results obtained from other gas engines? Mr. Pray, C. C. and M. E., makes no attempt to answer this question in his report, but instead flourishes a comparison between the Lorois gas engine and the steam engine. The pamphlet issued by the Bates Thermic Engine Co. opens with an extract from a lecture delivered by Mr. Pray before the Franklin Institute in 1889, from which we quote as follows:

> In the ordinary form of steam engines the expenditure of 5 to 8 lbs. of coal per horse-power per hour is not considered excessive, and with the latest improved type of quadruple compound condensing stationary engines, the best results show that from 2 to 3 lbs. of coal are necessarily consumed in the production of a horse-power per hour.

With all due respect to Mr. Thos. Pray, Jr., C. C. and M. E., it must be said that a fuel consumption of 5 to 8 lbs. per horse-power hour in a steam engine is considered excessive, and that instead of a quadruple engine "necessarily" consuming 2 to 3 lbs., such engines have given on test a consumption of less than 1.4 lbs. But in any fair study of the possibilities of any new form of gas engine accomplishing a "revolution in motive power," its fuel consumption should be compared not with that of such a poor variety of steam engines that "a saving of 80% of fuel" can be shown by the comparison, but with the results which have already been obtained with other gas engines which have been on the market for years. In order to show what actual saving, if any, the Lorois engine, with its consumption of 1 lb. per 1 HP. hour and 1.2 lbs. per B. HP. hour, makes as compared with other gas engines, we quote the following from the 2d edition (1896) of Mr. Bryan Donkin's recent work on "Gas, Oil and Air Engines:"

> In the Otto-Crossley gas engine, using Dowson gas, the consumption of anthracite is from 1.0 to 1.4 lbs. per I. HP. per hour, or of coke 1.5 lbs. (Donkin, p. 91).
>
> In 1891 a test of an Atkinson gas engine at the Uxbridge Water Works, with Dowson gas, gave 21.95 I. HP., and the consumption of anthracite was 1.06 lbs. per I. HP. per hour (p. 106).
>
> In 1895 a 65-HP. Stockport gas engine, near Tonbridge, with Dowson gas gave a result of 0.93 lb. fuel per I. HP. hour or 1.6 lbs. per B. HP. hour. Another test on an engine driven by Dowson gas at Portadown gave 44.6 I. HP., the consumption of best Welsh anthracite being 0.91 lb. per I. HP. hour (p. 119).
>
> At Schwabing, near Munich, a 40 B. HP. Otto engine, worked with Dowson gas made from German anthracite gave a consumption of 1.54 lbs. per B. HP. hour (p. 120).
>
> One of the latest types of Tangye engine is a single cylinder engine of 24. ins. diam. and 30 ins. stroke, driven by Dowson gas, with a consumption of 0.8 lb. Welsh anthracite per I. HP. hour (p. 122).
>
> A simplex gas engine of 81 B. HP. tested at Aubervilliers, in France, in Nov., 1894, using the Lencauchez gas generator showed a consumption of 1.10 lbs. of Anzin coal per I. HP. hour, and 1.45 lbs. per B. HP. hour. Another simplex engine of 220 B. HP. at Pantin, France, tested in Feb., 1894, showed a consumption of 0.80 lb. Anzin coal per I. HP. hour and 1.02 lbs. per B. HP. hour (p. 483.)
>
> A Schleicher-Schumm Otto gas engine, tested by Prof. Spangler, of the University of Pennsylvania, in 1892, using the Taylor gas producer, gave 92.5 B. HP. with a coal consumption of 0.94 lb. per I. HP., and 1.30 lbs. per B. HP. hour. (Jour. Franklin Institute, May, 1893.)

It will be seen that the test last quoted was made in Philadelphia four years ago, on an engine built in Philadelphia, and it gave a result nearly the same as that now given by the Lorois engine: and yet the Otto engine has not yet proved itself a "revolution in motive power" to such an extent as to seriously interfere with the market for steam engines.

The Gardie engine (of which the Lorois engine is a later form) is referred to on p. 162 of Mr. Donkin's book as below; the Lorois engine does not appear to be mentioned:

> One of the latest developments in gas engines is the introduction of motors having gazogenes attached, in which generator or power gas is made per stroke and passes direct to the engine, without intermediate storage in a gas holder. Two forms of this apparatus have lately appeared in France, the Gardie and the Benier; the former seems to be still in the experimental stage. * * * *
>
> In the Benier engine the gas is produced automatically per stroke as required, by the suction of the motor piston; thus its quality is said to be always uniform, and being generated below atmospheric pressure, loss by leakage is avoided. As the gas is only at atmospheric pressure a pump is required to mix it with air and deliver it to the engine.

From an examination of Mr. Lorois's patent it appears that the essential difference between his and the Benier engine is the manufacture of gas in the Lorois system under high pressure, 43 lbs. per sq. in. or above. The only advantage which this method can have, apparently, is the superiority of the quality of the gas made under pressure, which is claimed by M. Lorois. The power to compress the gas and the air is exerted by a separate air compressor, while in gas engines using the Otto cycle the power is exerted in the cylinder of the engine itself during the "compression stroke." There does not seem to be any important difference as far as the power required for compression is concerned, whether it is exerted in the engine cylinder or in the compressor cylinder. The difference, if any, in the quality of the gas, in favor of the Lorois method does not give any direct advantage in fuel economy, its sole advantage consisting in the alleged freedom from tarry matters liable to deposit in the cylinder and valves of the engine, and the consequent suppression of the scrubbers and washers which are used in connection with the gas producers of ordinary gas engines. To offset this advantage the whole plant, including air receiver, heat interchangers, gas producer and dust catcher, together with the piping system, has to be built of sufficient strength to resist with abundant safety the pressure which exists throughout the plant, 70 lbs. in the engine at Philadelphia. This necessitates a somewhat expensive construction.

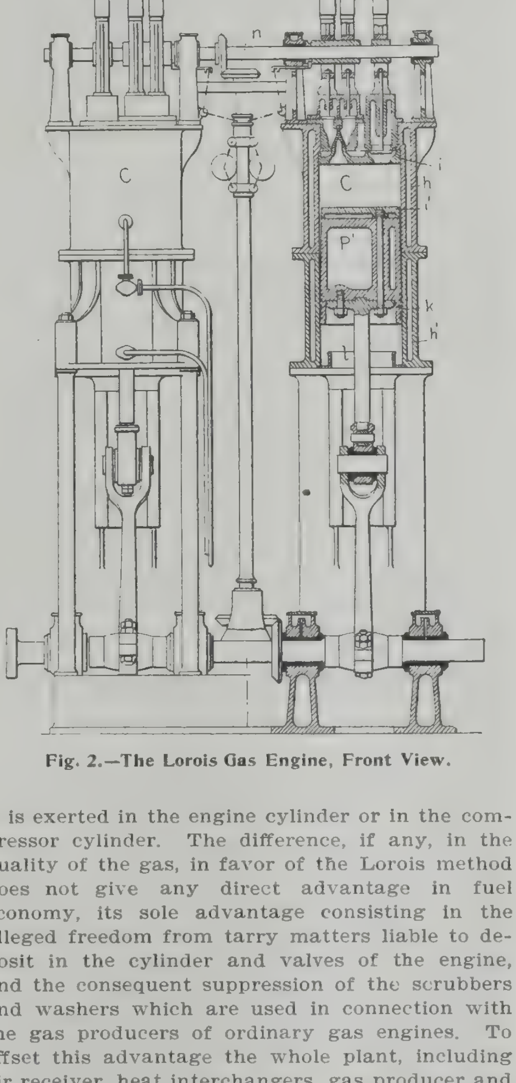


Fig. 2.—The Lorois Gas Engine, Front View.

Mr. Pray discusses a number of other features of the engine, besides its fuel consumption. His following remarks concerning the operation are interesting:

> To start the engine a small auxiliary steam boiler is required, for a short time, and so far as possible for me to say, an 8-HP. boiler would handle this 100-HP. engine, and furnish the steam required until the engine had its own steam. it is also necessary to have a dynamo of about ⅜-HP. output to run the firing wire until the plates are hot, and the dynamo in use, is used for from 55 to 70 minutes, according to pressure and load, when it is "cut out of circuit" and is of no further use until the engine is cold; this is also true of the auxiliary air compressor, a small one outside of the engine is needed, for charging to start with, but when running, if any accident to belts or machinery occurs necessitating a stop, there is no difficulty with ordinary care, in holding the pressure for some hours, and starting on as easily and with the same certainty as with half a dozen steam boilers with "steam up," for, if the air connections are tight, they will hold for ten hours or more, pressure sufficient to go on and re-heat the whole, which requires ten to twelve minutes (at proper pressure), and in that time the whole load can be taken on and run with no waiting for "steam" or pressure.
>
> When running, the proportions of air to the gascogen, and of steam, can be easily and certainly known, with the same care used or needed in operating a steam plant, but with no such waiting for "steam to get up" the fire requires constant feeding, not continual, but at stated intervals, and if it is allowed to get low and is still in the possibilities to keep at speed, you can add one or two hods (we feed 28 lbs. at a time in coal hod)—and in three minutes you can get on full, then add at stated intervals as already stated (28 lbs. in 24 minutes keeps nearly a 100-HP. going), with a surplus at the end of the day. And in its full load and speed, it will compare with the best built steam engines very favorably, as to care and the amount of work to be done on it, but it is not a machine that will run without care and attention, or by a careless man in its charge, nor will it do to put ignorant men, or cheap ones who know nothing and care less, into the care or charge of such a high speed sensitive machine, using such heat, but with the men who delight in fine running machines, ease, certainty, and fullest control, this motor will be more than welcome; it cannot be blown up, unless by criminal intention, and I do not know now how it would be possible to do that; there is not a trace of smell from the gas, and a person visiting the machine cannot tell whether it is run by one or the other force, from any smell which is perceptible in or about the room where it is.
>
> When the gas does escape, it has a smell once experienced, not forgotten, hence it is not insidious, and is so apparent that if it was poisonous it could not endanger human life, but when smelled it gives in a few moments a feeling as though a hearty dinner had been eaten, and in about six hours a most peculiar headache, in front, above and through the temples, and this is about twelve hours in leaving, after which no "after effects" are perceptible.

Mr. Pray concludes his report as follows:

> YOUR ENGINE IS THE NEAREST APPROACH TO THE DREAM OF SCIENTIFIC MEN OF MANY YEARS, BY WHICH THE ENERGY IN COAL WAS TO BE DIRECTLY APPLIED TO THE PRODUCTION OF POWER. I do not imagine that your board appreciate the value of what you have in your hands, in a strict business way. The engine has been sensitive to changes, and has in every point responded to adjustment, and shown its capacity for hard work, its beautiful regulation, and its great efficiency, ease of management, and if it is put into proper hands for future development, and conducted on lines intended, it will be the fault of whoever has it in charge, it is NOT one of the most successful business ventures attempted in the line of "prime movers."
>
> I have become more and more pleased with the splendid ability of the inventor, and the persistent patience of his French nature in putting his ideas into iron and steel for the benefit of the human race.

Our own opinion of the engine, after examining the engine itself and carefully reading M. Lorois's patents and Mr. Pray's report, is that it is a gas engine which may some day, at considerable expense, be developed into an engine which will be a commercial rival of the Otto and the numerous other gas engines that are now on the market. Its method of saving heat by means of the regenerators or heat interchangers, is not new, and they may be applied to engines of the Otto type whenever the saving of heat made by them is found to justify their cost. Whether the advantage of the manufacture of a gas which requires no washing or scrubbing, which is claimed for the Lorois system is sufficient to compensate for the increased cost of apparatus, which the production of gas under pressure makes necessary, is a question which can only be answered after long experience in practical work.

The machine embodies some interesting departures from ordinary gas engine practice, such as the igniting of the charge by the hot interior of the cylinder; but the figures of Mr. Pray's test do not show that the net results of these departures is to make the machine generate power with any less fuel consumption than is attained by other gas engines now on the market.

Perhaps when the apparatus has been further developed and perfected, better results will be shown; but after a careful perusal of Mr. Pray's report we are constrained to believe that he has said everything favorable that can be said concerning the machine in its present condition.

In view of all these facts we can see no shadow of justification for the capitalization at $5,000,000 of a company which owns not even the patents on this motor, but merely the rights for two states and part of another under patents of unknown value and has, so far as we can learn from its own published statements, no other property whatever. The capitalization of the enterprise and the valuation at which it is offering its shares appear to us to be about as exaggerated as are the rhetorical flights of Mr. Pray's report. Some other aspects of the subject we have discussed in our editorial columns.

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According to items from the daily press now in circulation the timber dry-docks lately built at our various government navy yards are being seriously damaged by marine worms. The Bureau of Yards and Docks of the U. S. Navy Department is also credited with being inclined to favor the construction of stone docks hereafter, as being in the end more durable and economical notwithstanding their first heavy cost. This news would be important, if true; but inquiry made of the proper sources of information leads to a very different conclusion. Timber dry-docks have now been in use in the United States for over 30 years, and somewhat longer than that in England. Official inspection of the older docks in this country shows that the timber in the interior is unaffected by the teredo-navalis, as this part of the structure is empty much of the time, and it is impossible for the worm to do any considerable damage in the short working time at its disposal. But the teredo does attack the dock entrance, and the outer parts of the caisson abutments, and when made of timber these must be renewed from time to time. It is for this reason that the Puget Sound dry-dock, the latest one completed by the U. S. government, is provided with a concrete abutment lined with cut masonry, and the approach wing walls are also of concrete faced with stone. As to the general durability of timber dry-docks it is found that the timbers in the oldest one in this country are practically intact and exhibit no decay except upon a very thin outer shell. The timbers in the upper part of the dock proper, above mid-tide mark, do deteriorate in time, but these can be readily renewed at a comparatively small cost. As this part of the dock could easily be constructed of concrete, by cutting off the piles at low tide mark and capping them, it seems strange that this is not done in our government docks, especially at Puget Sound, where concrete was extensively used for purposes of protection. It is clearly demonstrated by expert examination and by actual experience with these docks for more than 30 years, that timber dry-docks are not only comparatively very cheap to construct and generally durable, but that with a little additional expense they can be protected efficiently against their worst enemy, the teredo-navalis.

When it comes to a question of comparative cost, between stone and timber docks, the advantage is decidedly with the latter. The Mare Island stone dry-dock, at San Francisco, is 513 ft. long and 79 feet wide and is said to have cost about $4,000,000 to build. The Puget Sound timber dry-dock is 650 ft. long by 97 ft. wide and cost $607,951, or less than one-sixth of the cost of the stone dock. But the timber dock is not only vastly cheaper, but is vastly more convenient for working upon the hull of a ship. There is really no comparison between the modern wide-flaring, well-lighted and roomy timber dock and the steep side walls of the average stone dock. The Mare Island dock, in this respect, compares more nearly with the timber dock, as it has a much flatter slope and is wider in proportion than any of its stone predecessors; but to build a stone dock on the generous proportions of the later timber docks would make the cost prohibitory. If the interest on the cost of the Mare Island dock is taken at 4 per cent. it will be found that this accumulated interest would build a timber dock of the Puget Sound type about every five years, even assuming that the cost of the latter was increased by a sum sufficient to replace with concrete the whole upper part of that dock now exposed to gradual decay. And this estimate does not take into consideration the fact that the timber dock was completed in 43½ months as compared with the ten or eleven years consumed in the construction of the Mare Island stone dry-dock. In view of these considerations it is not at all probable that the government engineers propose to return to the old stone type of dry-dock construction.

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The review of the prospectus of the Lorois gas engine, on another page in this issue, will prove interesting reading to those who are watching the progress of the gas engine in its rivalry with the steam engine for use in electric lighting and power plants. The fact that gas engines are capable of furnishing power at a fuel cost of but little over 1 lb. per brake horse-power hour, while few steam engines, even of the most expensive types, have shown a better record than 1½ lbs., should induce engineers who have anything to do with the installation of new electric plants to give the gas engine careful attention. The probability of the gas engine supplanting the steam engine to any serious extent, however, seems at present remote. Fuel economy is not the only thing to be considered in the selection of motive power, and the disadvantages of gas engines in other respects, such as high first cost, difficulty of keeping in order, expense of operating gas producers etc., which have hitherto kept the gas engine from being a dangerous rival of the steam engine, are likely for some years to come to delay its progress.

In this connection a recent experience with gas engines at Aurora, Ill., is of interest. The gas company desiring to supply electricity as well as gas light to its customers, bought a number of dynamos and had them set up in the engineroom of the Aurora Street Ry. Co., which company ran them by belt from its steam engines. The gas company, thinking it could run its dynamos more cheaply by gas engines than by rented steam power, purchased under guarantee a number of gas engines and removed the dynamos from the railway company's power-house to its own. After about two weeks' trial, the gas engines were condemned, and returned to their builder, the dynamos were set up again in the street railway power-house, and the gas company is now planning to buy boilers and engines and run its dynamos by steam in its own gas works.

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The common method of power transmission on board naval vessels is by steam pipes, extending from the main boilers to the various engines, and the great variety of machinery which is necessary on a modern battleship makes a great amount of steam piping necessary. This piping is objectionable for many reasons. It is bulky and takes up valuable space, when protected as it must be with non-conducting covering. The covering is subject to more or less deterioration with the vibration of the ship and the machinery. The heat from the pipes is objectionable in every closed space. The necessity of providing for the exhaust and of keeping the pipes drained of condensation is a constant source of trouble. But more than all else is the danger which exists in every such steam pipe in time of action. The cutting of any one of them by a projectile means the escape of high-pressure steam, involving in a horrible death every one within its reach.

At the International Congress of Naval Engineers at Chicago in 1893, Mr. George W. Dickie, of the Union Iron Works, of San Francisco, advocated a system of hydraulic power transmission for use on ship-board, with large pressure pumps in the engine room and Pelton wheels, hydraulic rams, etc., to perform the work of dynamo driving, hoisting, etc. The system certainly possesses many advantages over the steam distribution system, especially with respect to its freedom from danger; but the equipment which has been installed on the U. S. monitor "Terror" seems to even surpass it in efficiency. On this vessel, as described in a news note in this issue, compressed air is used for performing all the various mechanical operations on board, from moving the rudder to hoisting ammunition. That this is far superior to a system of steam pipe distribution or to the scattering of donkey boilers over various parts of the vessel, will be apparent. The only system that promises to be able to at all compete with it is electrical power distribution. It would appear that compressed air would be superior to this in simplicity for direct hoisting, while where a rotary motion is wanted the electric motor would have the advantage.

That one or the other of these systems, or perhaps both combined, are bound to displace the dangerous steam pipes wherever shot and shell can come, seems certain. If two vessels were to engage in such a naval duel as that of the "Kearsarge" and the "Alabama" for example, one equipped with steam pipes and the other with electric or compresed air transmission, it would take a great deal of superiority in armor and armament in the former to make its chances of success in the contest equal.

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In these days of improvements, real and alleged, those in charge of both public and private undertakings have a host of devices presented to them for examination. The advocates of these devices do not always have an opportunity to set forth the reasons for their adoption, and even when they do, the claims urged are often speedily driven from the minds of those to whom they are presented by a multiplicity of cares. If a fairly good article of a certain class is in service there is a natural tendency to continue it in use, without giving much attention to alleged improvements, urged in the ordinary manner. Numerous changes in standards are often disadvantageous, although in some lines it matters little whether a new article is like those of the same class previously used, the main object being to have the best, regardless of previous custom. In the course of a few years, often in a very few, important improvements are sure to be made in almost every line. On this account a general survey of the field is desirable now and then. Such a course gives ample opportunity for comparing various devices and settling upon the best in a truly critical manner, instead of relying upon impressions gained from time to time in a few hasty moments, and perhaps due quite as much to the suavity of a skillful agent as the merits of the device. A careful examination of one class of appliances is about to be made by the New York Department of Public Works, as noted in our news columns last week. Valves, hydrants and accessories are to be considered with care, first through the literature put forth by manufacturers and next through an exhibition, to be held Nov. 10, at the Corporation Yards, 437 East 24th St., which yards are in charge of Mr. A. G. Gear. All communications on the subject should be addressed to Gen. Chas. H. T. Collis, Commissioner of Public Works, 150 Nassau St., New York city.

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The separation by means of magnetic machines of materials which have hitherto been considered non-magnetic, which is described in the paper of Messrs. Wilkens and Nitze, elsewhere in this issue, is the latest novelty in metallurgical processes, and one that may some day prove to be of great importance to owners of deposits of low grade hematite iron ores. There are vast bodies of such ores in certain districts of this country which are now entirely valueless by reason of the availability of low-priced better ores in their vicinity. In other places high grade and low grade ores are found in the same mine, and the latter are now left in the ground or thrown away on the waste dump. If they can be concentrated by the new magnetic machines at reasonable cost, a notable benefit to the iron trade will result, in the securing to it a new and large supply of cheap ores.

ENGINEERS AND SPECULATIVE ENTERPRISES.

In the "Code of Ethics," which has been adopted by the Canadian Society of Civil Engineers and was printed in our issue of Feb. 13, 1896, occurs the following:

> The Civil Engineer should avoid connecting himself with schemes or projects of a merely speculative character, always bearing in mind that his professional reputation will be to a great extent judged by the inherent merits and commercial value of the undertakings with which his name may come to be associated.

If this code of ethics be considered as nothing more than a statement of general principles, which one may accept or reject as he pleases, it will yet be agreed, we believe, that no more sound and wholesome advice could be given to an engineer than is conveyed in the above.

The commonest question which is ever asked concerning an engineer is, "What work has he been connected with?" People in general judge an engineer not by his stores of knowledge, or his executive ability; not even by his professional work, so much as by the character and the success of the enterprises with which his name comes to be associated. We are speaking now, of course, not of subordinate positions, but of the engineers in responsible charge of work. No one will deny that this standard is often an unjust one. Because the financial management of an enterprise causes its ruin is really no reason why injury should be done to the reputation of the engineer, who very likely did hard and faithful work all through. But be the standard just or unjust, it is the standard which people in general accept, and the fact is one which every engineer will do well to bear in mind.

It will, of course, be understood that we are not speaking now of the reverses which may come to any buisness enterprise, though these to some extent fall under the same rule, but rather of the enterprises "of a speculative character," as the code of ethics above quoted describes them. Concerning new enterprises the code says:

> The Civil Engineer whose advice is sought in respect to the usefulness, practicability and cost of a work should, before expressing his opinion, obtain reliable information on all points involved in the matter submitted to his judgment, including the probable paying capacity of the contemplated undertaking.

No one, we presume, will question that the term "Civil Engineer" in the above quotation should be given its broadest meaning, and that the rule of conduct is applicable equally to engineers in all branches of the profession. Let us express the same thing in somewhat different words: The engineer sells advice. He is subject then to the same rules that govern all trade. If he sells good, safe and sound advice, the demand for his services will continue. But if he gives bad advice in return for his fee, either through ignorance or because he wishes to say what will please his client, he will soon find that no one wants to buy advice of that sort. Even the clients who want an engineer who will twist his report to further their ends without regard to the truth, will pass him by because they know that his word carries no weight with the investing public.

These things are not fancy or mere theory by any means. We have in mind, as we write, concrete instances. In one case an engineer's name was used in connection with a concern against which a "fraud order" has been issued recently by the Post Office Department through the efforts of this journal. It need hardly be said that nothing can ever efface the injury done to that engineer's professional reputation by that connection. Another engineer has become noted for his connection with schemes of a highly speculative character. His reports upon them, designed to attract investors, are marvels of ingenuity; but he has become so well known in this field that the mere fact of his connection with an enterprise is sufficient to make one look upon it with suspicion.

If the engineer whose ignorance or dishonesty leads him into such a course injured only himself and those who are foolish enough to rely on his opinions, his misdeeds would be of comparatively little interest to the profession at large. The punishment would fall where it was deserved. But this unfortunately is not the case. The engineer who gives bad advice or whose work fails always brings discredit upon the profession, just as surely as the engineer who succeeds in a great work raises the profession in the public estimation. And the injury done to the profession by an unworthy member is tenfold greater where it is the honesty and not merely the engineering ability that is at fault.

But it will be said that it is unfair to hold the profession at large responsible for the acts of individual members. Any one, no matter what his qualifications or lack of qualifications, may call himself an engineer and may sell engineering advice—if he can find purchasers for it. This is, of course, true; and yet, we believe that in this matter, the public is not quite so ignorant as is sometimes thought. People do understand, we believe, the difference between the engineer of character, reputation and high standing in the profession, and the ignorant and incompetent man, whose claim to the title of engineer rests on no substantial basis. It is clear then that the injury done to the profession when its members of high reputation commit unworthy acts is by far greater than can result from the acts of those hangers-on of the profession whom the public generally estimates at their real worth.

And if this is true, it follows at once that the members of the great engineering societies, and especially such members as have attained professional eminence owe to their fellow members and to the profession at large an avoidance of anything which may result in discredit to the profession. Perhaps there is no temptation which meets such engineers oftener than proposals of connections with "speculative" enterprises. We are far from saying that the engineer should on principle refuse all such offers. Every new enterprise must have something of a speculative character at the start. But it is clearly the duty of the engineer to scrutinize every such enterprise with the greatest care before associating himself with it in any capacity where the public may be led to place confidence in it by reason of his connection. The engineer who is asked as an expert to report on such an enterprise or who is offered an executive position in it must accept the responsibility that necessarily accompanies such a position. People who invest their money will do so on the strength of his opinions, and if the investment proves a loss, his reputation, and to a certain extent the reputation of the profession will suffer. The only safe rule to follow for an engineer in such a position is—to tell the truth and the whole truth. Ascertain the facts which count against the success of such an enterprise as carefully as you do those which make its prospects promising, and report them as faithfully to those who contemplate investment. This may seem Quixotic to some, but the engineer who pursues any other course is gambling with his own reputation.

What would be thought of a lawyer who in submitting a report upon the title to a piece of property included all the favorable documents and omitted any which threw a cloud upon it? Why should not the engineer be held to an equal responsibility? Is it not clear that he must be so held, if engineering is to be the honorable profession that it deserves to be?

It may be argued that investors could not be secured for enterprises if they were not painted in glowing colors. We do not believe this. Nearly every one who invests money in new enterprises would far prefer an honest, unbiased report of the prospects of failure and of success from an expert. It is not too much to say that the scheme which cannot attract capital upon a fair and impartial showing of its points of merit and of risk, ought not to succeed.

If there be any of our readers who hold that the position we have urged is too advanced for engineers, at the present day, we invite them to consider for a moment the result of taking an opposite position. Suppose, for the sake of argument, that an engineer is justified in presenting in his report only facts favorable to an enterprise. Suppose, we say that he may occupy an executive position in such an enterprise, and permit the distribution of misleading statements respecting its engineering features. If such a condition of affairs were to obtain, it is clear that engineers' reports would be worthless as a guide to investors; and we may be sure it would not take the public long to find out this fact. Would a banker be responsible if he occupied an executive position in a concern and permitted it to publish misleading statements as to its financial condition? Would an attorney be responsible, if, as one of the officers of a company, he misled investors as to its condition with respect to pending litigation? We realize well that in any such case the public would be prompt to hold such men to a due responsibility for their acts; and so in like manner does it hold the engineer responsible.

LETTERS TO THE EDITOR.

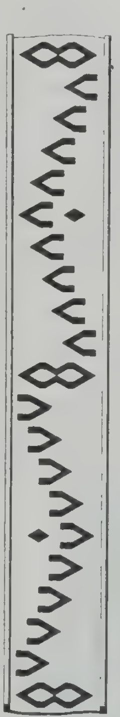
Paving Along Street Railway Tracks.

Sir: Referring to the article in the last issue of the Engineering News, entitled "Paving Along Street Railway Tracks," and the criticism of Mr. H. P. Jones, concerning the plan for paving along the street railway tracks in this village, contained therein, I wish to say that the plan covered only the paving proper and had nothing to do with the substructure of the track, the local authorities having no control over that portion of the work. Though strongly urged to put concrete under the ties, the local street railway managers refused to do so, stating that as they have to maintain the track in good order, they should have the right to choose the method of constructing it; and the village authorities are powerless in the matter as the laws relating to villages give them no control over the substructure of the tracks. I am aware that a durable or permanent street railway track can be best obtained by using a concrete foundation under the ties, but in the case noted such a roadbed cannot be secured.

Respectfully yours,
Wm. B. Landreth.

Cortland, N. Y., Oct. 17, 1896.

A New Stadia Rod Graduation.



Sir: I enclose a design for the graduation of a stadia rod which is simple and easily read. The groups of divisions for each 100 ft. are alternated or staggered, and thus at long distances the hundreds of feet are more easily counted than if they were placed centrally on the rod. Another advantage is that no black division extends entirely across the rod, so that wherever the wires may cut, the white spaces which they cross are greater than the black.

Some engineers might prefer to have distinguishing numbers for each 100-ft. interval, but I have never experienced the need of such distinctions even when working in heavily wooded territory. Mr. Kenneth Allen has advocated the use of small mirrors, inserted at certain points on the rod, as an aid in avoiding mistakes at long ranges.

To prevent the graduations on the rod from being scratched or defaced, it is advisable to have narrow projecting strips down each side, and in order to protect the rod during transportation, the upper portion should fold forward upon the lower, so that the graduations are face to face.

Yours truly,
T. J. McMinn, M. Am. Soc. C. E.
277 Pearl St., New York city, Oct. 1, 1896.

THE PROPOSED CANADIAN FAST TRANSATLANTIC STEAMER SERVICE.

Deeper canals, "fitted to handle the Western as well as the Canadian trade," are advocated by the Premier of the Dominion of Canada, and in this connection a fast Atlantic service between Canada and Great Britain is also proposed. But Mr. Sandford Fleming, M. Am. Soc. C. E., one of the most prominent engineers of Canada, has lately issued a pamphlet pointing out the difficulties of maintaining the 20-knot service on the St. Lawrence part of the route, which has been suggested. Speaking of the Belle Isle entrance he says that all winds from the southward bring up fogs, requiring the greatest caution in navigation; and for 200 miles east and 100 miles west of Belle Isle, icebergs may be encountered. Within and sometimes even beyond these limits, the track of steamers is rarely free from icebergs, and fogs are nearly always present. Mr. Fleming concludes that any attempt to establish on this route a line of steamers intended to rival in speed those running from New York, would end in disappointment; and to secure an all-the-year-round line, Halifax, in Nova Scotia, and Loch Ryan, in Scotland, present the shortest available route for fast steamers. He says that this route is 300 miles shorter than to a Milford Haven terminus; 81 miles less than to Holyhead; 90 miles less than to Southampton, and 125 miles less than to Liverpool. But Mr. Fleming believed that steamships of moderate speed could be usefully employed on the St. Lawrence route in the transport of staple products and ordinary cargo; and that steamers suitable for this trade could, at the close of navigation, in the St. Lawrence, find an open harbor at St. John, N. B., the nearest suitable Canadian seaport for the cities on the great river.

In the same connection, Mr. John Torrance, of the "Dominion Line" of steamers, at the late launch of the steamer "Canada," said that this steamer was built for a 16-knot speed, and with this speed she had a cargo capacity of nearly 7,000 tons. But if this same steamer were equipped for an 18-knot speed her cargo would be reduced to 3,000 tons; and at 20-knots, to 1,000 tons. As a consequence, he said, if a fast service is desired it must be practically devoted to passengers alone; and the freight and passenger service must be separate and distinct. He thought such a fast service would not pay commercially.

Mr. T. G. Shaughnessy, Vice-President of the Canadian Pacific Railway, answered Mr. Torrance by saying that his experience was that if business was to be secured proper facilities must be provided, and that there was a happy medium between the extremes of high speed and great freight capacity. He illustrated his remarks by saying that with old and slow boats on the China, Japan and Vancouver route, the proprietors lost $150,000 in 1888, though they received from the C. P. R. 75% on all through rates. They rarely secured more than 30 first-class passengers on a voyage, and this number was reduced to 12 or 13 in the winter months. The Canadian Pacific Ry. Co. then built ships of 16½ knots speed, with accommodation for 175 first-cabin and over 1,000 steerage passengers, and with a freight capacity of about 4,500 tons. These ships he said have been a financial success almost from the start, and they carry from 160 to 170 first-cabin passengers in summer, and rarely less than 40 in the winter.

COUPLINGS FOR MAKING LEAD AND IRON PIPE JOINTS WITHOUT SOLDER.

The accompanying illustrations show a method of connecting lead to lead, or lead to iron pipes, without the use of solder. Brass couplings are used for this purpose, and the ends of the lead pipe are swedged up to fit against rubber washers resting on corrugated cone-shaped surfaces.

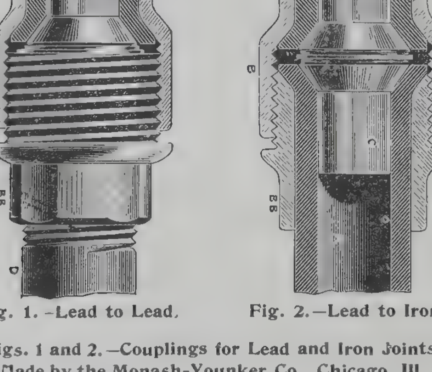


Fig. 1.—Lead to Lead. Fig. 2.—Lead to Iron.

Figs. 1 and 2.—Couplings for Lead and Iron Joints. Made by the Monash-Younker Co., Chicago, Ill.

Fig. 1 shows the lead to lead connection. To make this joint the brass parts, B and BB, are swedged onto the ends of the pipe to be jointed, making use of a swedging tool and clamp furnished for the purpose. The tubular double cone, CC, with the rubber washer pressed against each cone, is then put in place and the couplings are screwed up tight. Fig. 2 shows a lead to iron joint and needs no explanation. A variety of other joints, tees and connections can be made in the same general way.

The couplers and fittings are made by the Monash-Younker Co., successors to the Van Auken Steam Specialty Co., 201 South Canal St., Chicago. The company states that they have been in use for the past three years, and presents testimonials to the effect that they have given satisfaction in water-back connections and other places where both hot and cold water are used. It is claimed that the rubber washer, as here used, coming in contact with lead and brass, only, is not subjected to the disintegrating effect observed in iron unions, where much oxidation is going on.

As compared with the lead wiped joint it is obvious that any mechanic with ordinary tools can make these connections with ease, and it is claimed that their first cost is less and their safety and durability is greater than that of the wiped joint.

THE MAGNETIC SEPARATION OF NON-MAGNETIC MATERIAL.*

By H. A. J. Wilkens and H. B. C. Nitze, South Bethlehem, Pa.

The paradoxical title above used requires some explanation. The term "non-magnetic material" is applied to such substances as have heretofore been considered non-magnetic in the arts, more especially in the practice of ore-concentration.

Scientifically, it has been shown by Faraday, Plucker, Wiedemann and other physicists that magnetism is an inherent property common to all substances, solid, liquid and gaseous, i. e., all substances are either attracted or repelled by the poles of a magnet, although in the great majority of cases the manifestation of this force is so feeble as to be measured only by the most delicately arranged physical apparatus. The substances attracted are known as paramagnetic, and those repelled, constituting by far the greater class, as diamagnetic.

The diamagnetics show but a slight deviation in intensity as compared with air, which is the neutral substance. Bismuth is the most diamagnetic body known, and its diamagnetic permeability, expressed in figures, is stated to be 0.99982, taking air as unity. The paramagnetics, on the other hand, show a wide variation in intensity or permeability to magnetic forces.

There exists, however, a distinct and wide gap between such as are highly magnetic and such as are only feebly so, and accordingly two classes might be made, namely, such as can be and such as cannot be lifted by the common hand magnet or equivalent power. To the first class belong the metals iron, nickel and cobalt, and the minerals magnetite and pyrrhotite, and these are the only substances that are generally recognized as magnetic; while all other paramagnetics, comprising the second class possessing comparatively infinitesimal magnetic susceptibility, are regarded in the arts as practically non-magnetic. The abrupt gap between these two classes is not occupied by substances of intermediate and graduated magnetic susceptibility. It is with this second class of paramagnetic substances that we are concerned.

Faraday's list, published in 1846, includes a large number of metals, chemical salts and organic substances. It will suffice here to give the list of metals: Paramagnetic: Iron, nickel, cobalt, manganese, chromium, cerium, titanium, palladium, platinum, osmium. Diamagnetic: Bismuth, antimony, zinc, tin, cadmium, sodium, mercury, lead, silver, copper, gold, arsenic, uranium,* rhodium, iridium, tungsten.

Various attempts have been made by physical investigators in Europe, with more or less success and reliabilty of results, to determine the specific magnetic permeability of substances. To give at least some idea of the great gap existing between the commonly known magnetic and some of the other paramagnetic bodies, the following results obtained by Delesse may be cited: Taking the magnetic attractibility of steel at 100,000, he found that of magnetite to be as high as 65,000, of siderite only 120, of hematite 93 to 43 and of limonite 72 to 43.

Practical engineers and inventors have either taken for granted that the magnetic susceptibility of substances was constant, and about what was indicated by the ordinary hand magnet, or, if they were acquainted with the universal magnetic permeability of substances, they have felt that the attainment of sufficiently high power to affect the extremely low susceptibility of the paramagnetics, other than iron, nickel, cobalt, magnetite and pyrrhotite, was impracticable within the bounds of practical economy. At all events, they have been discouraged from making any attempt to design electro-magnets capable of such peculiarly concentrated and condensed a field as to attract these substances.

Even in the present case useful results were achieved only after making many experiments and actual trials, carried on in the beginning, without any knowledge of the previous theoretical investigations.

A large number of machines have been invented and perfected for concentrating the so-called magnetic minerals, that is, magnetite and pyrrhotite, chiefly the former. When it became desirable to separate other ferruginous minerals, such as hematite, limonite, siderite, etc., which were in the generally accepted sense, non-magnetic, methods for converting them into artificial magnetite were resorted to. This was done either by an oxidizing or a reducing-roasting in or without the presence of carbon-contact.

On the same general principle, Mr. G. G. Convers, designed in 1892 a process for the separation of the franklinite-ore of the Franklin mines, New Jersey. This ore is a crystalline granular aggregate of franklinite, willemite and calcite, with smaller amounts of zincite, garnet, fowlerite, tephroite, etc. It was the object to obtain the willemite and zincite as free as possible from franklinite (the principal iron and manganese-bearing mineral), thus rendering the franklinite magnetic, so that it could be separated on Wenstrom magnetic drums. This process gave good results; but the cost of roasting and the uncertainty of a uniform magnetic product led to further experimenting, and finally the method, a direct magnetic concentration of these ores, without previous roasting, was evolved by Mr. J. P. Wetherill, manager of the Lehigh Zinc and Iron Co., South Bethlehem, Pa.

Mr. Wetherill found that not only the franklinite, but also the garnet, fowlerite, tephroite and similar deleterious iron and manganese-bearing minerals could be thus eliminated.

These surprising and important results were attained by utilizing a peculiarly high magnetic power, applied in machines especially adapted for the purpose, and sufficient to act upon the comparatively almost infinitesimal magnetic permeability of these minerals, instead of attempting (as had heretofore been done) to raise this low permeability to a point known in practice as "magnetic," that is, capable of attraction by a common hand-magnet or the electro-magnets heretofore employed.

Further investigations showed that a large number of ferruginous and manganiferous minerals, such as hematite, limonite, siderite, garnet, pyrolusite, etc., besides many chemical salts of iron, manganese and chromium were affected by this extraordinary magnetic power, and were thus adaptable to this method of concentration.

Letters-patent were granted to Mr. Wetherill for his method of direct magnetic separation of paramagnetic substances of low permeability from mixtures containing the same, as well as for the machines employed to obtain this result; and these patents are now owned by the Wetherill Concentrating Co., located at South Bethlehem, Pa.*

The machines for making these separations are of two types. In the first the magnetic particles are lifted away from the original mixture. The machine consists of two magnetic cores and bobbins and four pole-pieces, which are adjustable, so that they may be moved nearer or farther apart as desired.

About each pole-piece revolves a belt.

The ore is fed from a hopper by means of a feed roller upon a belt which carries it in a thin layer, say ⅛ to 3-16-in. thick, in close proximity to the space between the poles, and the magnetic particles are withdrawn and lifted up into the highly intensified field existing at this point. They are removed by a horizontal belt and carried into a receptacle.

The non-magnetic tails fall from the belt into another receptacle.

The intensity of the magnetic attraction can be accurately adjusted by changing the distance of the feed-belt from the pole-points; or, by changing the distance between the pole-pieces, or, finally, by changing the amperage of the current.

So far machines have been used with a capacity of from ¾ to 3 tons per hour, depending upon the number of pole-pieces used, the speed of the belts and the nature and size of the material operated on. By widening the pole-pieces and the feed-belts, the capacity can be raised; but this may ultimately reach a point where it will be more advantageous to multiply the number of machines instead of further increasing their size.

The amount of amperage necessary for producing the extremely high field is comparatively small. This is due to the large-sized and correctly proportioned cores, yokes and pole-pieces employed, and the almost perfect condensation at the pole-points of the vast number of magnetic lines generated in them.

For the separation of the Franklin minerals, where the magnetic heads produced consist of franklinite, tephroite, rhodonite, garnet, etc., from 3 to 8 amperes, with from 16 to 30 volts, are necessary. In the concentration of the Clinton red fossil-ore from 4 to 8 amperes were used. For limonite and pyrolusite a somewhat higher amperage is employed, from 10 to 15 giving a good separation.

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*Abstract of a paper presented at the Pittsburgh meeting of the American Institute of Mining Engineers.

*According to later observations of M. Verdet, uranium is paramagnetic.

*U. S. patents Nos. 555,792 (dated March 3, 1896), and 555,794 (dated March 3, 1896).

The ability to adjust delicately the magnetic intensity of these machines permits, in many cases, the practical isolation from one ore of several products showing a slight difference of magnetic permeability. For instance, in the concentration of monazite sand the pure monazite can be separated from garnet and rutile at one operation, and the latter, by a slight change in the intensity of the current, can again be separated from each other.

Aside from the separation of several minerals from one ore, the discriminating power can be utilized for the separation of a desired quantity or quality of heads, where the magnetic mineral varies in itself in permeability. For example, in the concentration of the Clinton fossil-ores, the magnetic permeability of the hematite particles increases apparently with their percentage of iron, and either a small amount of high-grade heads can be produced with a low amperage, or a large amount of low-grade heads with a higher one. From a commercial standpoint, the exact quantity or quality which it would be advisable to produce would depend upon the increase in value of the concentrates per unit.

The machines described are adapted to dry concentration. Their arrangement for wet concentration would necessitate but a slight change in some of the mechanical features.

It is difficult as yet to judge of the full extent of the field to which this method of concentration is applicable. Its original application to the franklinite ores has been mentioned above. It should supplant those operations already enumerated, in which a magnetizing roasting has heretofore been found necessary before magnetic concentration, not only on account of the additional cost which the latter entails, but also because better results may be expected from the direct treatment of the raw material. Magnetizing-roasting is attended, in most cases, with considerable difficulties, such as the sintering and slagging of the ore, imperfect magnetization, etc., which not only decrease the quantity, but may also impair the quality, of the resulting concentrates. Such difficulties were encountered in the magnetization of the red fossil-ore of the Birmingham district and in the roasting of siderite-blende ores in several European localities.

Perhaps its widest application will be in the field of concentrating iron-ores, red and brown hematites and carbonates. It is estimated that over 90% of the material charged into the blast-furnaces in this country is of these classes, and that in European countries the proportion is even larger. These ores will practically be placed on the same level with magnetite, so far as the ability to concentrate them magnetically in the raw state is concerned.

Of importance to the iron and steel industry will be the concentration of manganese-ores, with which other methods of concentration, such as jigging, have always experienced difficulty and waste.

There are no doubt many other special cases in which this process of direct magnetic concentration may become applicable.

Among the materials, besides those mentioned above, which have been treated successfully are:

1. A mixture of apatite and rutile, occurring in a deposit near Charlottesville, Va.
2. Monazite-sands from North and South Carolina.
3. Garnetiferous rocks and schists, from which it was desired to extract the pure garnet.
4. Corundum ores, from which garnet and other deleterious ferrugunious minerals were to be removed.
5. Ores containing siderite as a deleterious ingredient, as in cryolite, for instance.

In certain metallurgical operations this method of magnetic concentration may form an intermediate stage, as, for instance, in the separation of pyrite from blende, after the mixture has received a dead roast to prepare the blende for the retorts.

Its application has not been exploited as yet in the chemical and other industrial arts.

Franklinite-Ores.—The process has been in operation on a large experimental scale at the works of the Lehigh Zinc and Iron Co., South Bethlehem, Pa., for the separation of the franklinite-ores. Some 15,000 tons of material have been treated here, and, on the basis of the experience thus gained, a large and comprehensive plant has been designed and erected at the mines of the Sterling Iron and Zinc Co., Franklin, N. J. This plant, having a capacity of 400 tons of raw ore per day, is about ready to go into operation. The ore, as it comes from the mine, is dried, crushed to 10-mesh size by means of Blake crushers and rolls, and sized. The franklinite, tephroite, rhodonite, garnet, etc., are removed on the Wetherill machines, leaving, as non-magnetic tails, a mixture of willemite, zincite and calcite, from which the latter is subsequently separated by jigging. The operation of the process on this material is highly successful, as is shown by the analyses at the bottom of the preceding column.

	Per cent.			
	Wt.	ZnO.	Fe.	Mn.
Run-of-mine ore	100	31.09	20.34	9.34
Franklinite separated	56	24.38	35.50	13.62
Willemite and zincite separated	28	60.00	1.50	6.10*
Calcite separated	16	4.00	....	....

*This manganese is to a great extent chemically contained in the willemite and zincite.

Clinton Fossil-Ores.—Of more general interest, on account of the greater application of the process and the large extent of the field, are perhaps the results obtained on the red fossil hematite-ores of the Birmingham district in Alabama.

The richer, soft ores of this district, such as are used in the furnaces, average from 45 to 48% in iron, and from 30 to 24% in insoluble matter. Such ores occur, however, only in few localities, which are limited in extent, and are now almost exhausted. By far the greater portion of the leached ore-beds consists of material running from 35 to 45% in iron and from 45 to 30% in insoluble matter.

This latter class of ore cannot be used in the furnaces to advantage, and is therefore practically worthless, unless the percentage of iron be raised by concentration, and at the same time the insoluble matter be proportionately decreased.

The tests on these ores were made under the auspices of the Tennessee Coal, Iron & Railroad Co., and were in direct charge of Dr. William B. Phillips, the consulting chemist of the company, who, for the past three years, has made a specialty of the problems involved in the concentration of the Birmingham ores.

Various working-tests were made on material from a great number of localities, and the results were verified by some 500 analyses made in the laboratory of the company.

Concentration-tests on this material by the Wetherill process gave the following results (calculated on a basis of 100 tons of raw ore):

	Iron. %	Insoluble. %
Original ore	48.03	25.20
	Iron. %	Insoluble. %
57 tons of heads, containing	57.10	13.10
28 tons of middlings containing	46.20	25.40
15 tons of tails, containing	10.00	70.80

It was further found that about 20% in weight of this raw ore could be brought up to: iron, 59.15%; insoluble, 10.45%.

At the prices offered for concentrates by the T. C. I. & R. R. Co., it would be perfectly feasible to purchase this grade of raw ore at the market-price, and make the concentrates at a profit. As, however, the ore of this quality is almost exhausted, the question of concentrating it on a large scale will hardly arise.

The above results compare most favorably with those previously obtained by the magnetizing-roasting process, particularly in the proportional amount of heads that were produced and the comparatively small percentage of iron carried in the tails.

The tests by direct concentration on the lower-grade ores showed a proportionately greater increase in the percentage of iron than those on the higher-grade material. The quality of the heads was, however, not as good, which shows that the hematite matrix in the low-grade ores carries a larger percentage of inherent insoluble matter than that of the richer ores.

Among others, the following results were obtained (calculated on the basis of 100 tons of raw ore):

	Iron. %	Insoluble. %
Original ore	41.58	37.51
	Iron. %	Insoluble. %
69 tons of heads, containing	52.00	23.00
31 tons of tails, containing	18.40	70.00

About 25% in weight of this original ore was raised to: iron, 56.40%; insoluble, 17%.

Tests were also made on the so-called "hard ore," which represents that portion of the ore-bed from which the lime has not been leached. The raw ore of this character, as used at the furnaces, averages: iron, 35.50%; insoluble, 17.50%; lime, 16%. From this were obtained from 50 to 60% in weight of heads, containing: iron, 48%; insoluble, 10.50%; lime, 10%.

The cost of mining this hard ore, on account of its being underground, is far in excess of that of the soft ore. And, therefore, although the use of such concentrates as were produced would be of great advantage in the furnace, the cost of mining 2 tons of raw ore would be too great to permit the use of 1 ton of concentrates obtained therefrom at a profit under present circumstances.

The above tests must be considered to a certain extent preliminary. There is no doubt that a wider experience with this material, and, as a rule, a somewhat finer crushing and more judicious sizing, will give still better results. Experiments have gone far enough, however, to prove that this process of direct magnetic concentration is not only technically the most feasible, but also commercially the most economical one.*

Brown Hematite-Ores.—To show the application of the process to brown hematite-ores, the following results, from experiments made at the testing-plant of the Wetherill Concentrating Co., South Bethlehem, Pa., may be of interest:

Brown Hematite from Iron Gate, Va., Allegheny Iron Co.

	Percentage by weight.	SiO_2. Per cent.	Fe. Per cent.
Original ore	100	31,29	42.08
Concentrates	63.4	11.24	51.04
Tails	36.6	66.00	31.74

Brown Hematite (Washer Tailings), Barren Springs, Va.

	Percentage by weight.	SiO_2. Per cent.	Fe. Per cent.
Original ore	100	29.93	32.03
Concentrates	30	7.43	53.14
Tails	70	39.58	22.98

Jigged Zinc-Ore (Consisting of Limonite and Calamine),
Wythe Lead & Zinc Co., Austinville, Va.

	Percentage by weight.	Fe. Per cent.	Zn. Per cent.
Original ore	100	18.60	29.57
Concentrates	33	49.45	5.58
Tails	67	3.41	41.40

In the application of this process, limitations will be encountered similar to those common to other methods of concentration. The constituents of the material to be concentrated must exist in a visible mechanical mixture, so that, after crushing, each constituent may be present in separate and distinct particles. As already stated, the Wetherill machines have successfully handled material up to ½-in. in diameter, and a coarser crushing than this is seldom advisable in concentration. As a rule, finer crushing is necessary on account of the structural condition of the raw material, as in the case in the Clinton fossil ores.

The antipathy against the use of fine ores in the blast-furnace has been greatly overcome by the successful utilization of the Mesabi fine ores in the Pittsburgh district, where 33% of material, running less than 8-mesh in size, constitutes the regular furnace-charge, and as high as 60% has been used without serious difficulty. Briquetting may, in some cases, be resorted to, especially where a self-fluxing and partially self-reducing briquette can be made, and where these advantages counterbalance the additional cost of manufacture.

When the difference between the magnetic permeability of the constituents is marked, a preliminary sizing of the material is unnecessary; but this must be resorted to, and the number of sizes be proportionately increased, as the magnetic difference becomes less. The process resembles in this respect an air or water-separation. In rare instances this difference may be practically nil, and a separation may become impossible. Such was found to be the case in the attempted separation of chromite and serpentine in a certain chrome-ore, these two ingredients showing practically the same magnetic properties.

Experience has shown that the actual cost of magnetic concentration, under usual conditions, will not exceed 5 cts. per ton of raw ore. The cost of preparing the ore for the machines by drying, crushing and sizing will depend to a great extent upon the character of the ore, locality of the deposit and other conditions, and will not differ from the corresponding cost under any other method of concentration.

SUSPENDED ARCH-CENTERS AT THE PORT OF BORDEAUX.

In building the new quays at the port of Bordeaux, France, the bad character of the soil and the unstable condition of the older works founded upon piles, at that place, made it necessary that some general plan be adopted that would reduce to the lowest degree the effect of the outward thrust of the filling material. With this end in view the engineers concluded to employ masonry arches, placed at right angles to the pier-line, and to support these arches by piers founded by the use of compressed air. The reasons for the employment of this system and a full illustrated description of the construction of these quays will be found in the "Annales des Ponts et Chaussees," for June, 1896, in a lengthy and interesting paper written by Mr. A. Pasqueau, Chief Engineer. One of the most novel features of construction was the use of suspended centers for the masonry arches connecting the piers, and these may be described as follows:

The foundation soil was made up of strata of mud, from 16 to 20 ft. deep, muddy sand and gravel, from 7 to 20 ft. deep, and a compact bed of yellow marl, or clay, lying from 50 to 66 ft. below datum; and upon this latter formation the piers were founded. This quay is 4,959 ft. long and required the sinking of 93 metallic, rectangular caissons or pier-foundations, by the employment of compressed air. The datum line used was 21.55 ft. below the highest known tide, and the height of the front edge of the quay was fixed at this highest tide mark. The normal rise of the tide is 18.04 ft. The face-width of the piers was fixed at 4 m., or 13.12 ft., from the springing line of the arches to 23 ft. below datum, and 5.4 m., or 17.71 ft. wide from that point to the foundation. The general length of these piers was 10 m., or 32.80 ft., with a face batter of 1 in 10 from the top to a point 23 ft. below datum. At this latter point a horizontal step increased the bottom length to 34.44 ft. Out of 93 piers, 9 were doubled in face dimensions, or made 8 m. wide at the spring, to support heavy cranes, etc.

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*It is regretted that business negotiations and commercial calculations are not far enough advanced to permit figures of costs and value of the concentrates to be published at the present time.

The springing line of the arches was fixed at 1.50 m., or 4.92 ft. above datum, and the normal arch span was 12 m., or 39.36 ft., with a rise of 2 m., or 6.56 ft. The width of the arch was 10 m., or 32.80 ft. Upon the completion of the arches the openings were closed by a filling of broken stone, having side slopes of 45°, and with the front-toe of the filling terminating on a line with the face of the caissons at a general depth of 23 ft. below datum. The top of this rock embankment extends up to the crown of the arches and sand was used as a back filling. The arches themselves, the face wall above them, and the front faces of the piers, to a point 23 ft. below datum, are built of cut stone.

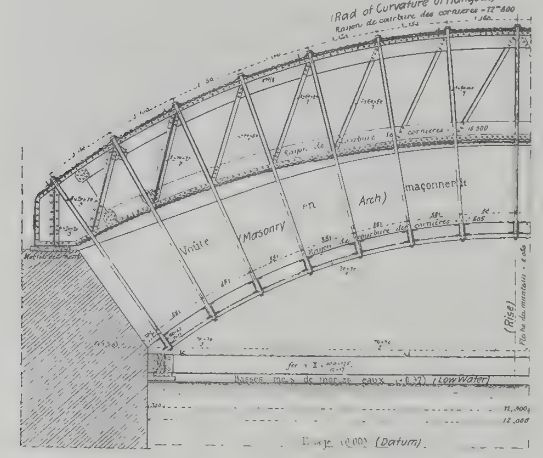
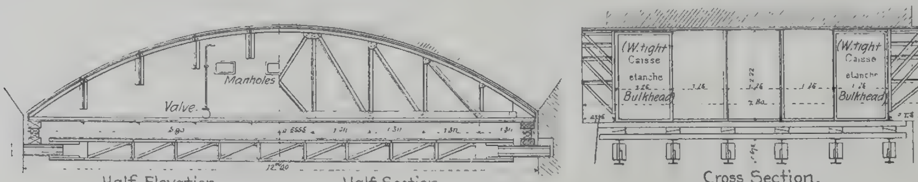

(Rad of Curvature of Flange 15.)
Rayon de courbure des cornieres = 12.800
Voûte
(Masonry
en
Arch)
maçonnerie
Rayon de courbure des cornieres
(Rise)
Fleche du manteau = 2.00
fer à I
Basses mers de mortes eaux (+0.37) (Low Water)
11,400
12,000
(0.00) (Datum)

Fig. 2.—Details of Suspended Centering

The springing line of the arches was 2 ft. above the level of mean low water, or 4.9 ft. above datum, and it might have been possible to have used centering of the ordinary type; but such a center would have been very difficult to place and to strike, owing to the slight height available. In this emergency, the contractors, Messrs. Zschokke and Terrier, devised the system of suspended centers here described and illustrated.

The elevation and photographic view show the design adopted for this purpose. The contractors at first used two steel, trussed ribs, spaced 8.53 ft. apart, to support a center 16.4 ft. wide, and built the arch, which was 32.8 ft. deep, in two sections. But they later employed three ribs and built the whole arch at one operation. As shown in the elevation, these trussed ribs rested upon iron plates fixed upon the piers at an elevation of 3 m., or 9.84 ft. above datum, and, by long rods arranged normally to the intrados of the masonry arch, these trusses supported a series of metal panels, 2.88 ft. wide, forming the center desired. The stone arches were built upon this center in the ordinary manner, by leaving holes for the passage of the supporting rods. After a sufficient time had elapsed the centers were readily struck by loosening the nuts at the top of these rods and the centers were then lowered onto boats and transferred to adjoining piers by utilizing the rise and fall of the tide.



Half Elevation. Half Section. Cross Section.

FIG. 3.—FLOATING CENTERS FOR ARCHES AT THE BORDEAUX HARBOR.

Mr. Hersent, who had a later contract on the same work, preferred to use a floating center for his arches; but for those of slight span and rise he also employed the suspended centers, and he recommends them for emergencies of this character. The Hersent floating center was composed of six metal trussed ribs following the curve of the intrados of the arch and the line of the chord of the arch. The two outer trusses at each end were enclosed in plates in such a manner as to make tight boxes provided with manholes, air-pipes, valves, etc., and the upper part of this center was covered with wood for the support of the arch voussoirs. Iron-trussed beams were put in place, below the spring of the arch and between the piers, to support this floating center with its wedges, etc., as shown in Fig. 3.

The placing in position of this centering was simple. The center was floated by emptying the two tight boxes, at the ends, and was guided between the piers at high-tide; it was then settled down upon the cross beams, put in place at low tide, by introducing water into the end boxes. The water was left to circulate freely between the four middle ribs of the center. Upon the completion of the arch the wedges were struck in the ordinary manner; the end boxes were again emptied and the center withdrawn and floated to the next pier. It should be remarked that where these floating centers were employed the springing line of the arches was 8.20 ft. above datum, owing to a change in the type of the piers. The weight of one of these floating centers was about 39,600 lbs. and its cost was estimated at $1,200, not including the beams below the springing line; it drew 2.16 ft. of water with the end boxes empty The cost of handling this center for one arch was about $25, or about 20 cts. per cubic yard of arch masonry.

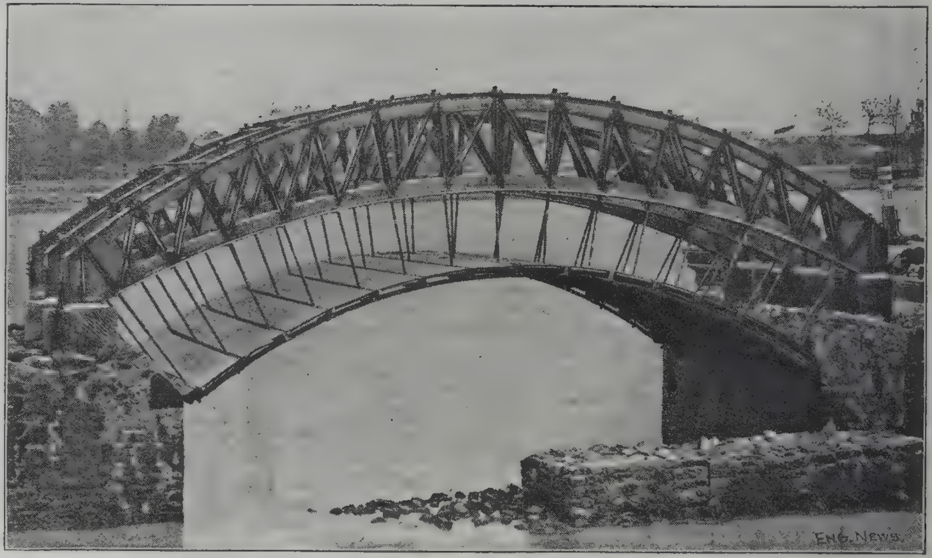


FIG. 1.—VIEW OF SUSPENDED CENTERING AT THE BORDEAUX HARBOR, FRANCE.

THE THIRD RAIL ELECTRIC SYSTEM ON THE NEW YORK, NEW HAVEN & HARTFORD R. R.

During the past summer the New York, New Haven & Hartford R. R. Co. installed the third-rail electric system on 3½ miles of the South Shore branch of the Plymouth division. This is the first surface railway that has ever operated its cars by a conductor laid upon the ground. A three months' trial has proved the success of the system for ordinary railway traffic at high speed. That part of the line where the third rail is laid is a continuation of the track on which the trolley is used. The trolley line is about seven miles long from Nantasket Beach to Nantasket Junction. At the end of this line the trolley slips from the end of the overhead wire, is pulled down and fastened and contact is made with the third rail. A knife switch under the hood of the car being closed, the current from the third rail is thrown into the motors and the operation of the train continues without interruption. The current for the third rail is brought from the power-house over two insulated feeders of copper cable laid along the tops of the poles which carry the overhead wires of the trolley division. At Nantasket Junction the feeders are dropped to the ground, and each is connected to its own third rail.

The third rail is of peculiar shape (Fig. 2), the end view resembling a flattened A; this form is used because it is cheaper than standard sections. It is laid in the middle of each track. Each section of third rail is 30 ft. long, and weighs 93 lbs. per yard. It is supported by three ash blocks to each section, the blocks being let into the ties. Before use these blocks were boiled in vacuum pans with a tar compound, and the cells thus filled with insulating and preservative material. At each rail-joint are two heavy copper bonds.

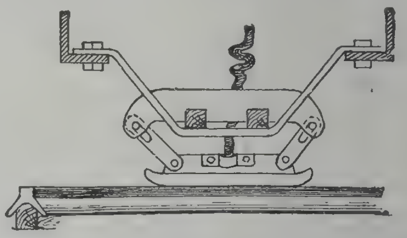


Fig. 1.—Side View of Sliding Shoe, Third Rail System; New York, New Haven & Hartford R. R.

The current is taken from the third rail by two sliding shoes (Figs. 1, 2, and 3) hung loosely from the car, one suspended between the axles of each truck by two slotted links which allow it to slide easily on the top of the third rail. The current is brought to the motors through the controllers and circuit breakers, and returns to the track rails by the wheels. The distance between the two shoes is 33 ft. No third rail is laid at the crossings, the circuit continuing between the broken ends by means of lead covered underground cables. At crossings less than 30 ft. wide, one of the shoes remains in contact, at wider ones the impetus of the moving car brings the shoes into contact again before the car can come to rest. The widest crossing which is run over in this way is 1,200 ft. Each shoe is a cast-iron plate 12 ins. long and 5 ins. wide, and weighs about 20 lbs. It is connected to the motor by a flexible cable. No difficulty has been experienced by the heating of the shoe from the friction, which is due probably in part to the air rushing past it, keeping it cool.

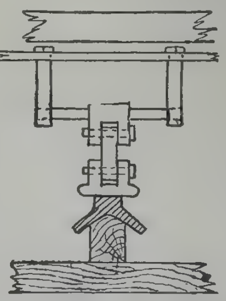


Fig. 2.—End View of Sliding Shoe, and Section of Third Rail; New York, New Haven & Hartford R. R.

The air for the brakes is supplied by an electrically driven air compressor automatically controlled by the air pressure itself. The apparatus consists of a double vertical air pump (Fig. 4) with single-acting cylinders, $5\frac{3}{4} \times 7$-in. stroke, directly connected to a series motor, the lower field of which is extended to form the base of the pump. The capacity of the pump is $52\frac{1}{2}$ cu. ft. of free air per minute, working against 90 lbs. pressure per sq. in. At this pressure the speed is 250 revolutions at 600 volts.

The air compressor is piped directly to the main reservoir, and is controlled automatically by a pneumatic governor consisting of a cylinder containing a piston working against a spring. The action of this automatic control is as follows: The pipe running from the main reservoir enters the cylinder below the piston. As the pressure rises the piston is forced upward against the spring. The other end of the piston rod carries the contacts through which the pump-motor circuit is made and broken. Any arcs that may be made when the contact is broken are blown out in a magnetic field, the coils of which are connected directly in series with the motor. As the pressure in the reservoir falls from 5 to 7 lbs., the piston is forced back by the spring, the contacts are pushed down to their seat, the circuit is closed, current flows to the motor and the compressor starts. The circuit remains closed until the pressure reaches normal when it overcomes the force of the spring, forces the piston upward, breaks the contact and the motor stops. This operation is repeated automatically, the machine requiring practically no attention. The governor can be adjusted to any pressure from 45 to 100 lbs. and works on a difference of from 5 to 7 lbs.

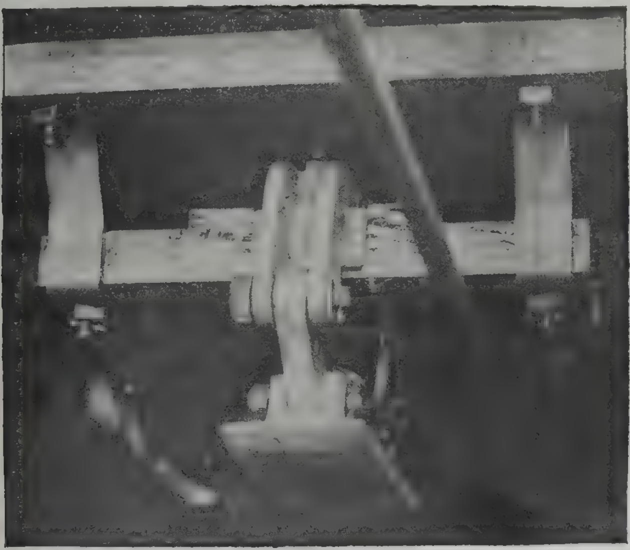


Fig. 3.—Cast-Iron Contact Shoe in Position; N. Y., N. H. & H. R. R.

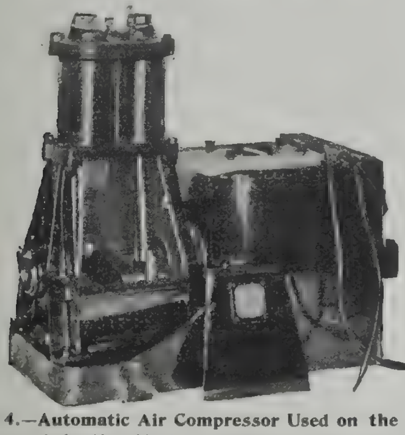


Fig. 4.—Automatic Air Compressor Used on the Electric Cars of the New York, New Haven & Hartford R. R.

Before the third rail was installed two steam locomotives were used on the $3\frac{1}{2}$-mile stretch from Nantasket Junction to East Weymouth. These locomotives burned each day four tons of coal apiece. With the new arrangement not more than four tons are used to generate power for the entire seven miles between Pemberton and Nantasket Junction. Trains have been operated at a speed of 70 to 80 miles per hour.

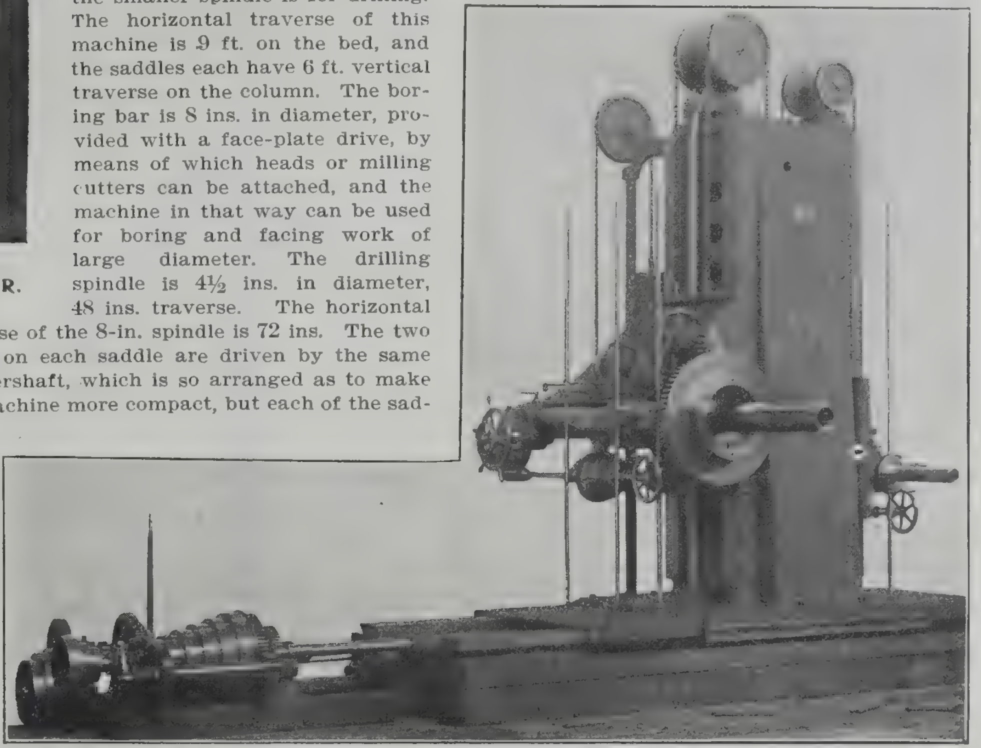
We are indebted to the General Electric Co. for the accompanying illustrations and the information from which this article was prepared.

◆

A HEAVY HORIZONTAL BORING, DRILLING AND MILLING MACHINE.

We illustrate herewith a powerful two-spindle horizontal boring, drilling and milling machine, recently built by The Niles Tool Works Co., of Hamilton, O. The cut shows the machine without the floor tables. These are attached to the bed. They are made either square, circular or rectangular in shape, as may be desired, for the particular work that is to be done on the machine.

The column is traversed on the bed, and is supplied with two saddles on opposite sides of the column. The saddle with the large spindle is for boring purposes, and the smaller spindle is for drilling. The horizontal traverse of this machine is 9 ft. on the bed, and the saddles each have 6 ft. vertical traverse on the column. The boring bar is 8 ins. in diameter, provided with a face-plate drive, by means of which heads or milling cutters can be attached, and the machine in that way can be used for boring and facing work of large diameter. The drilling spindle is $4\frac{1}{2}$ ins. in diameter, 48 ins. traverse. The horizontal traverse of the 8-in. spindle is 72 ins. The two heads on each saddle are driven by the same countershaft, which is so arranged as to make the machine more compact, but each of the saddles are independent of one another in every respect, and are so connected with the driving shaft (which is of large diameter) that either one or the other of the spindles may be thrown out at will. The driving cone is provided with six steps, and is powerfully back-geared. Each of the spindles is nicely counterweighted, and all the feeds and movements of the saddles are within easy reach of the operator, a platform being provided close to each saddle. The weight of this machine is about 80,000 lbs., without any floor plates. It is particularly adapted for large floor plates. It is particularly adapted for large engine work, electric generators, ship building, etc.


HORIZONTAL BORING, DRILLING AND MILLING MACHINE.
Built by The Niles Tool Works Co., Hamilton, O.

◆

A DOUBLE-BLADE SEMAPHORE FOR BLOCK SIGNALING ON THE PARK AVE. VIADUCT; N. Y. CENTRAL R. R.

The new four-track steel viaduct of the New York Central R. R., in New York city, which extends from 110th St. to and beyond the Harlem River, will have a very complete system of lock-and-block equipment, and all the signaling and interlocking plant has been installed by the National Switch & Signal Co., of Easton, Pa. On this viaduct the two western tracks are used for northbound trains and the two eastern tracks for southbound trains, the trains keeping to the left on this part of the line in consequence of the arrangement of the Grand Central terminal station at 42d St. The first signal station for the viaduct line is at 110th St., and this has 12 levers, operating 4 double-blade signals, 4 distant signals and 4 torpedo signals. The station at 125th St. has 22 working levers, operating 8 double-blade signals, 6 distant signals and 4 mechanical slots. The great four-track drawbridge, 400 ft. long, which crosses the Harlem River, between 133d and 135th Sts., is protected by signals controlled from a tower at 135th St., on the north side of the river.

In designing the signal plant, one requirement to be met was that of the officers of the railway to the effect that the system of lock-and-block working which has been in operation for some time in the Fourth Ave. tunnel, should be extended as far as 135th St. Pot signals are used in the tunnel, showing three colors; green, red and white. The block instruments used to control these pot signals are double instruments controlling two levers, and since the two levers operate the same signal, it was necessary to design a movement which would permit of the two levers operating on the same line of connections to the same signal. This was successfully carried out in the tunnel, and since all the signals on the elevated structure are high semaphore signals, it became necessary to design a special signal for that work.

Before proceeding further with the description of the special form of signal designed to accomplish the desired end, it is necessary to explain the purpose of using both red and green. It has been found desirable to use the red and green in the lock-and-block system so that in case of failure of the track circuit or apparatus operating and controlling the signal preventing the giving of a clear signal, it would be possible to pass trains over the road by clearing the red (or "stop") signal, leaving the green (or "caution") signal in the horizontal position. This indicates to the engineman that while both arms are not in a clear position he may proceed since the red signal was cleared, knowing that the only reason he does not receive the white signal is that the apparatus is out of order. It might seem that this is a condition which it is hardly necessary to provide against, but owing to the enormous volume of traffic on these four tracks (which carry all the trains of the New York Central R. R. and the New York, New Haven & Hartford R. R.), it was found that notwithstanding the most careful supervision of the work there were times when trains would be delayed unless this compound signal, as it might be termed, was operated. This is not really permissive signaling, for the red signal cannot be cleared unless the section in advance is unoccupied, but it is a special system introduced in order to provide for the prompt and safe handling of a very heavy traffic. This plan, it will be seen, avoids the necessity of stopping each train while the fireman goes to the signal tower for a green caution card to allow the train to pass the red signal under "caution" as far as the next signal tower. There are two separate circuits, one for each signal (the white and the green) so that it is impossible for an operator finding he cannot give the "white," and assuming that the apparatus is out of order, to give the "green" when as a matter of fact there is an obstruction on the track.

The following rule for signalmen governing this is included in the rules issued over the signature of Mr. J. H. Franklin, General Manager of the Harlem Line:

> Give three (3) bells to get unlocked on your red signal. If advance tower fails to unlock you on red you will put your slide in normal position, which is back. Then pull your green slide in center position and give three-one (3-1) to man in advance tower, and he will unlock you on the green lever. If both fail, use the "Clearance Card" and flag the train.

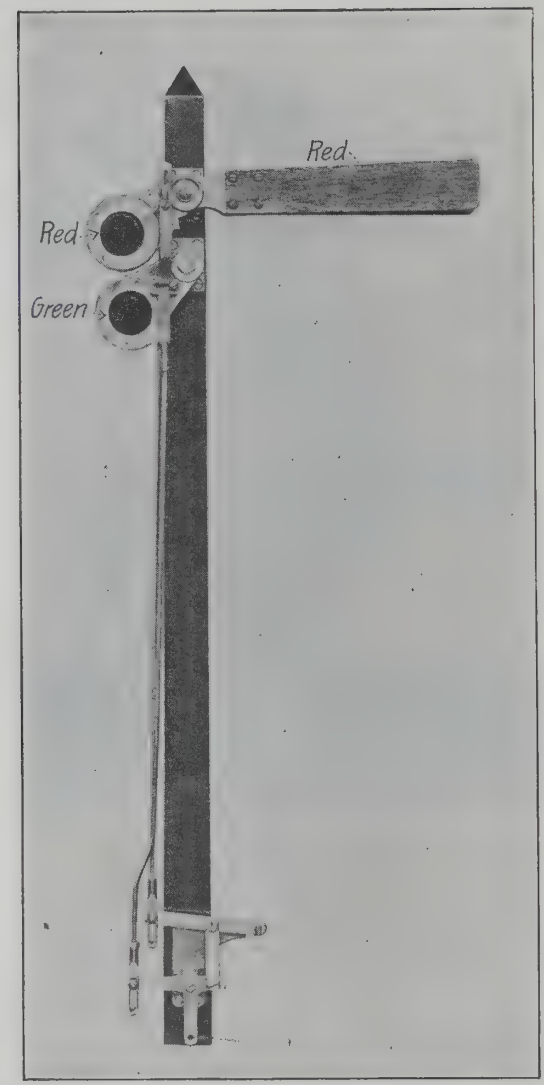


Fig 1.—Normal Position, "Danger."

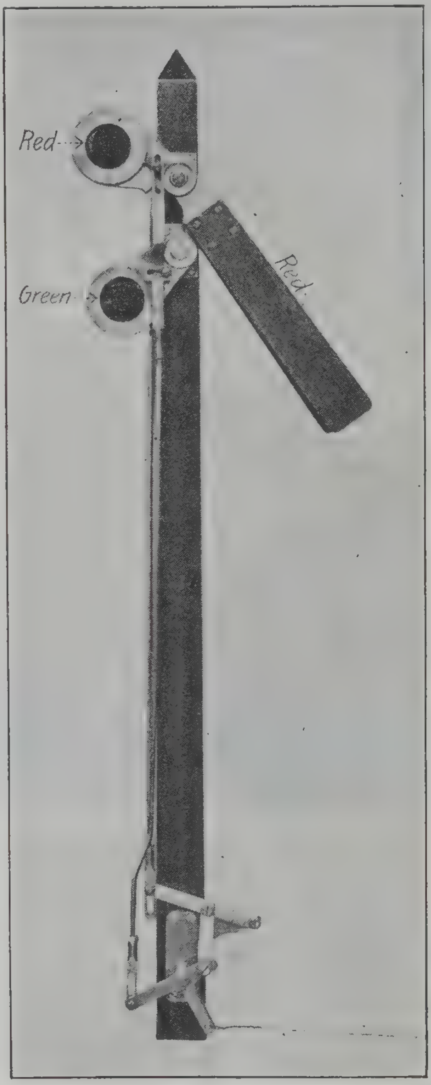


Fig. 2.—Position for "Track Clear."

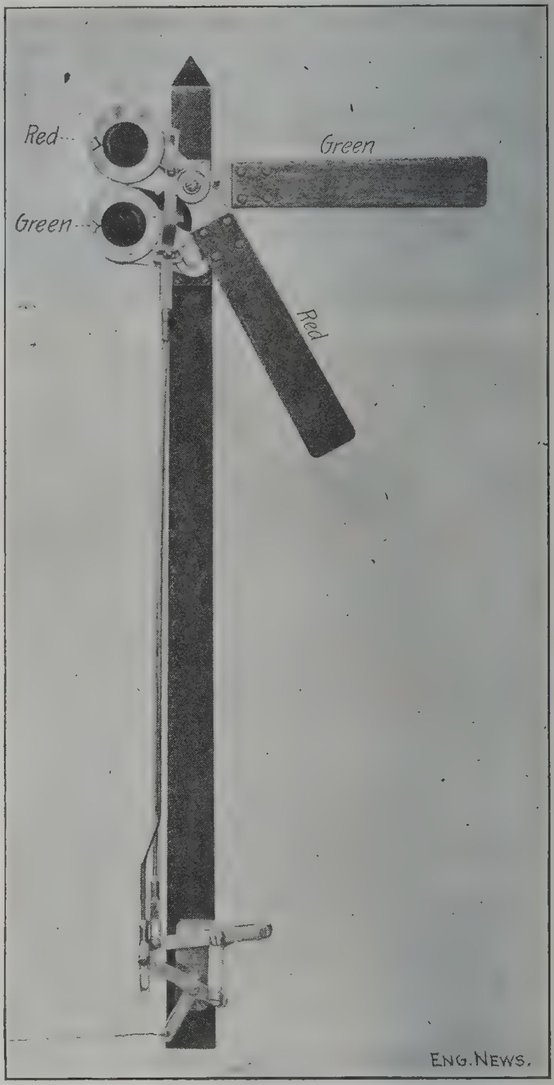


Fig. 3.—Position for "Track Clear," When Signal is Inoperative.

DOUBLE-BLADE SEMAPHORE FOR THE NEW YORK CENTRAL & HUDSON RIVER R. R.

Designed and Installed by the National Switch & Signal Co., Easton, Pa.

The style of double-bladed semaphore signal designed to meet these requirements is shown in the accompanying cuts. Fig. 1 shows the signal at the danger (or "stop") position, with but one semaphore blade visible. Below the regular blade grip will be seen an auxiliary or floating spectacle. There are two up-and-down rods, coupled onto a system of compound levers at the base of the pole. The adjustable jaws on these rods are slotted, as is the top of the outside up-and-down rod where it connects with the blade grip. The floating or secondary spectacle is actuated by a horizontal slot in this up-and-down rod. In the case of the Harlem River work the signal is operated by a single line of pipe. The interlocking machine in the tower has two levers for each home signal, one red and one green, and these levers are coupled to a compound lever below the machine, which in turn is coupled to the rocking shaft.

The normal position of the levers and signal is at danger and in case a clear signal can be given, the operator simply reverses the red lever, thereby clearing both arms as shown in Fig. 2. In case a clear signal cannot be given by reason of any failure in the apparatus, the operator reverses his green lever thereby exerting a pull on the line of connections which lowers the outside or red arm to an angle of 65°, leaving the green blade in the horizontal position as indicated in Fig. 3.

It will be seen by Fig. 3 that the floating spectacle is moved upward to a position in front of the lamp when the green lever is reversed; but when the red lever is reversed, clearing both arms, this spectacle remains in the position shown in Figs. 1 and 2, so that the white light shows between the floating spectacle and the spectacle in blade grip, as in Fig. 2. The blade grip on the green blade is not fitted with glass and simply acts as a counterweight.

Owing to the use of the slot in the adjustable jaws of the up-and-down rod, the reversing of the green lever does not actuate the up-and-down rod connecting with the green blade; while in reversing the red lever, the up-and-down rod actuating the red blade is not moved, the red blade being carried down by a lug on the blade grip of the green blade, which engages with a corresponding lug on the blade grip of the red blade, so that when the green blade is cleared it carries with it the red blade without actuating the floating spectacle.

This style of semaphore signal is applicable for ordinary permissive block signaling. In this case, however, it is not necessary to have two levers in the interlocking machine, as one lever can be made to do all the work, one arm being lowered by the half stroke, and both arms by the full stroke of the lever. This can be operated with either pipe or wire, but for block signal stations where the expense would be but little greater if pipe were used, the use of pipe is recommended as giving a more positive connection.

THE ANNUAL CONVENTION OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

The third annual convention of this society was held in Chicago, Oct. 14, 15, 16 and 17, 1896, and proved very successful both socially and in the character and variety of the technical papers and discussions. The total attendance was about 150 members, about half of whom were in constant attendance at the meetings. Altogether 21 papers and 6 reports of committees were considered during the six working sessions, rather too large a number for the proper discussion of all, yet by grouping the reports and papers on the same subject and discussing them in a body instead of individually the time was used to the best advantage. Some time was lost in irrelevant discussion, but the presiding officers kept such discussions pretty well in hand, all things considered. The discussions also lost something in interest through the fact that the members had to base their remarks upon what they could catch from hearing the papers read. It is to be hoped that the society will be in a condition by another year to have the papers printed and distributed to the members some time in advance of the convention.

The opening session on Oct. 14 was devoted to routine business and the usual addresses of the President and others. Mayor Geo. B. Swift, of Chicago, welcomed the convention to the city with a few brief remarks. Mr. Geo. G. Benzenberg, M. Am. Soc. C. E., the president of the society, then presented his annual address. Mr. Benzenberg called attention to the fact that the society's object was not so much to secure better city government as it was to secure to the citizens and taxpayers of such municipalities the most economical and best class of public improvements obtainable. He continued in part as follows:

> Millions of dollars are annually expended in reconstruction too frequently made necessary by the introduction of improper material, imperfect plans or by the lack of information and experience of those into whose hands such work has been intrusted. It is not to be supposed that the conditions largely responsible for such state of affairs are likely to be remedied, excepting through the slow process of development towards a more stringent and accountable administration of public affairs. With such evolution, however, this society has no connection, its object being distinctly to improve our competency and efficiency in the discharge of our respective duties by the interchange of experience, by the presentation and discussion of papers, and by preserving in our proceedings for mutual reference and study such practical information as may be collected.
>
> Although meeting to-day for the third time, this society was not fully organized until at its last meeting in Cincinnati, nor were its objects fully set forth nor its work intrusted into the hands of committees until at that meeting, hence no organized work of the convention was possible until now. The faithful and arduous work of the committees, represented in their reports at this meeting, indicates what may be accomplished by systematic and careful investigation, and the numbers and subjects of the papers to be presented demonstrates clearly the interest of our membership in the questions most prominent in municipal improvements to-day. This work, however, should be expanded, taking in every kind of municipal government in all its legislative and administrative branches, uniting them all into one organization whose work could be divided into sections under each department head, considering all topics not only in the entirety but in all its details, for it is the latter that most frequently puzzle the inexperienced in our smaller cities where growth demands new improvements. The best methods of selecting paving bricks, of testing sewer pipes, paving and other cements, the most satisfactory and economical system of cleaning streets, of collecting garbage and ashes, of cleaning or flushing sewers, the best manner of regulating the too promiscuous opening of street pavements by corporations and individual property owners, of introducing protective sanitary measures in all house plumbing and draining, of securing the best railway track construction in streets, the abatement of smoke and other nuisances, the regulating of traffic by a wagon or tire tax, of providing the best kind of underground service for all classes of wires, of securing to the public a suitable return for all corporate franchises, of enforcing honest competition and honest work on the part of contractors for public works, are some of the questions in which all are interested and many of us seek the experience of other cities.
>
> The rapid development and growth of many cities make necessary that municipal improvements assume a more permanent and durable character, obviating the necessity of frequent reconstruction. Temporary expedients in municipal work are too frequently expensive mistakes and should be always discouraged. It is preferable that progress in improvements be slow so they assume a permanent character and relieve the property owner as much as possible from the burden of reconstruction. Such practice, of course, is not always in the first instance approved of by the taxpayer, but there is no lack of object lessons to demonstrate its economy. Our efforts as an organization should be exerted in that direction and its work will be more readily appreciated by the citizens when they observe that perfection, durability and economy are the motives which direct our convention labors. Much study and committee work will be required to sift out the best methods and results from the different local experiences.

The report of the Secretary and Treasurer showed the society to be somewhat in debt, but in such a condition that the coming year with its increased membership might see the debt cleared away. To provide for future contingencies it was decided to consider at the next meeting the revision of the constitution so as to increase the annual dues from $3 to $5.

In the afternoon session the business of reading and discussing the committee reports and papers was begun. These were divided under the following heads: Street Paving, committee report and twelve papers; Electric Street Lighting, committee report and one paper; Sewerage and Sanitation, committee report and two papers; Water-Works and Water Supply, committee report and five papers; report of committees upon Taxation and Assessment, and City Government and Legislation; paper on Garbage Disposal at Milwaukee. In this report of the proceedings of the convention only a brief summary of the various papers and the discussion which followed them will be given, but in future issues it will be the purpose to present some of the papers in more extended form.

Street Paving.

The consideration of this subject was opened by the presentation of the corresponding committee report by Mr. A. D. Thompson, City Engineer, Peoria, Ill., Chairman. Its substance was that the committee had deemed it best at the present session to devote its attention simply to securing papers covering different branches of the problem. Twelve such papers had been secured and would be presented.

Under the title of "Advantages of an Asphalt Testing Laboratory," Mr. N. P. Lewis, Brooklyn, N. Y., described the asphalt testing laboratory established in that city at a cost of some $2,500. Although recently installed this laboratory had shown its value in many respects and gave promise when the analyses and tests had progressed further, of furnishing much valuable data for the use of the department. A paper on "Specification Requirements for Asphalt, Asphalt Mixtures and Tests for Asphalt," by Mr. A. W. Dow, Inspector of Asphalts and Cements, Washington, D. C., was read by title and will be further considered in another issue. Two papers of a descriptive character followed: One entitled "Paving Street with Brick," by J. S. Hathaway, Chairman Street Committee, Marietta, O., and the other entitled "Paving in Nashville, Tenn.," by J. L. Kennedy, Member Board Public Works, Nashville, Tenn. Mr. F. W. Cappelen, City Engineer, Minneapolis, Minn., in a paper entitled "Modern Street Railway Track Construction on Asphalt Paved Streets in Minneapolis," described the special methods of track construction adopted in the city mentioned. Some of the particular features of this work will be presented in a future issue. The paper following was by Mr. A. D. Thompson, City Engineer, Peoria, Ill., entitled "Testing of Paving Brick," and described the absorption, transverse breaking, and abrasion tests adopted in the city mentioned and already described in Engineering News.

Two papers discussing regulations for opening street pavements were read by Capt. Lansing H. Beach, U. S. Engineer Corps, Washington, D. C., and Mr. G. D. Snyder, City Engineer, Williamsport, Pa. Capt. Beach gave in much detail the laws and regulations governing the opening of pavements in the National Capital, where the restrictions were very stringent as compared with most other cities. In Williamsport the idea followed is to anticipate future openings as far as possible by requiring all improvements to be made before the pavement is laid. When openings are necessary the permit is charged for at the rate of the original cost per square yard of the pavement to be opened. In replacing the pavement the person opening it is required to fill the trench as thoroughly as possible, and then, whatever the foundation of the original pavement, to lay a concrete foundation spanning the trench for the new pavement. This construction had been fairly satisfactory in preventing settlement.

In a paper on "Rumbling of Brick Pavements," Mr. E. Adam, Engineer Board Street Commissioners, Newark, N. J., described the troubles of this nature experienced in the city mentioned. He found that the rumbling occurred on pavements with grout filling, but not on pavements with sand filling, and was disposed to attribute the cause to expansion which raised the pavement from its foundation. A paper on "Improved Streets and Their Care," by Col. M. A. Downing, Chairman Board of Public Works, Indianapolis, Ind., followed next and described briefly the work of the city named in the matter of street paving. Practically all the work of improving streets in Indianapolis had been done within five years, and that city now had, exclusive of the work done in 1896, 28 miles of asphalt, 15 miles of brick, 5 miles of wood block and 2 miles of macadam. These pavements, except in a few suburban streets and in alleys, were laid on a 6-in. concrete foundation. In suburban streets 4 ins. of concrete were used and in alleys broken stone. Brick pavements did not find much favor, partly from the fact that poor material had been used. At present wood block pavement was favored. Yellow pine blocks, 4 × 6 × 9 or 12 ins., creosoted with 12 to 14 lbs. of creosote per cubic foot, laid on a 6-in. concrete foundation were used. The final paper on street paving was by Mr. E. B. Guthrie, Chief Engineer, Buffalo, N. Y., and was entitled "Cost of Repairing Asphalt Pavements." As the information given was largely in the form of tables it will be considered separately at a future time.

Discussion.

The discussion which took place on the papers presented was somewhat discursive, and neglecting its order of occurrence it is here collected under separate heads as far as practicable.

Asphalt Pavements.—Mr. N. P. Lewis, in response to questions, stated that chemists were not agreed as to what chemical action took place when carbonate of lime was added to asphalt. Physically it filled the voids, made the pavement harder and consequently tended to make it more slippery. The experience with the testing laboratory at Brooklyn had not yet been long enough to enable a certain determination whether a sample was lake or rock asphalt, but it indicated that the relative percentages of petroline and asphaltine might be a good determination. The use of asphalt in Brooklyn had been too short to enable a determination as to whether rock or lake asphalt was the better, but the major part of the pavements now laid were Trinidad lake asphalt. The cost, exclusive of curbing, of a pavement made up of a 6-in. concrete foundation, ½-in. cushion coat, and 2 ins. wearing surface, was $2.54 per sq. yd. for a 24-ft. roadway; cost of a 1-in. cushion coat and 2-in. wearing surface laid over old cobblestone pavement on a 34-ft. roadway, was $1.84 per sq. yd.

Mr. L. W. Rundlett, City Engineer, St. Paul, Minn., stated that the lowest cost for asphalt pavement in that city had been $1.95 per sq. yd. A five-year guarantee was required. Mr. A. D. Thompson, City Engineer, Peoria, Ill., stated that in Peoria, Ill., asphalt pavement, 6-in. concrete foundation, ½-in. binder, and 2-in. wearing surface cost from $1.84 to $1.90 per sq. yd. A five-year guarantee was required. Mr. E. B. Guthrie, Chief Engineer, Buffalo, N. Y., stated that for the last two or three years the asphalt paving in that city had cost about $2.45 per sq. yd. Mr. Geo. H. Benzenberg, City Engineer, Milwaukee, Wis., stated that pavement with a 6-in. concrete foundation, 1-in. binder, and 2-in. wearing surface, excluding curbing and deducting spaces for manhole covers, etc., but including grading, cost from $1.95 to $1.99 per sq. yd. This was pavement in streets having no street railway tracks, but in streets having such tracks, 7 ins. of concrete, 1-in. binder and 2-in. wearing surface was used, with a 20-in. brick gutter on each side, and cost $2.31 to $2.34 per sq. yd. This included laying a granite course along the inner line of tracks, stone being furnished by the railway company. The railways were also required to maintain the pavement between tracks and 1 ft. outside of outer rails. If the stone courses were not used unsatisfactory results followed. These also occurred when the cross ties and rails were not laid on a concrete foundation as the oscillation broke up the pavement.

The discussion closed with a brief consideration of what was meant by an asphalt pavement in good repair, which was called out by the fact that trouble occurred with asphalt paving companies as to the meaning of the term when turning over pavement to the city at the end of their guarantee. The opinion of those most familiar with the subject was that rigid specifications should be drawn to cover this point, and a resolution was adopted by the convention asking that a special committee be appointed to present such specifications at the next annual convention.

Brick Pavements.—Practically the whole discussion turned upon the testing of brick and the rumbling of brick pavements, the first drawing out the usual variety of conflicting opinion. Mr. M. L. Holman, of St. Louis, Mo., stated that that city had gone thoroughly into the subject of testing paving brick for the purpose of evolving a practical commercial system of testing. They had even laid pavements and driven horses and wagons over it continuously to discover the real action of traffic. In the laboratory their tests and the results from them had been as follows: The absorption had been rapid at first, but became slower the longer the time, and continuing to a small extent for some months. From the experiments, he concluded that 48 hours could be considered to give a fair test. Abrasion tests were carried out in a 26-in. × 4-ft. foundry tumbling barrel. It was found that by plotting the results a regular curve was obtained which was comparable with other curves obtained from bricks of the same manufacture but not with those of other manufacture. In cross breaking tests it was found that bricks of good quality broke at the center of the span, but poor quality bricks broke irregularly, the break following lines of defect. To determine the interior structure an apparatus had been devised to split the brick. Good quality bricks split straight, while the fracture in those of poor quality followed the lines of defect. Tests were now being made to determine the effects of freezing by artificially freezing the bricks from the top down, just as such freezing would occur in the pavement. As the result of all experiments, he had excluded all but the cross breaking and abrasion tests for practical use. He did not think that the interior of a brick which absorbed more than 2% of water was thoroughly compacted and free from laminations.

In respect to the rumbling of brick pavements Mr. N. P. Lewis stated that they had experienced trouble in Brooklyn, N. Y., and attributed it to the fact that the sand cushion contained frost when the pavement was laid, and when in warm weather the sand thawed a void was left under the pavement. His opinion had been confirmed by reports from other cities, and he could not bring himself to believe that grout filling and expansion had much to do with the trouble. Mr. A. D. Thompson, City Engineer, Peoria, Ill., considered that if the pavement was properly laid no trouble from rumbling need be had with grout filling or any other kind of filling.

Wood Pavements.—The paper describing the adoption of a wood block pavement in Indianapolis and the approval of its continued use by the Board of Public Works of that city raised a somewhat heated discussion. A number of the members were disposed to condole the city on the mistake it had made and cited numerous cases in which wood block paving had been a total failure in this country. It developed in most instances, however, that the cities having these sad experiences had adopted wooden block because it was cheap, if constructed as it usually is constructed in America, and the sand and plank foundations, untreated blocks of cedar and white pine, and improper joint filling, had worked the failure which might have been readily anticipated. In a brief discussion Mr. Geo. H. Benzenberg insisted upon the fact that such wooden block pavements as were usually constructed in this country could not be justly compared with pavements made of sound creosoted or otherwise treated blocks, laid on a concrete foundation with proper attention to joint filling, such as are laid in European cities. He, however, considered that no advantage in cheapness of cost could be expected in wood pavements properly laid. Mr. F. W. Cappelen, City Engineer, Minneapolis, Minn., considered wood block inadvisable on account of cost of maintenance. Where, however, the people were willing to stand this expense no better pavement could be desired. In Europe it was tacitly understood that the blocks were to be replaced every four or five years, but for the other advantages secured the people were willing to pay for this maintenance.

Opening of Pavements.—Although the discussion was quite voluminous on the question of regulating the opening of street pavements by persons and corporations desiring to make gas and sewer connections, etc., it consisted mostly of a relation of troubles and of stating the urgency of more stringent laws. Mr. N. P. Lewis, of Brooklyn, N. Y., stated that it was the practice of that city when about to lay a new pavement to give 15 days' notice to all persons to complete their improvements in advance. After the pavement was once laid no permits were allowed for a period of five years for asphalt and brick pavements, or three years for other kinds. This could not be enforced. At present the cost of permits for street openings is $13 from March to December and $18 for the remainder of the year. In the city of New York the least charge was $4.50 per sq. yd. and no permit was granted for less than a 4-sq. yd. opening. In further discussion it was developed that many states had laws authorizing connections to be carried to the curb lines at the time of constructing the pavement.

Electric Street Lighting.

The consideration of this subject comprised an elaborate committee report and a paper by Mr. J. A. Cabot, City Electrician, Cincinnati, O., entitled the "Municipal Control and Inspection of Electrical Construction in Cincinnati." The report consisted of a tabular statement of plant, operating expenses, cost, etc., of the electric street lighting plants in upwards of 100 American cities and will be considered in a future issue. Only a brief discussion followed the report and papers, and this consisted mostly of replies to questions regarding misunderstood points in the report and paper.

Sewerage and Sanitation.

The committee on this subject had no formal report to present but had secured two papers which were then read. Capt. Lansing H. Beach, U. S. Engineer Corps, Washington, D. C., presented the first of these under the title of "Construction of Pipe Sewers to Prevent Root Intrusion." In the city of Washington, D. C., the great abundance of shade trees had caused much trouble from the roots getting through the joints into the sewers and otherwise disturbing them, and a special construction had to be adopted to overcome the difficulty. The plan adopted was to bed the pipe in concrete on the bottom and sides and at the joints to carry a 4-in. thick ring of concrete over the top. Hub and spigot joints were not used in this construction, which had been very efficient for the purpose intended. The second paper under the head of sewerage was read by Mr. G. L. Clausen, Superintendent Sewer Department, Chicago, Ill., and described the "Sewers and Sewage Disposal of Chicago." The paper was a relation of subject matter already familiar to our readers. The discussion on the papers proper was brief and needs no extended mention. Mr. Geo. H. Frost, of Engineering News, described at some length the sewage disposal system constructed under his direction at Plainfield, N. J., and already fully described in these columns, and called attention to the fact that with the growing stringency of legislation regarding the pollution of streams, this and similar methods of disposal should be carefully studied by engineers.

Water-Works and Water Supply.

The report of the committee on this subject was read by the Chairman, Mr. H. Van Duyne, Newark, N. J., and consisted in a summary of the features particularly needing study. Among these the report mentioned particularly, growth of algae and other organisms, trouble from anchor ice at all gate houses, and sewage pollution. Four papers followed this report, of which those on "Water-Works at Nashville, Tenn.," "Filtration of Water Supply at Davenport, Iowa," and "Biology of Water, Microscopical Organisms and the Determination of Quality," covered features already made familiar to our readers in previous issues. The fourth paper was by Mr. John W. Hill, M. Am. Soc. C. E., Cincinnati, O., and took up the question of the purification of "Water Supply in Eight Cities in Relation to Typhoid." A description of the methods of water purification at Berlin, Zurich, The Hague and Liverpool was given and compared with the lack of such methods in New York, Philadelphia, Cincinnati and Chicago. Comparisons were drawn between the death rates by typhoid of these cities, in which perhaps the most notable fact was that Chicago showed the worst conditions, its typhoid death rate being for the past five years 10½ times that in Berlin. No discussion followed these papers.

Under this same head came the paper on "Method of Treating Garbage in Milwaukee," by Dr. Walker Kempster, Commissioner of Health. This plant has already been fully described in Engineering News, as has also the plants at Buffalo, N. Y., and Cincinnati, O., which were described in the discussion which followed. The discussion brought out nothing concerning these plants which we have not given in the articles mentioned.

City Government.

Under this head came two reports of committees on "Taxation and Assessment" and "City Government and Legislation," both of which were very elaborate and entered into the general discussion of broad questions of law and municipal management too extensively to be taken up here. They elicited no discussion.

Election of Officers.

The election of officers for the society for the coming year took place on the second day of the convention and resulted in the following selections: President, August Herrmann, President Board of Administration, Cincinnati, O.; First Vice-President, E. B. Guthrie, M. Am. Soc. C. E., Chief Engineer, Buffalo, N. Y.; Second Vice-President, Wm. R. Kerr, Health Commissioner, Chicago, Ill.; Third Vice-President, E. Adam, Engineer Board of Street and Water Commissioners, Newark, N. J.; Secretary, D. L. Fulton, Superintendent of Sewers, Allegheny, Pa.; Treasurer, J. L. Kennedy, Nashville, Tenn.; Finance Committee, L. W. Rundlett, City Engineer, St. Paul, Minn.; A. F. Monroe, Chairman Public Works, Omaha, Neb., and F. J. O'Brien, Superintendent Public Works, Oswego, N. Y.

Committees were appointed to report at the next annual convention upon the following subjects: Street Paving, Electric Street Lighting, Sewerage and Sanitation, Water-Works and Water Supply, Taxation and Assessment, City Government and Legislation, Disposition of Garbage and Street Cleaning, Reviews. The place selected for the next place of meeting was Nashville, Tenn.

Excursions and Entertainments.

Several excursions and entertainments were arranged by the local committees for the pleasure of the convention members. On Oct. 15 an excursion along the line of the Chicago Drainage Canal was tendered by the trustees of that work, and on Oct. 17 an excursion to the water-works intakes by boat and a coach ride through the South Side parks and boulevards took place. On the evening of Oct. 16 a banquet was tendered to the members by the local committee. These various entertainments were participated in by the majority of the delegates present and were thoroughly enjoyed.

BOOK REVIEWS.

A TEXT-BOOK ON GAS, OIL AND AIR ENGINES, or Internal Combustion Motors without Boiler.—By Bryan Donkin, M. Inst. C. E. Second edition. Revised and largely Rewritten. London, 1896. Chas. Griffin & Co., Limited. 8vo.; pp. 500; 154 illustrations.

This work, by a well-known English engineer, is the standard work on its subject. The present edition brings it up to date. It is a very complete treatise, including the history, theory, practice, bibliography, list of patents, etc., A table in the appendix contains the principal results of 147 tests of gas, oil and air engines from 1878 to 1895.

A PRACTICAL TREATISE on Segmental and Elliptical Oblique or Skew Arches, setting forth the principles and details of construction in clear and simple terms. By George Joseph Bell, County Surveyor and Bridge Master of Cumberland. London and New York. E. and F. N. Spon and Spon & Chamberlain. 8vo.; 125 pp.; 8 plates. $8.40.

The author aims to simplify the rules of construction for oblique arches, and devotes pages of text to a description of the mathematical processes to be gone through with. Close attention to these directions will doubtless enable an engineer to build an oblique arch—if he must, but the plates are chiefly elevations of plans of such arches as built and have little value to the student. It is to be regretted that the author did not indulge more in illustrative matter relating to the practical application and the appearance of the various necessary templates. The construction of arches of this type is rarely called for in the United States; and when the occasion does arise both the engineer and the stone-cutters have to be initiated in what may be simple work to Mr. Bell. This detail is just what he has omitted, and it is the only part that would warrant a new treatise on a rarely applied art, in this country at least.

ELEMENTS OF MECHANICS, including Kinematics, Kinetics and Statics. With Applications. By Thomas Wallace Wright, M. A., Ph. D., Professor in Union College. New York: D. Van Nostrand Co. London: E. & F. N. Spon. 12mo.; pp. 372. $2.50.

This book, the author states in the preface, is a completely rewritten edition of his "Text Book of Mechanics." The sections on graphical methods have been extended. Machines have been discussed in greater detail. New problems and illustrations have been added throughout. To each chapter is appended a series of examination questions on the text preceding or capable of being easily deduced from it. No mathematics has been introduced beyond the elementary principles of geometry, trigonometry and the calculus. The book is so arranged that the sections involving calculus may be omitted without disturbing the continuity, and thus a more elementary course be taken. The British and metric gravitation systems of units and also those of the C. G. S. system, with their dimensions, are all fully treated.

We find a great deal to commend in this book, and in the hands of a skillful teacher it should prove an excellent text book. The explanations are in general very clear, and the great number of practical examples for numerical computation will prove an admirable exercise for the student. We regret, however, that the author has fallen into the pitfall which has been prepared for all modern writers of mechanical text books by those scientists who have injected into the literature of the subject new terms and definitions and new methods of theorizing. With the various gravitation units, British and metric, the absolute or C. G. S. (centimeter, gramme second) and the M. K. S. (meter, kilogramme second) with their "dimensional" formulas, in which force is defined as a function of length, mass and time with a negative exponent, and with a great number of new units, such as megalergs, kines, boles and spouds, it is no easy matter for any author to steer a clear course, and at the same time make his text consistent with his definitions and clear enough to be understood without a great deal of labor. That the present author has made an earnest effort in this direction is apparent, but he has not been very successful. In his preface he tells us that he uses the term "centrifugal force," although there are objections to it, because as all engineers use the term it will not do to ignore it. On the other hand, he confines the use of the term mass to the absolute system of units only. It is not easy to see why he does not use it in the sense in which all engineers who have studied Rankin use it, namely, as the quotient of the weight of a body divided by the factor g, or the acceleration due to gravity. With the more recent writers he begins the study of the subject with velocity instead of with force. The second chapter treats of Newton's laws of motion, and in it we find his first definition of force in these words:

> From the law (Newton's first law) we also learn that by the term force is meant a cause of change in motion, not in the sense of moving agent, but in the sense of antecedent. Force is thus not to be regarded as the cause of a state of motion, but of a change of state, from rest to motion, motion to rest, or to an alteration of motion—in a word, of acceleration. Whenever force acts an acceleration of the motion of the body acted upon is produced.

To say that force is not to be regarded as the cause of a state of motion, but as the cause of a change of state from rest to motion, is a verbal splitting of hairs which is highly objectionable in a work of this kind, but the last sentence in the above quotation is unpardonable, for it is untrue except when the force is unbalanced and the body is free to move.

Under Unit of Energy we find the following:

> The unit of energy must be the same as the unit of work. In the British system the unit is therefore the foot-pound. Note that unit kinetic energy is not the energy of unit weight (1 lb.) moving with unit velocity (1 ft. per sec.), but only one-half that quantity.

The expression "unit kinetic energy" is a bad example of the prevailing tendency to define "units" of every conceivable kind, compound as well as simple. If the unit of energy, kinetic or other, is one foot-pound, and the formula for energy is $\frac{1}{2} w v^2 \div g$ then the energy of a body whose weight is 1 lb. and whose velocity is 1 ft. per second is $1 \div 2g$ foot-pound. According to the author's statement, "unit kinetic energy" is one-half of this quantity or $1 \div 4g$. No doubt he does not mean this, but this is our understanding of his language.

Further on we find this, under Conservation of Energy:

> It is perhaps more in accordance with the spirit of modern science to consider space, time, matter and energy as the fundamental concepts of mechanics rather than space, time, matter and force. * * * The latter method, which is that followed in this book, is given as being more readily appreciated by the beginner. But as it involves difficulties from which the first is free it seems likely that the notion of energy will in time be adopted universally as the fundamental one rather than that of force.

We think the author has done well in following the second notion spoken of, in considering force and not energy to be the fundamental concept. If it is "more in accordance with modern science" to consider energy as the fundamental concept, then it seems to us that modern science is science run mad. Force, defined as anything which tends to cause motion, such as a push or a pull, is a fundamental concept which can be appreciated by any student, but energy, whether defined as F S, the product of the acting force into the distance through which it acts, or as $\frac{1}{2} M V^2$, or half the product of the mass into the square of the velocity, is a compound concept, and its measure can only be given in a compound unit, such as a foot-pound. Consider one of the simplest cases of mechanical action, an apple falling from a tree. We have as fundamental ideas in mechanics the matter, mass or weight of the apple, the attraction of gravitation, or the force which causes it to fall, the space or distance through which it falls, and the time during which it falls. We cannot calculate its energy without considering at least two of these elements, the weight and the distance, or the mass (weight $\div$ g) and the final velocity.

We have expressed ourselves thus at length upon this subject because we consider it is high time that a protest should be made against one of the tendencies of "modern science," which is the introduction into literature of new and unnecessary terms, definitions which are lacking in clearness and precision, and in many cases contradict those which have been approved by the usage of generations of scholars, and "fundamental concepts" which are contrary to common sense. If there is any science which should be kept free from such innovations it is mechanics, a science which is practically as finished and unprogressive as geometry. No new facts are likely to be developed in it in the next century, and the method of presenting it which was in use 20 years ago can scarcely be improved on. The only change that can be made is that which is attempted by some writers who are introducing the innovations, and are apparently trying to make mechanics not a useful tool for engineers, but a branch of metaphysics, in which discussion of "concepts" takes the place of exemplification of facts.

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- A New Mississippi River Dredge—Correction—The Cement for the Melan Bridge at Topeka, Kan.—Noisy Brick Pavements.

THROUGH TRAINS OVER THE BROOKLYN BRIDGE, connecting with the elevated railways and street car lines on either side, were considered at the meeting of the Bridge Trustees Oct. 26. Mr. Wurster, mayor of Brooklyn, spoke strongly in favor of some definite steps being adopted instead of continually postponing consideration of the question. It was eventually decided to employ three engineers, who, together with Mr. C. C. Martin, the Chief Engineer, will form a board of engineers to examine the bridge and settle once for all the feasibility of through and continuous traffic; the sum of $3,000 was ordered appropriated for this purpose. Two engineers are to be selected by the mayors of the two cities, and the third one by the vice-president or president of the Board of Trustees. Mr. Howell, the president, has appointed Mr. L. L. Buck, M. Am. Soc. C. E., who is chief engineer of the new East River Bridge.

◆

PNEUMATIC TUBES FOR CARRYING MAILS are to be laid across the Brooklyn Bridge, connecting the main post-offices of New York and Brooklyn. There will be two 8-in. tubes, the terminals and power plant being in the two post-offices. The right to lay the tubes has been granted to the New York Mail & Transportation Co., at a rental of $1,000 per year for five years. The work is to be done under the supervision of Mr. C. C. Martin, Chief Engineer, and is to be completed by March, 1897. The company will receive $14,000 per year from the government.

◆

AN EAST RIVER TUNNEL RAILWAY to connect New York and Brooklyn is now proposed by the New York & Brooklyn Ry. Co. The tunnel tracks are to come to the surface at each end, to afford direct connection with other lines. The proposed tunnel is to run from the junction of Myrtle and Willoughby Aves., Brooklyn, across the East River, in almost a straight line, parallel to the Brooklyn Bridge, to the New York terminus, at Park Row and Ann St. It will be lighted by electricity. The general plan is to have two tracks in two tunnels, thus making a four-track line. These tunnels will be 8,700 ft. long, and the two tunnels together will be 45 ft. wide. The grade at either end will not be more than 4%. This is the project which has been brought forward from time to time by Mr. B. S. Henning, who is President of the company. The directors include Emerson McMillin; Silas B. Dutcher, President of the Hamilton Trust Co., of Brooklyn; J. N. Partridge, President of the Brooklyn City & Newtown Ry.; Henry W. Slocum, former President of the Coney Island & Brooklyn Ry., and James C. Church, Secretary of the Nassau Electric Ry.

◆

THE NEW EAST RIVER BRIDGE contract for the New York tower has been awarded to Patrick H. Flynn, of Brooklyn, for $367,000, under a bond of $250,000. The stone is to come from the New Jersey quarries of Jesse S. Carman. The engineer's estimate for building this tower was $477,000.

◆

AN AIR-BRAKE PATENT SUIT is now being argued in the U. S. Supreme Court, though that court does not often take up patent suits. The case is that of the Westinghouse Air-Brake Co. against the Boyden Brake Co. The case was carried to the Supreme Court on a writ of certiorari from the appellate court of the fourth circuit at Richmond.

◆

THE LOOP TERMINAL of the Chicago elevated railways, described in our issues of July 16 and Aug. 20, is now to be pushed to completion, the Supreme Court having decided that the property owners along the line cannot prevent by injunction the building of the line.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week, and the most serious accident which we have had to record for some time, was a head collision, Oct. 25, on the St. Louis & San Francisco R. R., near Meramec Highlands, St. Louis, Mo. The second section of a westbound excursion train for St. James, Mo., had orders to stop at the Windsor siding to pass an eastbound accommodation train from Valley Park. The engineman, however, tried to reach the next siding, with the result of causing a collision, in which eight persons were killed and 16 injured. The eastbound train was composed of a combination passenger and baggage car and one day car. The westbound train was composed of a combination baggage and refreshment car, and ten day cars. The first two cars of this train were telescoped and smashed, and in them occurred most of the casualties.

◆

TWO RAILWAY DRAWBRIDGE ACCIDENTS are reported. On Oct. 20, while the drawbridge which spans the guard lock of the Morris Canal, at Dover, N. J., where the canal crosses the Rockaway River, was being raised to allow a canal boat to pass, a work train on the High Bridge branch of the Central R. R. of New Jersey backed down upon it. The rear car, a combination car, filled with laborers, ran half-way up the draw, which was tilted at an angle of about 45°, causing the bridge to fall, but nobody was injured.——On Oct. 26, the theater train from New York, on the New York, New Haven & Hartford R. R., was derailed by the derailing switch at the drawbridge at South Norwalk, Conn. Owing to the speed of the train, it ran through the sidetrack and the engine and baggage car went down a 50-ft. bank, but nobody was hurt. An investigation will be made to ascertain whether the accident was due to a wrong signal or to a failure to observe the signals.

◆

A RUNAWAY CAR on a cableway at the works of the Pioneer Electric Power Co., near Ogden, Utah, struck one of the posts and two persons were thrown out and injured. The accident was due to a failure of the brake on an incline 300 ft. long.

◆

THE COLLAPSE OF A RAILWAY BRIDGE on the Chicago Great Western Ry., over the Platte River, occurred Oct. 21, while a freight train was crossing. Three men were killed and 11 cars were wrecked. A passenger train had crossed the bridge only a few minutes before.

◆

AN EXPLOSION OF DYNAMITE occurred, Oct. 26, at the works of the Acme Powder Co., near Pittsburg, Pa., and two men were killed. It is said that 1,000 lbs. of dynamite exploded in the packing house.

◆

A BIG QUARRY BLAST WAS FIRED at the Long Cove quarries of Booth Bros., in Maine, Oct. 23. About nine tons of powder were used and 500,000 tons of rock were lifted and split up. A shaft had been sunk 64 ft. deep, and two tunnels were run from this, with a cross tunnel at each end.

◆

THE RESPONSIBILITY FOR THE BUILDING ACCIDENT at 1078 Madison Ave., on Sept. 26, has been placed by the coroner's jury on Frederick H. Hawkins, who superintended the construction of the building; on Anton D'Andrea, the stone mason, who built the foundation walls; and on the Building Department. The jury recognized the difficulties under which the department labors, and added the following rider to the verdict:

> We hold responsible the Department of Buildings of the city of New York for insufficient inspection. We deplore that a lack of finances tie the hands of the Department of Buildings, while the law calls upon it to perform inspections, which, under the present conditions, are practically a physical impossibility to the available force.

◆

THE EXCESSIVE COST OF ELECTRIC STREET lighting in New York is explained, as follows, by the Commissioner of Public Works: The subways, though under the control of the city, are owned by a private corporation charging rentals. Under the terms of the contract the city can place its police, fire and other wires in these subways free of charge; but the electric light companies pay $1,000 per mile per year for the use of these subways, and must contract for five years, though their contract with the city for street lighting is limited to one year by statute. In some parts of the city, the lighting companies cannot afford to extend their system under the terms imposed. In Boston, 2,000 c. p. arc-lights are furnished for $124 to $127 per light per year, and in Philadelphia the cost is $128. In New York, a 1,200 c. p. light costs from $146 to $182 per year. The Commissioner of Public Works recommends legislation enabling the Gas Commission to extend the time of its contracts, and he further believes that companies should be allowed to use subways free of charge, where such subways were employed exclusively for street lighting.

◆

PAVING BLOCKS MADE OF MEADOW GRASS, says the Atlantic City "Union," are now being made in that city. The inventor is Rev. J. H. Amies, a resident of Atlantic City, N. J., and the meadow grass, impregnated with oil, tar and resin, is pressed into blocks measuring 14 × 21 × 6 ins., and then bound with iron straps. These blocks are said to weigh 40 lbs. per cu. ft., and can be made denser if desired. The claim is made that the street pavement of these blocks is noiseless and elastic, resists wear well and is impervious to heat and cold. Its manufacturers guarantee its life for five years. A plant was erected in Norfolk, Va., about three years ago and experiments were made with the pavement in Norfolk and Richmond and the results are claimed to have been very successful. The grass used is the ordinary wiry salt meadow grass, common along the Atlantic coast.

◆

FIFTH AVENUE, NEW YORK, carries the largest traffic of any street in the United States, says the Commissioner of Public Works of that city. This traffic is greatest between 28th and 42d Streets, where 6,272 vehicles, loading 10,165 tons, pass daily. Broad Street, Philadelphia, in front of the Pennslyvania railway station, comes next in daily traffic, according to Commissioner Collis. The better water supply of the down-town district has necessitated the laying of two 48-in. mains on this avenue, and this work is now in progress. Sewers are also wanting on parts of this highway and these gaps are now being filled up. The fact that Fifth Avenue has been torn up is taken advantage of to replace the stone block pavement with asphalt, from Washington Square to Central Park. This paving is authorized under the appropriation of $1,000,000 for laying the water mains which also provides for repaving the trenches; the repaving over the new sewers is paid for by the property-owners and the balance comes from the annual appropriation for new paving. The asphalt pavement is to have a crown of only 4½ ins. instead of the 7 and 8 ins. of the old stone pavement.

◆

THE NEW YORK CANAL IMPROVEMENTS, authorized under the late $9,000,000 appropriation for this purpose, are reported upon as follows by Mr. A. R. Smith, Secretary of the Executive Canal Committee: With the funds at the disposal of the state three modern double-length steel lift-locks will be built at Cohoes, Lockport and Little Falls, and it is not yet decided whether there will be, at Newark, one double-length steel lift-lock, or two double-length ordinary locks, in place of the present three single-length locks. The Erie Canal will be 9 ft. deep throughout, instead of only in the prism of the canal, as contemplated in the bill, and the depth of 9 ft. will be obtained over all existing permanent structures, allowing boats to load to 8 ft. instead of to 7 ft., as in the bill. These provisions allow for boats 115 ft. long and carrying 60% more load than at present, with a full foot of water under their keels. The amount of money now available is $4,000,000, and power to issue the remaining $5,000,000 in bonds is to be asked from the next legislature. The canals to be improved include the Erie, Oswego and Champlain main canals, aggregating 640 miles of navigable canal, 84 miles of navigable feeders, 261 locks, 33 aqueducts, and 1,100 bridges and other structures. For this work over 1,000 surveys, with maps and blue-prints, have been already made. The work to be undertaken immediately is as follows: Oswego Canal—Raising the Phoenix, Braddock, Minetto, High and Oswego dams about 29 ins. each; the improvement of the Ontario Level, and the lengthening of Lock 18, at a total estimated cost of $159,000. Champlain Canal—Excavation and improvement between Lock 5 and the Waterford side cut; between Locks 6 and 7, and the level between Fort Edward and Fort Ann; at a total estimated cost of $409,758. Erie Canal; Western Division—Excavation, largely through solid rock, at Buffalo and Lockport, and the rebuilding of the Cartersville waste-weir; estimated cost, $1,023,856. Middle Division—From Oneida County line to Lock 51, and lowering of the bottoms of Locks 46, 49 and 50; total estimated cost, $780,973. Eastern Division—Improvements costing $744,099. The total estimated expenditure on the above canals, as given, amounts to $3,117,692. The total probable quantities, as given upon the bidding sheets, are as follows for the principal items: Total excavation, 3,261,077 cu. yds total iron and steel, 1,725,491 lbs.; lumber, 6,475,520 ft. B. M.; 33,855 cu. yds. concrete; wall masonry, 235,150 cu. yds.; lining, 158,930 cu. yds.; channeling, 263,150 cu. yds.; embankment, 209,540 cu. yds.; puddling, 26,265 cu yds.; piling, 104,265 lin. ft.

◆

A BRICK CHIMNEY IS BEING MOVED about 1,000 ft., at Bridgehampton, L. I. This chimney is 75 ft. high and weighs about 100 tons; it belonged to a hotel destroyed by fire and is to form part of a newly built structure. The contractors for the work are William and Charles P. Topping, of that place.

STRUCTURES ON THE SAN FRANCISCO & SAN JOAQUIN VALLEY RY.

(With inset.)

The line of the San Francisco & San Joaquin Valley Ry., which is now under construction, will extend from Stockton, Cal., to Fresno, and Bakersfield, a distance of about 250 miles, and is already completed as far as Fresno, while at Stockton there is connection with river steamers for San Francisco. The first train entered Fresno on Oct. 5. The railway parallels some of the lines of the Southern Pacific Ry., having one of that rival's lines on each side (about 12 miles away), nearly all the way to Fresno, but it is to open up a large local traffic in the wheat and fruit growing district of the San Joaquin Valley. Mr. Claus Spreckels is at the head of the enterprise. Mr. Wm. B. Storey, Jr., M. Am. Soc. C. E., is Chief Engineer, and during a visit to San Francisco last summer we obtained from Mr. Storey the blueprints, photographs and information made use of in the preparation of this article.

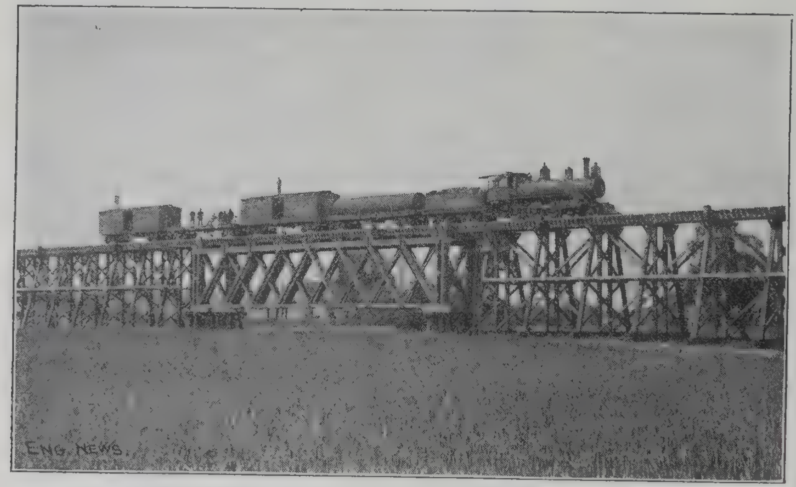

FIG. 1.—BRIDGE & TRESTLE ACROSS DRY CREEK; S. F. & S. J. V. RY.

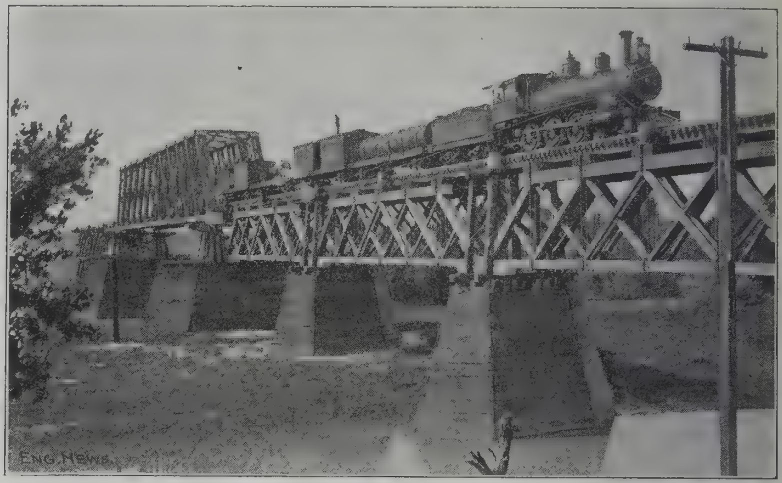

FIG. 2.—BRIDGE ACROSS STANISLAUS RIVER; S. F. & S. J. V. RY.

The railway traverses a fairly level country, and has easy grades, the maximum grades being 0.3%. The earthwork is mainly adobe soil and hardpan, the latter requiring a considerable amount of powder to break it up. Grant Bros., of Los Angeles, and San Francisco, were the contractors for the grading.

The generally flat country of the valley is intersected by a number of deep, wide ravines, or river channels, which necessitate a considerable amount of bridge and trestle work. These structures are mainly of Oregon pine. All the bridges were designed by and all bridge material was purchased by the chief engineer of the road, the contract for the work of erection being let to the San Francisco Bridge Co.

Fig. 1 shows the bridge and trestle across Dry Creek, and represents the general type of trestle approach to the bridge spans. In this particular case the right hand bank falls away sharply at the pile abutment to the level of the stream crossed by the Howe truss deck span. The trestles have four-post bents of squared timber, and a noticeable and commendable feature in the design is the ample provision of transverse and longitudinal diagonal bracing, the latter bracing being far too often omitted in structures of this kind, leaving the stringers and the waling-pieces to carry all the longitudinal strains. Fig. 2 is a view of the bridge over the Stanislaus River, having one through truss channel span, and deck trusses for the approach. The piers are of pile clusters, sheathed with timber to protect them from floating driftwood, etc.

Fig. 3 (on the inset sheet) gives the details of the construction of one of the three 150-ft. Howe truss deck spans over the San Joaquin River. The lower chord is continuous over the three spans, the upper chord is broken over each pier. The panel length is 12 ft. 6 ins., and the truss depth (between chords) is 20 ft. The truss rods pass through tubes or sleeves in the chords, and the joints in the lower chord-members are spliced by eyebars. The truss has a camber of 3 ins., 2 ins. of which are taken out by sizing the ties over the stringers, and 1 in. of camber is left in the track. At each panel point are the floor timbers 6 × 18 ins. and 8 × 18 ins., 20 ft. long, carrying track stringers 6 × 14 ins., on which again are the ties, 8 × 8 ins., 8 × 9 ins. and 8 × 10 ins., 9 ft long. There are inside guard rails of the same weight as the track rails and set 8 ins. clear from them, while the guard timbers 6 × 8 ins. (set flat) are on the outside, 8 ins. from the track rails. The guard timbers are bolted through tie and stringer at every fourth tie, these ties being boxed out 1 in. for the guard timbers, while at the other ties the guard timbers are boxed out 1 in. A horizontal lateral bracing connects the upper chords and the lower chords, while at each panel point is a vertical diagonal sway bracing, the pieces of which (in the larger sizes) are boxed out ½-in. at their intersection.

The combination passenger and freight stations of this railway are of simple and attractive design, and conveniently arranged, as will be seen by the plans and elevations in Fig. 4 (on the inset sheet). On the ground floor, all under one roof, are an open waiting room, a closed waiting-room and an agent's office and storeroom; then comes a baggage-room and then a large freight room, the latter having a raised platform on three sides. The middle part of the building is carried up to form a second floor with living accommodation for the station agent.

The track is laid with rails weighing 62½ lbs. per yd., rolled by the Bethlehem Iron Co. and the Homestead works of the Carnegie Steel Co. They are of the Am. Soc. C. E. section, the dimensions being a mean between those of the 60-lb. and 65-lb. recommended sections. There are 16 redwood ties to a rail length of 30 ft., with Servis tie-plates on every tie. The rails are laid with suspended broken joints, spliced by angle bars and four bolts. The ballast is of gravel. The switches and frogs were designed in the chief engineer's office and built by the Pacific Rolling Mills and other coast works, being a new class of manufacture in that part of the country. The engines were built by the Baldwin Locomotive Works, of Philadelphia, Pa., and the cars by W. L. Holman, of San Francisco, Cal., and the Ensign Car Mfg. Co., of Huntington, W. Va.

◆

MODERN OVERHEAD CONSTRUCTION FOR ELECTRIC RAILWAYS.*

By Benjamin Willard.

The steel pole presents a neat appearance, and takes up a small amount of space. The insulating qualities are not as good as with the wood pole. As to its lasting qualities, I have made some observations on wrought iron columns that have been in the ground for several years, and I am convinced that in a moist climate a limit on the practical life of such poles would not be over 30 years. I believe that from a practical and financial standpoint, wood poles should be used in many instances.

Through the business sections of cities steel poles are in some respects better, as they cannot be either wilfully or accidentally mutilated. In suburban or residential districts the wood poles when properly dimensioned answer every purpose, and look fully as well as the steel poles. A heart pine or cedar pole will, if properly selected and kept painted, last in some climates 20 years. This is a known fact from observation of poles that are now in sound condition after having been erected for that length of time.

Suppose we select New Orleans as a suitable location to build a road and base our estimates on cost of material there. The cost of steel poles would be greater than in many northern cities owing to freight rates and distance from the manufacturers of such poles. Wood poles can be furnished for less in New Orleans owing to their near production, so that I think an estimate covering the cost at that point would be a fitting proposition elsewhere.

The following are estimates for cost of construction in New Orleans, where steel poles cost more and wooden poles less than in Northern cities. For one mile of span wire construction 104 steel poles, at $15 each, would cost $1,560, and assuming their life to be 30 years, the interest on the investment for 30 years at 5% per annum would be $2,340, or a total first cost and interest of $3,900. The setting of steel poles necessitates the use of concrete. I estimate the cost of this and the labor of placing it at $4.50 per pole, or $468 per mile, which, with interest for 30 years at 5% per annum, would be $1,170, or a total for interest and first cost of material and labor of $5,070 for the steel poles.

Assuming the life of heart pine poles to be 12 years (instead of 20 years) I will make a comparison on that basis. Such poles for one mile of span wire construction at 104 poles to the mile at $4.50 each would cost $408; labor and material for erecting at $2.50 per pole, $260, or a total first cost of $728; to this must be added interest for 30 years at 5% per annum, $1,092, making the first investment at the end of 30 years $1,820. At the expiration of 12 years the construction must be renewed at a cost of $728, and to this must be added interest for 18 years at 5% per annum, $655.20, making the second investment at the end of 30 years cost $1,383.20.

At the expiration of 24 years the construction will be renewed for the third time at a cost of $728, and to this will be added the interest for six years at 5% per annum, $218.40, making the third investment at the end of 30 years cost $946.40, a grand total for wood pole construction of $4,149.60. The difference between the total costs of steel and wood pole construction for a period of 30 years would be $920.40 per mile, which would be more than a liberal allowance for changing span wires and other work necessary in renewing the wood poles, but assuming it would take this amount we would stand even at the end of 30 years and still have six years more life in the wood pole construction.

If steel span poles are used I would recommend for the average span of 40 ft. a pole weighing about 700 lbs., made in two parts. The lower section to be constructed of 6-in. extra heavy standard steel pipe and the upper section of 5-in., swaged at the joint for a distance of 18 ins. Such a pole should be 28 ft. long, 18 ft. for the lower and 10 ft. for the upper section, and provided with a cast-iron and wood pole top for the attachment of the span wires. There should be a wood filling to fit the bottom of the lower half to prevent it from sinking, and the pole should be set 6 ft. in the ground with a rake of 10 ins. from the perpendicular to allow for being straightened when under strain. The average size of hole to be dug would be 20 ins. in diameter with a depth of a little over 6 ft., requiring (after the pole is inserted) a

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*Abstract of a paper read at the Annual Convention of the American Street Railway Association at St. Louis.

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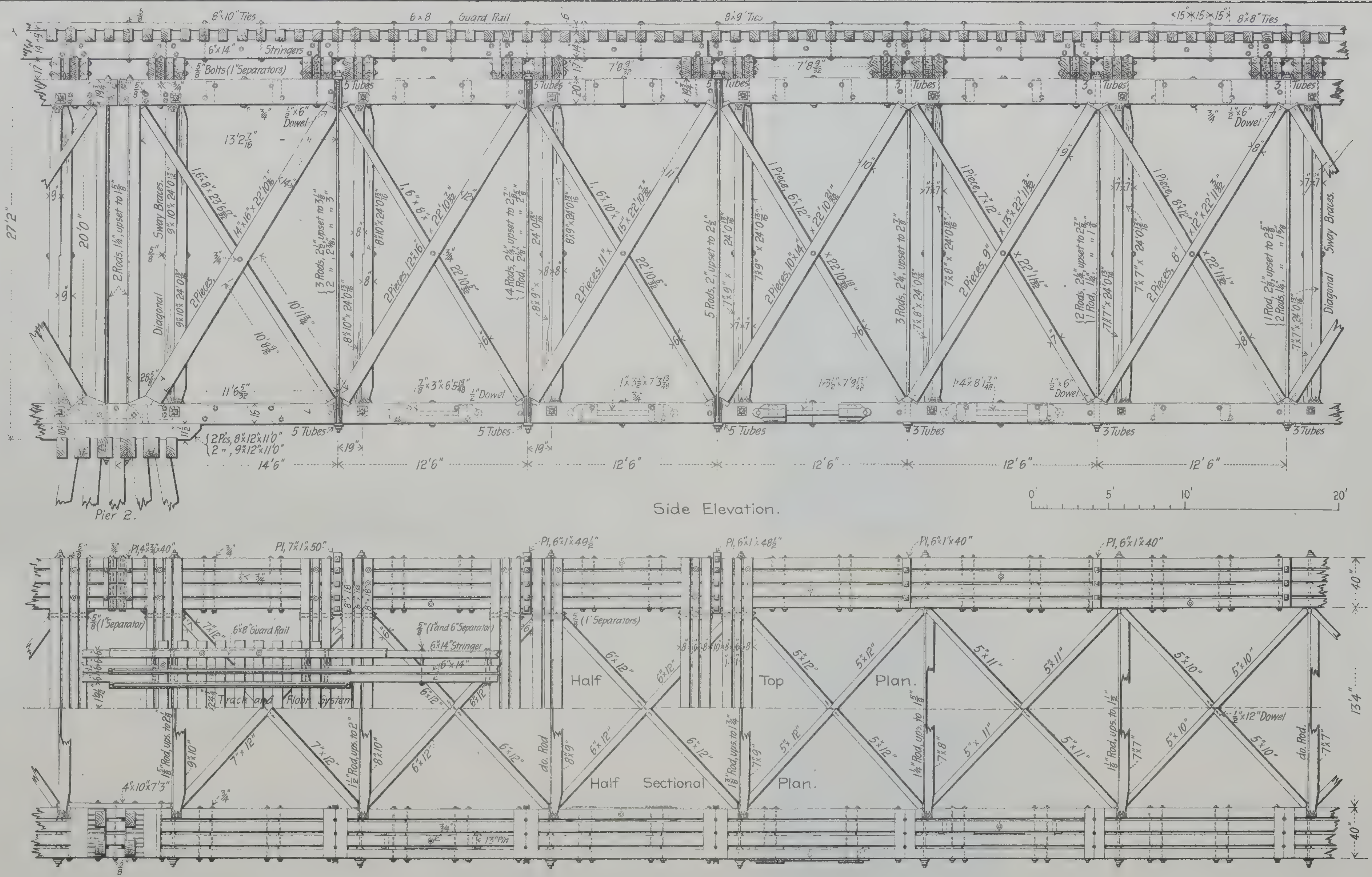
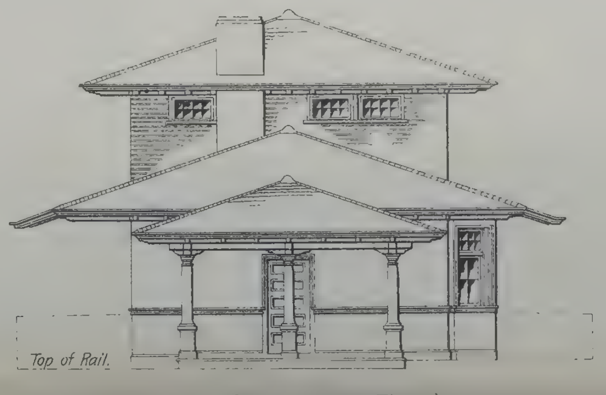
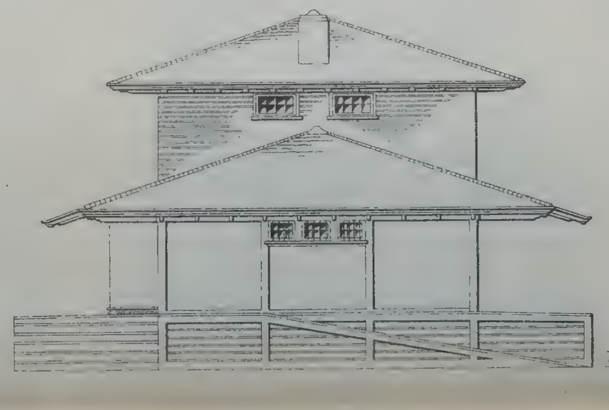
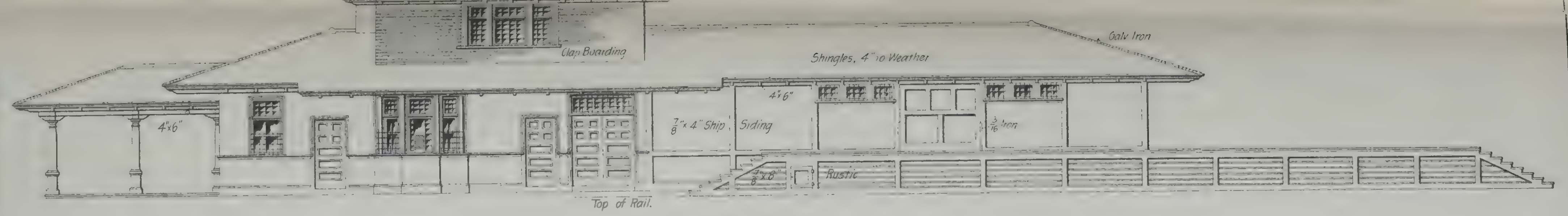


FIG. 3. HOWE TRUSS DECK SPAN OVER THE SAN JOAQUIN RIVER.

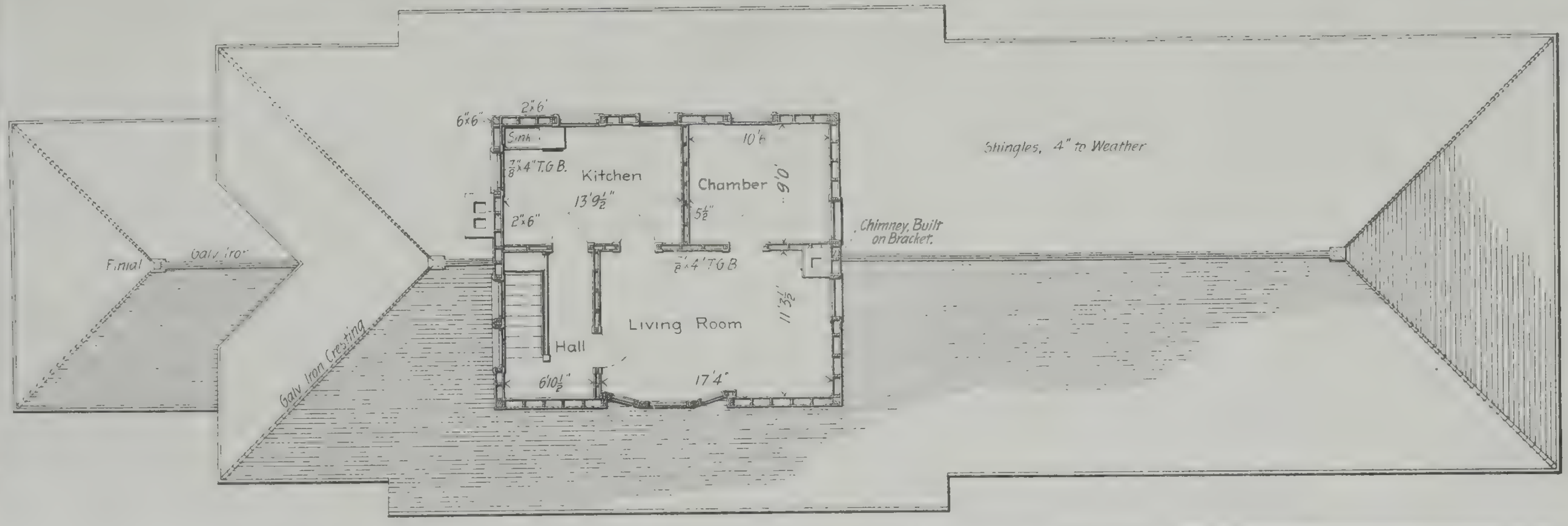


Passenger End Elevation.

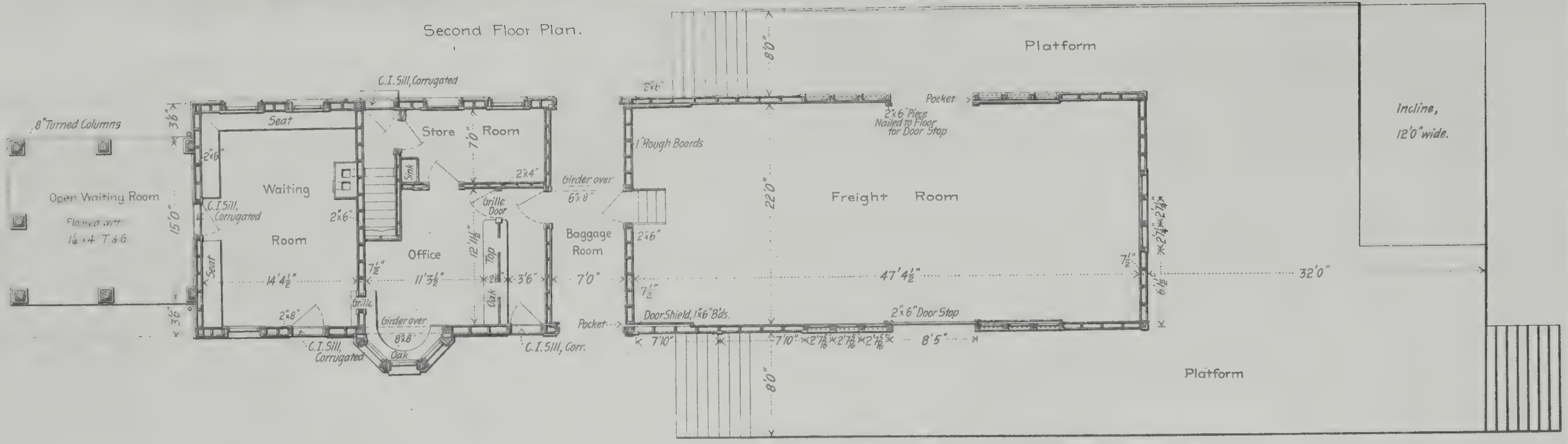




Elevation Towards Track.



Second Floor Plan.



Ground Floor Plan.

FIG. 4. COMBINATION PASSENGER AND FREIGHT STATION.

STRUCTURES ON THE SAN FRANCISCO & SAN JOAQUIN VALLEY RY.

Wm. B. Storey, Jr., M. Am. Soc. C. E., Chief Engineer.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

mixture of about ½ cu. yd. of 1, 2 and 4 Portland cement concrete. The cement should be set at least three days before attaching the span wires. Whenever it is practicable, allow poles to bear against the curbing, as it affords an efficient stay for the pole. Otherwise a good-sized rock having a bearing surface of about 1 sq. ft. would assist very much, and keep the pressure from cracking the cement.

If wood poles are used where it is necessary to provide neat and substantial construction, I would recommend for the average span of 40 ft. a long leaf yellow pine pole dressed and chamfered, 30 ft. long, sawed square, 11 × 11 ins. at the base, and 7 × 7 ins. at the point, free from sap, rot or knots, and corners evenly chamfered, 1½ ins., beginning at a point 14 ft. from the base, and terminating in an octagonal form and roofed evenly for a space of 3 ins.

In setting wood poles where concrete is not used (and I do not consider it necessary) a great deal depends upon the soil encountered. In a soil of medium clay, and average condition, poles should be set 6 ft. in the ground with a rake of 12 ins. from the perpendicular, and the hole should be dug to a vertical depth of 6 ft. (or more if necessary to allow the pole to stand a given height above the track) and should be about 2 ft. square at the top and not less than 18 ins. at the bottom. Where it is practicable allow poles to bear against the curbing (or paving). Place a substantial bearing at the heel to prevent the pole from pressing through the earth; for this purpose a small quantity of coarse broken stone or brick bats will answer every purpose. Where this is not easily obtainable, and the earth is soft, a piece of plank 12 ins. wide by 3 ins. thick, 4 ft. long, sharpened and driven in the earth to a depth of about 2 ft. at the back and base of the pole will give good results.

Whenever it is necessary to erect poles in the absence of substantial material at the surface, such as paving or curbing, I would recommend that the base of the pole be well rammed with broken rock for a distance of 18 ins., taking pains that the greater quantity is placed at the back where the pressure is greatest and leaving a small quantity in front where no pressure takes place. The space to within 20 ins. of the top may be filled with earth taken from the hole and well rammed. To prevent the pole from yielding at the surface a breast plank of oak (or cypress) timber 3 × 12 ins. × 6 ft. should be placed and spiked in front and at right angles to the pole about 8 ins. under the surface of the ground. About 20 ins. from the top of the hole and in front of the breast plank should be filled and well rammed with the same material that is used at the base of the pole. The necessary quantity of broken rock required would be about 1-5 cu. yd. per pole.

Poles of wood or steel which may be used for holding strains at curves should necessarily be heavier than those used for straight line construction, and should also be set at greater depth in the ground. A steel pole for curve construction should be 29 ft. long, made of 6-in. and 7-in. extra heavy pipe, the larger section to be 19 ft. long and the smaller section to be 10 ft. long and made to weigh 1,050 lbs. Such poles should be set 7 ft. in the ground, and raked 10 ins. from the perpendicular in a direction radiating from central point of curve where strain is required. The filling would be the same as specified for straight line iron pole construction.

Wood poles for curve construction would be made similar to those specified heretofore for straight line construction, excepting dimensions of such poles should be 31 ft. long by 14 × 14 ins. at the butt, 9 × 9 ins. at the top. Such poles should be set 7 ft. in the ground and raked 12 ins. from the perpendicular in a direction radiating from the center of curvature where strain is required. The hole should then be entirely filled with about 7-10 cu. yd. of broken rock well rammed.

The holes for eye-bolts should be bored in wood poles before their erection and the bolt should incline slightly downward towards the eye to prevent the water from following in and rotting the top of the pole. The correct location for eyebolt holes would be determined by the height at which the trolley wire is to be placed, 22 ft. from the base of the pole would be correct, assuming that we allow 2 ft. for drop in the earbody and ear, and also dip in the span wire would make the height of trolley wire about 20 ft. To facilitate the setting of poles to a uniform height it is a good plan to place grade stakes near the location selected for poles indicating a given height relative to the grade of the track.

Center pole constuction is required in many locations, but I consider span construction better owing to its flexibility and for being less unsightly. There are now on the market appliances for making bracket suspensions flexible, which are an improvement over the old type of rigid construction. One of the most practical which I am familiar with is an attachment to receive a short span of flexible wire and the ordinary straight line hangers.

Poles used for center and bracket construction should be made according to the same specifications as those used for span construction, excepting that an ornamental pole top would be required for the steel pole instead of an insulated one. For the bracket arm a 1½-in. pipe of the required length attached to a malleable iron collar made in halves and encircling the pole and supported by truss rods leading from the end and center of the arm to near the top makes an excellent and neat construction.

Wherever guard wires are required it will be necessary to leave about 2 ft. additional space on the top of the pole above where the trolley span wires are attached for the attachment of the guard wire span. It would hardly be practical to provide an insulated pole top for both span wires, so the trolley span would be supported by means of a wrought iron clamp collar encircling the pole at the proper point and provided with suitable insulating fastenings. I do not especially approve of this method of construction (as I do not favor guard wires), but I would recommend it where it is compulsory to erect guard wires.

All poles should be painted with one coat before their erection, as it affords better opportunities to carefully apply the priming coat and at less expense than after the poles are set. A paint of dark green composed of graphite mixture I find to wear well, and although it costs more than some other paints, it has better lasting qualities (especially in iron work). A second coat of this paint after the poles are erected will cover marred places made necessary in setting, and will look well and last for at least two years.

Span Wires.—Span wires should be of flexible steel, 5-16 in. in diameter, composed of seven strands of No. 12 galvanized wire, and when under strain with conditions of pole setting as above would have a tension of about 750 lbs. when erected. Whereas I have allowed 18 ins. for sag in the span, it probably would not be over 12 ins. at the time the wire is first suspended, but it will gradually sag more as the wire stretches and the poles spring or yield in the ground, so if a 40-ft. span is attached 22 ft. above the rail surface, the trolley wire within the course of a year would measure aproximately 20 ft. above the rail.

Where wood poles are used (or wood pole tops for steel poles) the ordinary ⅝ × 12-in eye-bolt, threaded about 4 ins., answers every purpose for the attachment of the span wires, and other devices more expensive which are used for the same purpose are not necessary. Poles when properly set will bear a given strain on the span wires for many years without much yielding, consequently an adjustable device is rarely, if ever, used. Hard drawn copper trolley wire of No. 0 B. & S. gage has been found to be the most practical dimension of wire and is generally considered a standard for most trolley construction; therefore, overhead appliances are made of various manufacture to meet such requirements. There has been a trolley wire recently manufactured of a figure 8 section which is now in use on some roads and has given very good results. Where this wire is used it leaves a perfectly unobstructed surface for the trolley wheel and gives greater current carrying capacity, but in modern construction the hanging appliances have reached such a degree of perfection that the round wire can be used with equally as good results, and as the trolley wires on large systems are relied upon but little as a conductor for current capacity, I can hardly recommend anything that would be more practical than the round wire.

The best forms of span wire hangers and insulators are those in which the insulation is concealed from the weather as much as possible, and with a metallic covering to prevent them from being broken by accidental contact of the trolley pole. Brass hangers are more expensive than iron, but resist the moisture and are maintained at much less expense. Iron hangers if kept in good condition should be painted at least once a year, as the oxidization if allowed to accumulate will form a conductor between the conductors and span wires, and in course of time will cause the escape of current by leakage. Hard rubber insulation for hangers is more expensive than many other compositions, but it has fine insulating qualities, and stands different conditions of climate with little or no deterioration.

Suspension ears are of as many varieties as hangers. I have had experience with many, and have concluded that a little modification of the old brass solder ear is the most practical and lasting of all, if properly attached. A solder ear should be 15 ins. in length tapped for a ⅝-in. cap bolt and provided with thin lips at either end so dimensioned as to encircle but little more than half the trolley wire. One point which should be observed very particularly is to have the ends of the ears ground to a thin tapering end so that they will be flexible with the vibrations of the wire. If the ends are made heavy or unyielding, the vibrations will have a tendency to detach the ear at the points, and when this takes place it is a question of a short time before the ear is wholly detached.

For curve construction I favor what is known as the goose-neck hanger, which is simply a ⅝-in. steel forging of such dimensions as to allow good clearance for the trolley wheel and fastened to the soldered ear in a manner to permit it to swivel, also provided with an eye for the attachment of pull-over wires. Such devices are strong, and do not present an obstructive object for the trolley to catch in. There is no insulation attached to such ears and this is the only thing in their disfavor, but as there are many insulating devices to overcome this difficulty which can be attached to the hanger, this could be considered a minor point.

There is a wide difference of opinion relative to the arrangement of sections and the methods of feeding the sections of the trolley wire. In many installations a practice is made of leading each individual section feeder to the station and separating the trolley into sections by sectional insulations, making it possible to cut out the various sections at the power-house. This is a convenience in that it makes every section of the line directly controllable from the power plant. Another method is to have every feeder on the whole line doing a share of work at all times, whether the cars be assembled on one section or distributed over the entire line. This, of course, can only be done by means of connections representing the whole line as being in one general section, making short sections controllable by external switches. In the first method mentioned an accumulation of cars may be assembled on one section not estimated for carrying an abnormal load, consequently the feeder would be overtaxed on this particular section, whereas the feeders on other sections would be doing little or no work. Consequently, there would be a difference of potential between the adjoining sections. If there is a bridge around each section insulator connecting each section together and connected by a feed wire so that the current will equalize itself between two sections and will distribute itself from all feeders, then we have a small amount of variation of potential from section to section, and every feeder is auxiliary to every other.

To carry out this method of uniting the trolley sections the line is divided into sections by means of sectional insulators. A switch box is placed on the pole (at a convenient height) in which is contained two switches and fuses, one for the section on either side of the sectional insulator; the feeder is then divided by connection through each switch so that the feed wire delivers current to either section through feeder span wires attached to connections on each side of the sectional insulator. When the entire line is in operation there is an equalization of current in all sections, and the trolley remains virtually as a solid conductor, but with all necessary features for disconnecting the sections.

In most localities where a large system of feed wire distribution is required it is necessary to erect special construction for that purpose. The most economical plan is to select centers of distribution reached by the most direct routes from the power station and establish at such points what may be called junction poles to which are attached the heavy trunk line feeders leading from the power plant, and smaller feeders for distribution to the trolley line. By this plan we may erect wires of 500,000 or more circular mils. capacity from the plant to the junction pole, and attach them to a junction frame or frames attached to the pole which is provided with a bus-bar of sufficient carrying capacity to carry the current of the branch feeders. The large cables are dead-ended in the junction frame by eye-bolts and strain insulators, and copper connections are made with the bus-bar. The branch feeders are ended and connected in the same way so that it is possible with little delay to cut out any feeder and make changes which are often necessary in operation.

Southern pine cross arms, 5 × 3½-ins., bored to receive 1½-in. pins and doubled on each pole will make sufficiently strong construction to receive the heaviest wires. The pins should be of locust-wood, bored to receive a ½-in. bolt, which should extend verticallly through the center of the pin and terminate with a washer and nut on the under side of the arm.

Top grooved glass insulators are desirable in all classes of heavy feed wire construction. Feed wire conductors of larger area than 0000 B. & S. gage should be in stranded, or in cable form, triple insulated with the best waterproof covering. Care should be taken in splicing cables that an even strain is brought on each smaller wire and that none are allowed to remain without good contact, and that all flux used in soldering is carefully removed before tapeing.

THE STONE INDUSTRY OF THE UNITED STATES IN 1894 AND 1895.

The Department of the Interior has issued a report upon "The Stone Industry in 1895," prepared by Mr. William C. Day, of the U. S. Geological Survey. From it the following extracts are made: The values of the several kinds of stone produced in the two years are set down as follows:

Kind.	1894.	1895.
Granite	$10,029,156	$8,894,328
Marble	3,199,585	2,825,719
Slate	2,790,324	2,698,700
Sandstone	3,945,847	4,211,314
Limestone	16,190,118	15,308,755
Bluestone	900,000	750,000
Totals	$37,055,030	$34,688,816

Divided by states, Pennsylvania ranks first with a product, chiefly limestone, worth $5,563,451; Vermont marble and granite was worth $3,254,647 in almost equal amounts; Ohio limestone and sandstone was valued at $3,018,372; Maine's product was worth $2,240,154, mainly granite, and Massachusetts produced $2,335,381 worth of stone, almost all granite. After these states come New York, Indiana, Illinois, Connecticut, Georgia and Missouri, in the order named, with products valued at more than $1,000,000 and less than $2,000,000; although 39 states in all contribute something to this industry. The total value of granite paving blocks made in 1895 was $1,773,328; Maine and Massachusetts contributing $1,132,607 of this amount. In 1894 the value of paving blocks produced was $2,254,587. The granite output of the United States shows a steady decline from $14,464,095 in 1890, to $8,894,328 in 1895; with the exception of the gain noted for 1894 over the $8,808,934 of 1893. The marble product shows a gain from 1890 to 1893, a maximum in 1894 and a decline in 1895. The total of roofing slate for 1895 was 729,927 squares valued at $2,351,509, as compared with 738,222 squares valued, in 1894, at $2,301,138; the price, however, has increased from $3.11 to $3.23 in 1895. The sandstone industry shows a slight improvement in general condition; though the value of this product in 1890 was $10,816,057. The value of the lime output, in 1895, was $6,595,122 as compared with $8,610,607 for the preceding year, a falling-off nearly sufficient in itself to account for the total decrease in the value of the industry as compared with 1894. But the decrease in lime burned was offset by an increase of more than half a million in the limestone used for fluxing in 1895 in Alabama, Colorado, Montana, Ohio and Pennsylvania. The bluestone output is estimated for both 1894 and 1895, and the report enters into no details of this industry.

SPIRAL CURVES FOR STREET RAILWAYS.*

By Chas. A. Alden, C. E.**

The use of the railway spiral as an entrance to street railway curves, has not been as extended as it should have been, owing to the lack of suitable tables for its use.

While many variations of its form might be made, it is believed that the following tables will meet most cases arising in usual practice.

Table I. gives a choice of 50 spirals for curves of radii from 30 ft. to 1,785 ft. In case a special spiral is desired for any reason, these may be modified by multiplying by a suitable factor, in the same way that spirals No. 1 and No. 2 have been obtained from spirals No. 4 and No. 5.

Spiral No. 3 was designed as the spiral of shortest length to enable a certain double-truck car to pass on a double-track curve. Branch-off Easement No. 2 was designed in the same manner.

While the car used for this purpose was one of the largest double-truck cars in use, on surface roads, in the East; this should be carefully tried with the car in use on the road in question, as, indeed, it must necessarily be, in order to select a radius for the outer curve.

Substantially the same chord length was carried throughout the system with a view to ease in giving the necessary information to the track-layers.

At switches it is mechanically undesirable to have a greater initial radius than 100 ft. This will prevent the use of a true spiral at these points, but Table II. gives a set of arbitrary easements which conform as nearly as possible to the theory of the spiral; i. e., they have a constant increase or decrease of angle in each length of arc after leaving the switch.

Office Work.—The most satisfactory way of plotting these curves is to cut out thin celluloid templates of each one which is to be used. Mark each P. C. C. of the spiral on the curved edge and the direction of a radial line through this point.

Problems No. 3 and No. 4 can generally be solved accurately enough on a drawing made to scale and in less time than by calculation for "special work" curves, as a plan must be made in any event, in order to have the work made by the manufacturer.

If only a few curves are to be drawn up, however it may be more expeditious to figure the curve and plot the points on the spiral by the x and y taken from the table, and connect them with a variable or "French" curve.

Field Work.—The problems which are solved below give all the rules necessary for laying out nearly any curve with symmetrical spirals. In the appendix is given the solution for the most common form of non-symmetrical curve.

It is by no means necessary to lay out on the ground every point on the spiral. If the curve is "special work" and curved by the manufacturer, the point of spiral, a point about in the centre of the spiral and the junction of the spiral with the main curve should be laid out.

Points for the latter should be laid out from 20 to 30 ft. apart, depending on the radius of the curve and the location of the joints.

If the curve is to be "sprung in" by the track-layers, every alternate point on the spiral should be laid out and the track-layer furnished with sufficient middle ordinates for 10-ft. chords.

These can be obtained by Problems 9 and 10 and Table III.

The most expeditious way to lay out a spiral curve, if the "x" does not exceed 2 ft., is to set the transit on the intersection point and lay off the tangent distances, then lay out sufficient points on the spirals by the successive offsets x and the long chords. Then bisect the included angle and lay out a temporary point v; Problem 8.

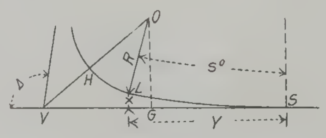
Move the transit to the last point on the spiral, set the vernier to a back reading equal to the spiral angle. Set the telescope on an offset from v equal to x inside of the intersection point. Deflect to 0° and the line of the telescope should strike v′ and the distance $v' L = R \tan(\frac{1}{2} \nabla - s°)$. This will check the preceding calculations and field work. The circular arc can then be laid out in the usual manner.

Problem No. 1.—To Select a Spiral.—(a). The radius of the main curve must be less than the preceding branch of the spiral; must be more than the next branch would be, were it produced; and should nearly equal the latter.

Note.—Easements No. 3 and No. 4, Table II. For greater, read less; and for less, read greater.

(b). The longer the spiral, the easier the entrance will be. But bear in mind that the main body of the curve should be circular, the spiral simply acting as an entrance to it.

(c). A spiral of less than three branches should not be used.



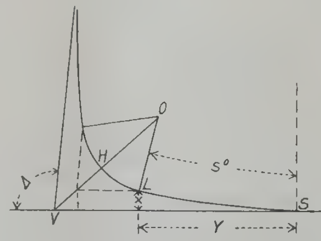
Problem No. 2.—Given: A circular curve with symmetrical spirals, to find the tangent and external distances.

$$O G = R + x - \text{ver. sine } s° R.$$

$$G S = y - \text{sine } s° R.$$

Tangent distance $= O G \tan \frac{1}{2} \triangle + G S$.

External distance $= O G \text{ ex. sec. } \frac{1}{2} \triangle + x - \text{ver. sine } s° R$.



Problem No. 3.—Given: The tangent distance vs. the intersection angle △, and the desired length of spiral to find the radius of the curve.—Approximate R = cotangent ½ △ (vs. — ½ length of spiral.)

Having selected a spiral by this radius, the exact radius may be found, if required, by the following formula:

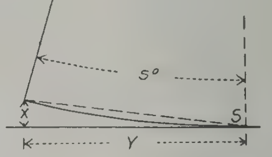
$$R = \frac{\cos. \frac{1}{2} \triangle (v s - y - x \tan \frac{1}{2} \triangle)}{\text{sine } (\frac{1}{2} \triangle - 5)}$$

Caution: If the result is enough different from the original radius to require a change in the spiral by Problem No. 1 (a), a second trial must be made. This rule does not apply for approximate radius to the easements in Table II.

Problem No. 4.—Given: The intersection angle △ and the external distance VH; to find the radius.—Approximate to the radius by finding that for a simple curve passing through the point H, and select a spiral for a radius somewhat smaller. Then

$$R = \frac{V H \cos. \frac{1}{2} \triangle - x.}{\cos. s° - \cos. \frac{1}{2} \triangle.} \text{ (Searle.)}$$

Caution: If the result is enough different from the original radius to require a change in the spiral by Problem No. 1 (a), a second trial must be made.



Problem No. 5.—Given: The x and y for any point on the spiral; to find the deflection from the tangent at the point of spiral.

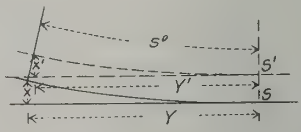
$$\text{Tan. deflection } ° = \frac{x}{y}.$$

Problem No. 6.—Given: The x and y for any point on the spiral; to find the long chord.

(a). $\text{Long chord} = \frac{Y}{\text{cosine def. angle}}.$

or

(b). $\text{Long chord} = \sqrt{x^2 + y^2}.$

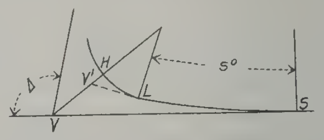


Problem No. 7.—Given: x and y for a point on the spiral; to find x′ and y′ on a line paralel to the spiral, and offsetted the distance ss′ inside the spiral.

$$x' = x - s s' \text{ ver. sine } s°.$$

$$y' = y - s s' \text{ sine } s°.$$

Note.—Problems Nos. 5 and 6 can then be applied to x′ and y′ if it is desired to use deflection angles to lay out the curve. As these curves will almost invariably be laid out on an offset, varying with the gage of the road; the deflections are not figured in the table.

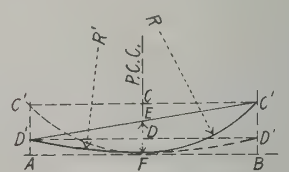


Problem No. 8.—Given: A circular curve with spirals; to find the distance VV′, in order to lay out a tangent to the circular curve, from which the latter may be laid out in the usual manner.—

$$V H = \text{see Problem No. 2.}$$

$$V' = R \text{ ex. secant } (\tfrac{1}{2} \triangle - s).$$

$$V V' = V H - V' H.$$

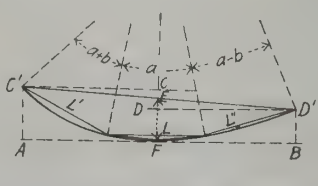


Problem No. 9.—Given: The middle ordinate for a chord of length AB for R and R′; to find the middle ordinate at the P. C. C. From the figure it is evident that

$$D' C' \text{ bisects } C D \therefore E F = \frac{C F + D F}{2}.$$

Therefore, the middle ordinate at any P. C. C. in the spiral equals ½ the sum of the middle ordinates for the radii on each side for the same chord.

Note.—See remark following Problem No. 10.



Problem No. 10.—Given: That portion of a spiral with equal chords L, L′ and L″ and angles a—b, a and a+b; to find the middle ordinate at the centre of the chord L in the length D'C'; CF = C' A and DF = D'B. From the figure it is evident

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**Principal Assistant Engineer, Street Railway Department, Pennsylvania Steel Co.

$$\text{that } D'C' \text{ bisects } CD, \therefore EF = \frac{CF + DF}{2}.$$

Then

$$C'A = \tfrac{1}{2} L \tan \tfrac{1}{4} a + L' \text{ sine}\left(\tfrac{1}{2} a + \frac{a+b}{2}.\right)$$

$$D'B = \tfrac{1}{2} L \tan \tfrac{1}{4} a + L'' \text{ sine}\left(\tfrac{1}{2} a + \frac{a-b}{2}.\right)$$

and since the sines of small angles are proportional to the angles;

$$\frac{CF + DF}{2} = EF = \tfrac{1}{2} L \tan \tfrac{1}{4} a + L \text{ sine } a.$$

But this last equation equals the middle ordinate in the length AB for the radius of the central arc; and since the increment to the angle, b, would be equal if L' and L'' were equal; the middle ordinate at the centre of any arc of the spiral, for any length of chord; is equal to the middle ordinate of the radius of that arc in the same length.

Remark: It will be noticed that the solutions of Problems No. 9 and No. 10 are slightly inaccurate in not allowing for the increase of length of D'C' over AB, nor for the inclination of the middle ordinate found to the true middle ordinate.

Problem No. 10, if applied to the curving of rails, as intended, also assumes that each rail forms a spiral, whereas they are simply parallel lines to one.

Both solutions, however, are sufficiently accurate for any spiral of 5 ft. chords or greater.

Taken in connection with Table III. the m. o's can be easily found for points on the rails from 2½ ft. to 3 ft. apart. The rails being curved to these, exactly what is desired will be obtained, i. e., a curve of constantly changing radius, which is considered a compound curve for the purpose of calculation only.

These spirals are figured for a length suitable to the ordinary street railway speeds. For greater speeds, the writer would advise the use of the regular railway spirals. Tables in convenient form for these have been published by Wm. H. Searle, C. E., and others.

The tables given herewith have been carefully checked, and no error found as great as 1 in the last place.

TABLE I.—Spirals.

Spiral No. 1.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
210	0° 42′	0.015	2.565	0° 42′	.00007	.01222
105	1° 24′	0.078	5.130	2° 6′	.00067	.03664
70	2° 6′	0.219	7.692	4° 12′	.00269	.07324
52½	2° 48′	0.469	10.245	7° 00′	.00745	.12187
42	3° 30′	0.860	12.780	10° 30′	.01675	.18224
35	4° 12′	1.420	15.283	14° 42′	.03273	.25376

Spiral No. 2.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
300	0° 30′	0.011	2.618	0° 30′	.00004	.00873
150	1° 00′	0.057	5.235	1° 30′	.00034	.02618
100	1° 30′	0.160	7.851	3° 00′	.00137	.05234
75	2° 00′	0.342	10.463	5° 00′	.00381	.08716
60	2° 30′	0.627	13.065	7° 30′	.00856	.13053
50	3° 00′	1.036	15.651	10° 30′	.01675	.18224
42½	3° 30′	1.587	18.187	14° 00′	.02970	.24192
37½	4° 00′	2.309	20.703	18° 00′	.04894	.30902

Spiral No. 3.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
300	1° 00′	0.046	5.236	1° 00′	.00015	.01745
150	2° 00′	0.229	10.468	3° 00′	.00137	.05234
100	3° 00′	0.639	15.688	6° 00′	.00548	.10453
75	4° 00′	1.368	20.871	10° 00′	.01519	.17365
60	5° 00′	2.501	25.982	15° 00′	.03407	.25882
50	6° 00′	4.118	30.959	21° 00′	.06642	.35837
40	7° 00′	6.143	35.403	28° 00′	.11705	.46947

Spiral No. 4.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
420	0° 42′	0.031	5.131	0° 42′	.00007	.01222
210	1° 24′	0.157	10.261	2° 6′	.00067	.03664
140	2° 6′	0.439	15.384	4° 12′	.00269	.07324
105	2° 48′	0.939	20.490	7° 00′	.00745	.12187
84	3° 30′	1.720	25.561	10° 30′	.01675	.18224
70	4° 12′	2.839	30.567	14° 42′	.03273	.25376
60	4° 54′	4.352	35.469	19° 36′	.05794	.33545

Spiral No. 5.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
600	0° 30′	0.023	5.236	0° 30′	.00004	.00873
300	1° 00′	0.114	10.471	1° 30′	.00034	.02618
200	1° 30′	0.320	15.703	3° 00′	.00137	.05234
150	2° 00′	0.685	20.926	5° 00′	.00381	.08716
120	2° 30′	1.255	26.130	7° 30′	.00856	.13053
100	3° 00′	2.073	31.302	10° 30′	.01675	.18224
85	3° 30′	3.175	36.374	14° 00′	.02970	.24192

Spiral No. 6.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
900	0° 20′	0.015	5.236	0° 20′	.00002	.00582
450	0° 40′	0.076	10.472	1° 00′	.00015	.01745
300	1° 00′	0.213	15.706	2° 00′	.00061	.03490
225	1° 20′	0.457	20.936	3° 20′	.00169	.05814
180	1° 40′	0.837	26.158	5° 00′	.00381	.08716
150	2° 00′	1.385	31.365	7° 00′	.00745	.12187
128	2° 20′	2.125	36.524	9° 20′	,01324	,16218

Spiral No. 7.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
1,260	0° 15′	0.012	5.498	0° 15′	.00001	.00436
630	0° 30′	0.060	10.995	0° 45′	.00009	.01309
420	0° 45′	0.168	16.492	1° 30′	.00034	.02618
315	1° 00′	0.360	21.987	2° 30′	.00095	.04362
252	1° 15′	0.660	27.475	3° 45′	.00214	.06540
210	1° 30′	1.091	32.597	5° 15′	.00420	.09150
180	1° 45′	1.678	38.424	7° 00′	.00745	.12187

Spiral No. 8.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
1,890	0° 10′	0.008	5.498	0° 10′	.00000	.00291
945	0° 20′	0.040	10.996	0° 30′	.00004	.00873
630	0° 30′	0.112	16.493	1° 00′	.00015	.01745
472½	0° 40′	0.241	21.990	1° 40′	.00042	.02908
378	0° 50′	0.441	27.483	2° 30′	.00095	.04362
315	1° 00′	0.729	32.973	3° 30′	.00187	.06105
270	1° 10′	1.120	38.457	4° 40′	.00332	.08136

Spiral No. 9.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
2,730	0° 7′	0.006	5.559	0° 7′	.00000	.00204
1,365	0° 14′	0.028	11.118	0° 21′	.00002	.00611
910	0° 21′	0.079	16.677	0° 42′	.00007	.01222
682½	0° 28′	0.170	22.234	1° 10′	.00021	.02036
546	0° 35′	0.311	27.791	1° 45′	.00047	.03054
455	0° 42′	0.515	33.346	2° 27′	.00091	.04275
390	0° 49′	0.792	38.899	3° 16′	.00162	.05698

Spiral No. 10.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
3,780	0° 5′	0.004	5.498	0° 5′	.00000	.00145
1,890	0° 10′	0.020	10.996	0° 15′	.00001	.00436
1,260	0° 15′	0.056	16.493	0° 30′	.00004	.00873
945	0° 20′	0.120	21.991	0° 50′	.00011	.01454
756	0° 25′	0.220	27.488	1° 15′	.00024	.02181
630	0° 30′	0.364	32.983	1° 45′	.00047	.03054
540	0° 35′	0.560	38.478	2° 20′	.00083	.04071

Spiral No. 11.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
5,250	0° 4′	0.0035	6.109	0° 4′	.00000	.00116
2,625	0° 8′	0.0178	12.217	0° 12′	.00001	.00349
1,750	0° 12′	0.0498	18.326	0° 24′	.00002	.00698
1,312½	0° 16′	0.1066	24.434	0° 40′	.00007	.01164
1,050	0° 20′	0.1955	30.542	1° 00′	.00015	.01745
875	0° 24′	0.3234	36.649	1° 24′	.00030	.02443
750 .	0° 28′	0.4975	42.756	1° 52′	.00053	.03257

Spiral No. 12.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
7,140	0° 3′	0.0027	6.231	0° 3′	.00000	.00087
3,570	0° 6′	0.0136	12.462	0° 9′	.00000	.00262
2,380	0° 9′	0.0381	18.692	0° 18′	.00001	.00524
1,785	0° 12′	0.0816	24.923	0° 30′	.00004	.00873
1,428	0° 15′	0.1495	31.153	0° 45′	.00009	.01309
1,190	0° 18′	0.2474	37.384	1° 3′	.00017	.01832
1,020	0° 21′	0.3806	43.613	1° 24′	.00030	.02443

TABLE II.—Branch-off Easements.

Easement No. 1.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
75	7° 50′	0.700	10.222	7° 50′	.00933	.13629
70	2° 30′	1.182	13.238	10° 20′	.01622	.17937
52½	3° 20′	1.816	16.225	13° 40′	.02831	.23627
42	4° 10′	2.646	19.164	17° 50′	.04805	.30625
35	5° 00′	3.707	22.027	22° 50′	.07836	.38805

Easement No. 2.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
102⅓	6° 30′	0.658	11.584	6° 30′	.00643	.11320
83⅓	3° 30′	1.388	16.621	10° 00′	.01519	.17365
62½	4° 40′	2.475	21.593	14° 40′	.03258	.25320
50	5° 50′	4.011	26.444	20° 30′	.06333	.35021
40	7° 00′	5.998	30.906	27° 30′	.11299	.46175

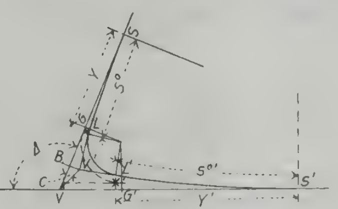
Easement No. 3.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
75	7° 50′	0.700	10.222	7° 50′	.00933	.13629
85	2° 55′	1.399	14.492	10° 45′	.01755	.18652
100	2° 30′	2.306	18.759	13° 15′	.02662	.22920
120	2° 5′	3.383	22.987	15° 20′	.03560	.26443
150	1° 40′	4.598	27.178	17° 00′	.04370	.29237
200	1° 15′	5.919	31.336	18° 15′	.05030	.31316
300	0° 50′	7.315	35.470	19° 5′	.05496	.32694
600	0° 25′	8.757	39.588	19° 30′	.05736	.33381

Easement No. 4.

Radius.	Angle.	x	y	s°	ver. sine.	sine.
102⅓	6° 30′	0.658	11.584	6° 30′	.00643	.11320
120	2° 00′	1.204	15.737	8° 30′	.01098	.14781
144	1° 40′	1.884	19.870	10° 10′	.01570	.17651
180	1° 20′	2.671	23.984	11° 30′	.02008	.19937
240	1° 00′	3.542	28.082	12° 30′	.02370	.21644
360	0° 40′	4.473	32.166	13° 10′	.02629	.22778
720	0° 20′	5.439	36.242	13° 30′	.02763	.23345

APPENDIX.



General Solution for Unsymmetrical Curves.

$O\,G = R + X - R \text{ ver. sine } S°;$

$G\,S = Y - R \text{ sine } S°;$

$O\,G' = R + X' - R \text{ ver. sine } S°';$

$G'\,S' = Y - R \text{ sine } S°';$

$$V\,S = \text{Tan } \tfrac{1}{2} \Delta\; O\,G + G\,S + \frac{O\,G' - O\,G}{\text{sine}};$$

$$V\,S' = \text{Tan } \tfrac{1}{2} \quad O\,G + G'\,S' \cdot \frac{O\,G' - O\,G}{\text{Tan}}$$

Note— ± in above; + if $\Delta = 90° +$ and − if $\Delta = 90° -$.

$\Delta' = \Delta - (S° + S°');$

$V'\,L \text{ or } V'\,L' = \text{Tan } \tfrac{1}{2} \Delta'\, R;$

$V'\,B = X + V\,L \text{ sine° } S;$

$V\,B = V\,S - (Y + V\,L - V\,L \text{ ver. sine } S°);$

TABLE III.

MIDDLE ORDINATES, 10 FT. CHORDS.

M. O.	RADIUS.		M. O.	RADIUS.		M. O.	RADIUS.	
in.	ft.	in.	in.	ft.	in.	in.	ft.	in.
0	infinity.		1	150	0 1/2	2	75	1
1/32	4807	8	1 1/32	145	6	2 1/32	73	11 3/16
1/16	2399	3	1 1/16	141	2 11/16	2 1/16	72	9 3/4
3/32	1600	6	1 3/32	137	2 1/4	2 3/32	71	8 3/4
1/8	1200	9	1 1/8	133	4 3/4	2 1/8	70	8 1/8
5/32	960	1	1 5/32	129	9 5/16	2 5/32	69	7 7/8
3/16	800	3 1/16	1 3/16	126	4 3/8	2 3/16	68	7 15/16
7/32	682	3 1/16	1 7/32	1 3	2 3/8	2 7/32	67	8 3/8
1/4	600	0 1/8	1 1/4	120	0 5/8	2 1/4	66	9 1/8
9/32	533	4 1/8	1 9/32	117	1 1/2	2 9/32	65	10 3/16
5/16	480	0 3/16	1 5/16	114	4 1/4	2 5/16	64	11 9/16
11/32	436	4 9/16	1 11/32	111	8 3/16	2 11/32	64	1 3/16
3/8	400	0 3/16	1 3/8	109	1 3/4	2 3/8	63	3 1/16
13/32	369	3	1 13/32	106	8 11/16	2 13/32	62	5 1/4
7/16	342	10 5/16	1 7/16	104	4 13/16	2 7/16	61	7 11/16
15/32	320	0 1/2	1 15/32	102	2 1/4	2 15/32	60	10 5/16
1/2	300	0 1/4	1 1/2	100	0 3/4	2 1/2	60	1 1/4
17/32	282	4 9/16	1 17/32	98	0 1/4	2 17/32	59	4 3/8
9/16	266	8 1/16	1 9/16	96	0 3/4	2 9/16	58	7 3/4
19/32	253	0 13/16	1 19/32	94	2 3/16	2 19/32	57	11 1/4
5/8	240	0 7/16	1 5/8	92	4 1/2	2 5/8	57	3
21/32	228	7 1/16	1 21/32	90	7 1/16	2 21/32	56	7
11/16	218	1 13/16	1 11/16	88	11 1/2	2 11/16	55	11 1/8
23/32	209	1 15/16	1 23/32	87	4 1/8	2 23/32	55	3 7/16
3/4	200	2 9/16	1 3/4	85	9 7/16	2 3/4	54	7 15/16
25/32	192	0 3/8	1 25/32	84	3 7/16	2 25/32	54	0 9/16
13/16	184	7 3/4	1 13/16	82	10	2 13/16	53	5 7/16
27/32	177	9 11/16	1 27/32	81	5 1/4	2 27/32	52	10 3/8
7/8	171	5 1/2	1 7/8	80	0 15/16	2 7/8	52	3 1/2
29/32	165	6 5/8	1 29/32	78	9 1/4	2 29/32	51	8 13/16
15/16	160	0 1/2	1 15/16	77	6	2 15/16	51	2 1/4
31/32	154	10 1/2	1 31/32	76	3 1/4	2 31/32	50	7 13/16

TABLE III. (Continued.)

MIDDLE ORDINATES, 10 FT. CHORDS.

M. O.	RADIUS.		M. O.	RADIUS.		M. O.	RADIUS.	
in.	ft.	in.	in.	ft.	in.	in.	ft.	in.
3	50	1 1/2	4	37	8	5	30	2 1/2
3 1/32	49	7 5/16	4 1/32	37	4 1/2	5 1/32	30	0 1/4
3 1/16	49	1 1/4	4 1/16	37	1 1/8	5 1/16	29	10 1/16
3 3/32	48	7 3/8	4 3/32	36	9 3/4	5 3/32	29	7 15/16
3 1/8	48	1 9/16	4 1/8	36	6 7/16	5 1/8	29	5 13/16
3 5/32	47	7 7/8	4 5/32	36	3 3/16	5 5/32	29	3 11/16
3 3/16	47	2 5/16	4 3/16	35	11 15/16	5 3/16	29	1 7/16
3 7/32	46	8 13/16	4 7/32	35	8 3/4	5 7/32	28	11 1/2
3 1/4	46	3 1/2	4 1/4	35	5 11/16	5 1/4	28	9 1/2
3 9/32	45	10 3/16	4 9/32	35	2 9/16	5 9/32	28	7 1/2
3 5/16	45	5 1/16	4 5/16	34	11 9/16	5 5/16	28	5 1/2
3 11/32	45	0	4 11/32	34	8 9/16	5 11/32	28	3 1/2
3 3/8	44	7	4 3/8	34	5 5/8	5 3/8	28	1 9/16
3 13/32	44	2 1/8	4 13/32	34	2 11/16	5 13/32	27	11 5/8
3 7/16	43	9 3/8	4 7/16	33	11 7/8	5 7/16	27	9 3/4
3 15/32	43	4 11/16	4 15/32	33	9 1/16	5 15/32	27	7 7/8
3 1/2	43	0 1/16	4 1/2	33	6 1/4	5 1/2	27	6
3 17/32	42	7 1/2	4 17/32	33	3 1/2	5 17/32	27	4 3/16
3 9/16	42	3 1/16	4 9/16	33	0 13/16	5 9/16	27	2 3/8
3 19/32	41	10 11/16	4 19/32	32	10 1/8	5 19/32	27	0 9/16
3 5/8	41	6 3/8	4 5/8	32	7 1/2	5 5/8	26	10 13/16
3 21/32	41	2 1/8	4 21/32	32	4 7/8	5 21/32	26	9 1/16
3 11/16	40	10	4 11/16	32	2 3/8	5 11/16	26	7 5/16
3 23/32	40	5 7/8	4 23/32	31	11 13/16	5 23/32	26	5 9/16
3 3/4	40	1 7/8	4 3/4	31	9 5/16	5 3/4	26	3 15/16
3 25/32	39	9 15/16	4 25/32	31	6 7/8	5 25/32	26	2 1/4
3 13/16	39	6 1/16	4 13/16	31	4 3/8	5 13/16	26	0 9/16
3 27/32	39	2 3/16	4 27/32	31	2 1/16	5 27/32	25	10 15/16
3 7/8	38	10 7/16	4 7/8	30	11 5/8	5 7/8	25	9 5/16
3 29/32	38	6 3/4	4 29/32	30	9 5/16	5 29/32	25	7 11/16
3 15/16	38	3 1/8	4 15/16	30	7	5 15/16	25	6 1/8
3 31/32	37	11 1/2	4 31/32	30	4 3/4	5 31/32	25	4 9/16

$$\text{Tan } C = \frac{V'\,B}{V\,B}.$$

$$V\,V' = \frac{V\,B}{\text{cosine } C} \text{ if } C < 45° -;$$

$$V\,V' = \frac{V'\,B}{\text{sine } C} \text{ if } C > 45° +;$$

THE ACTUAL ACCURACY OF CHEMICAL ANALYSIS.

The degree of accuracy ordinarily obtained in every-day practice in chemical analysis was discussed by Mr. Frederic P. Dewey in a paper read on May 14, 1896, before the Washington Section of the American Chemical Society ("Jour. Am. Chem. Soc.," Sept., 1896; also "Trans. Am. Inst. M. E.," Denver meeting, Sept., 1896). In May, 1881, Mr William Kent presented a paper to the American Institute of Mining Engineers, entitled "Manganese Determinations in Steel," in which he gave 24 determinations of manganese, by ten different chemists, on samples from a plate of steel. These results presented the remarkable range of from 1.14 to 0.303%. In 1886, Capt. A. E. Hunt ("Trans. Am. Inst. M.E.," vol. XV., p. 104), in giving a measure of the accuracy of the colorimetric method, speaks of a variation of 0.2% in steels containing from 0.15 to 1.5% of Mn. as "sufficiently accurate for all practical work." This degree of accuracy shows a satisfactory advance over the results reported in 1881. In 1883, Mr. G. C. Stone began a series of contributions on "Determinations of Manganese in Spiegel" ("Trans. Am. Inst. M. E.," XI. 323, XII. 295, 514). In his first paper he reported 13 determinations by five chemists, on the same sample, ranging from 15.49 to 13.83, also 26 determinations by ten chemists, on a sample of the same spiegel, ranging from 14.56 to 10.36%, some of the low results being obtained by experimental methods. Of a total of 73 determinations by 19 different chemists, rejecting eleven on account of methods used, or because the chemists were not entirely satisfied with them; there are left 60 determinations by 18 chemists, ranging from 14.47 to 12.60% and averaging 12.60%. Mr. Dewey concludes from a study of Mr. Stone's results that variations of 0.5% in determinations of spiegel of this grade (10 to 15% Mn.), are to be expected, and much wider variations may be found.

In determinations of phosphorus in steel extensive researches have shown that the different chemists using modern methods obtain results which are highly satisfactory. On one sample 36 results obtained by 23 chemists ranged from 0.055 to 0.045%, an extreme variation of only 0.010%. On another sample 38 results ranged from 0.091 to 0.076%, an extreme variation of 0.015%. In determinations of phosphorus in pig iron the results show a wider variation. Mr. F. E. Bachman, in 1882 ("Trans. Am. Inst. M. E."), reported 44 results by 18 chemists, ranging from 0.165 to 0.096%, the extreme variation being 0.069%. Analyses of copper ores show a wide variation, 45 determinations by 17 chemists gave results ranging from 53.34 to 43.92%. On pig copper the results of 17 determinations by seven chemists ranged from 91.07% to 98.17%, but throwing out six of the results which differed widely from the average the remainder range from 94.91 to 94.38, which may be regarded as very good work. Copper mattes determined by electrolysis by eight chemists, gave from 55.17 to 54.50. The total range of 0.67% is regarded as very satisfactory. By the cyanide method six chemists reported results ranging from 54.08 to 50.55%. A plate of copper analyzed by six chemists gave from 98.46 to 97.04% of copper.

In gold and silver assays of copper-material 26 determinations by 20 chemists gave from 164.35 to 148.5 ounces of silver to the ton, and 0.501 to 0.205 ounces of gold to the ton.

A HARBOR OF REFUGE, near the mouth of Delaware Bay, is about to be constructed by the U. S. government. The location was fixed by a board of U. S. Engineers, under the provisions of the River and Harbor Act of 1890, between the Shears Shoal, about three miles off shore from Lewes, Del., and a breakwater to be constructed; the latter about 8,000 ft. long. In order to protect this harbor from ice coming down the Delaware River a row of ten ice-piers will be built across the head of the harbor, about one-half mile above the breakwater. This breakwater will be about two miles from the old Delaware breakwater and almost north of it; constructed of random stone in very large blocks, with a top width of 40 ft., at low-water mark, and a sea-slope of 1 in 3 and a harbor-slope of 1 in 1.35. For 14 ft. above mean low water the blocks will be laid in courses, with a top width of 20 ft. The protected anchorage will include an area of about 800 acres, with a minimum depth of 30 ft. over 552 acres, and a low-water depth of not less than 24 ft. over the remainder. The total estimated cost is about $4,600,000, divided as follows: Breakwater complete, $3,863,373; ten ice-piers, $377,500; engineering and contingencies, $424,127. The board fixing upon the location was made up of Gen. Wm. P. Craighill, now Chief of Engineers; Major C. W. Raymond and Capt., now Major W. H. Bixby, all of the Corps of Engineers, U. S. A.

A SLIDE-RULE SEWER COMPUTER, which is an application of the Kutter formula to a slide-rule for use in obtaining the discharge, diameter or grade of sewers, has been devised by Mr. B. H. Colby, M. Am. Soc. C. E., Sewer Commissioner and Member of the Board of Public Improvements of St. Louis, Mo. All problems relating to egg-shaped as well as circular sewers can be solved by this simple instrument; and the results are guaranteed to be correct according to Kutter's formula. The computer is made of box wood and is 21 ins. long; it is manufactured and sold by the A. S. Aloe Co., of St. Louis.

STREET RAILWAY TRACK AND TRACK JOINTS.*

By M. K. Bowen.**

In considering this subject I have found that the life of a rail was measured by the wearing out of the head, and that less than 12% was worn away before we sold the old rail for scrap; hence the deduction that the point of contact between the wheel and the rail, or the bearing and wearing part of the track, was a most important consideration. The treads of wheels of street railway cars are made conical in order to center the car on the track. If the wheel were not coned, the wheel which once got behind, or an axle which once assumed a position not at right angles with the truck, would be apt to remain in its faulty position during the entire trip, requiring excess of power to haul the car, and abnormal wear of wheel and rail, resulting in sharp-flanged wheels and short life of rail. If the beveled tread is run on a flat-top rail, as in Fig. 1, all the bearing will be at A.

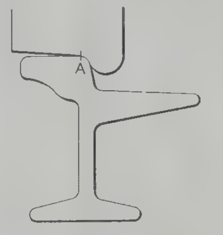


Fig. 1.

Fig. 1.—Bearing of Beveled Wheel Tread on Flat Rail Head.

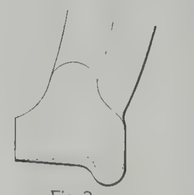


Fig. 2.

Fig. 2.—Character of Wear of Wheel Tread.

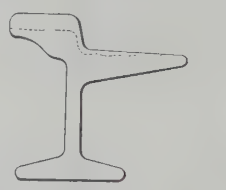


Fig. 3.

Fig. 3.—Wear of Rail in Cable Track After Eight Years' Service.

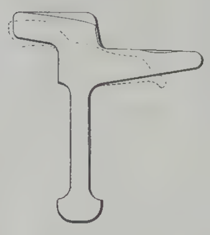


Fig. 4.

Fig. 4.—Wear of Rail After Eleven Years' Service (Wear Due Chiefly to Wagon Traffic).

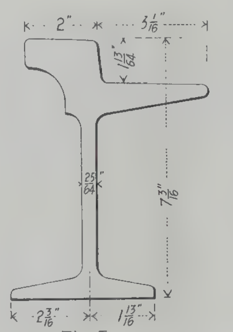


Fig. 5.

Fig. 5.—7-In. Girder Rail for Use with Chairs; Chicago City Ry. Co.

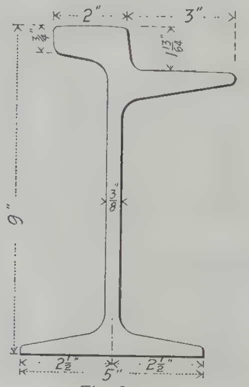


Fig. 6.

Fig. 6.—9-In. Girder Rail for Use Without Chairs; Chicago City Ry.

Fig. 2 is a section of a new and old car wheel which shows clearly the manner in which the tread of the wheel will wear if used on a rail with no bevel. The record of car miles of this wheel is not known, but no doubt a great amount of energy was lost before it had worn down to its most economical state. Fig. 3 shows a rail taken from the State St. cable track after 8 years' wear, during which time 8,000,000 car wheels passed over it. Fig. 4 shows a rail taken out after 11 years' wear. The rail should have been taken out three years before, but owing to impossibility of getting rails at the time and the Columbian Exposition coming at that time the track was not rebuilt. The true rate of wear cannot be found, as the flange of the wheel had begun to run on the flange of the rail long before it was taken out. The dotted lines show an interesting state of affairs. This section shows the wear due almost entirely to wagon traffic. Fig. 5 shows the rail used at the present time in our track construction with chairs or tie-plates. The rail weighs 83 lbs. per yd. and has a head 1 3-16 ins. high, beveled as described to conform to the car wheel tread for two-thirds of its section from gage line across the head. Fig. 6 shows the rail used in our electric construction without chairs or tie-plates. The rail weighs 90 lbs. per yd., and also has a head 1 3-16 ins. high, beveled as described. The experience of the Chicago City Ry. Co., which first tried this form of head, has been that it saved wear of both rails and wheels, increasing their life by about 35%.

The weakest part of the track construction is in the rail joints. Once weakened they rapidly grow worse, and not only are the rails worn at such joints, but the rate of wear of the car equipment is greatly increased. We want some method of keeping the rails from pulling apart at the joints (due to contraction and spreading outward) and from bending down at the joints (due to the pounding and weight of the cars). The joint I have used for the past year is a cast-welded joint. This has been found to give perfect satisfaction as a joint; it is strong and substantial, as has been proved by its holding under the extreme changes in temperature for which Chicago is noted. In 1895 there were 17,000 joints put in on the Chicago City Ry. Co.'s lines, and of these only 154 joints were lost. The joint in comparative tests has been shown to be far stronger than the rail itself, and such breakages as have occurred were due to flaws in the metal. The metal cast around the joint has eight times the cross-sectional area that the rail has. Hence, considering steel as four times as strong as cast-iron, the joint is twice as strong as the rail. It has been found in some cases where this joint was used at crossings with other tracks, the tracks were apt to be pulled out of shape through the changes of temperature. To overcome this the joint nearest the crossing should be anchored in a substantial manner.

The method of making the joint is as follows: The rails at the joint are scraped and brightened, a cast-iron mold is placed around the joint, making a tight fit, and into this is poured the molten iron, 25% scrap, 25% soft and 50% hard silicon pig. The metal in contact with the mold begins to cool and forms a crust while the interior remains molten. This crust continues to cool and at the same time contracts, forcing the molten metal strongly towards the center, which makes a solid and rigid joint. The top, or bearing part of the head of the rail is afterwards filed off perfectly level so that it is very difficult to detect a joint by riding over it or looking for it. Upon breaking a joint which has been well cast, three spots (1½ to 2 ins. diameter) will usually be found where amalgamation has taken place between the rail and cast portion; one on each side of the web and the other on the bottom. I cannot recommend this joint with certainty as a bond for carrying electric current, as there are occasional joints where no such amalgamation has taken place, thus destroying the effect as a bond of all joints in that line of track. To overcome this difficulty I have adopted the plan of bonding all joints. However, future experiments and care in the casting of joints may develop greater efficiency as a bond.

The following is an outline of the specifiations for track construction used by the Chicago City Ry. Co., and Fig. 7 shows a section of this track:

Excavation.—Excavate to a depth of 9 ins. below the established grade of the street, taking out all dirt for a width of 18 ft.; then excavate for each tie to a depth of 5 ins. leaving the earth between the ties in place.

Ties.—The ties should be of good sawed white oak 5 × 8 ins., 7 ft. long, free from sap; they are laid 30 ins. c. to c., directly upon the ground, and thoroughly tamped with medium-size broken stone.

Rails.—The rails to be used are 9-in. girder rails, 5 ins. base, 60 ft. long; the head to be beveled for two-thirds its width to conform to the bevel of the car wheel. These are laid on the ties and fastened with ½ × ½-in. spikes, 4½ ins. long, 8 spikes to a tie. Double nut tie rods, 1¼ × ⅛ ins. are used, 6 ft. apart; the first and last to be 3 ft. from the ends of the rail. The rails are to have vitrified brick or wooden filling between the paving blocks and the web on each side.

Paving.—The road bed is now filled to within 8 ins. of the top of the rails with medium fine limestone, thoroughly tamped. Upon this are placed 1½-in. hemlock boards running lengthwise of the track. Upon this layer of boards a 1-in. layer of clean sharp sand is laid; and upon this are laid the paving blocks, which should be No. 1 white cedar. 6 ins. high. After being laid the joints are to be filled with good gravel or a limestone screening, tamped in place, the top of paving blocks to be even with top of rail both inside and outside.

Gage.—The gage must be 4 ft. 8½ ins., or ¼-in. wider than the gage kept in the shop for gaging car wheels.

Level.—There must be not over ⅛-in. difference in the height of two opposite rails. Any amount above this will be considered sufficient cause for rejecting such part of track and rebuilding or re-surfacing the same. The foundation should be solid as it is possible to make it. The ties should be of such material that their life will be about equal to that of the rail, if anything a trifle more. The expense of taking up and replacing pavement and repairing defective ties is very great. The wood most generally used, and the one which gives the best satisfaction is good sound white oak free from sap. Its life is about 8 to 10 years under ordinary circumstances. The nature of the soil has considerable to do with the life of the tie.

Brace chairs in place of tie rods cannot be recommended for use with high rails, as they are very apt to bend over in time, but with shorter rails this will not happen.

The paving of a street upon the right-of-way is generally regulated by municipal authorities. Wooden blocks are extensively used in the smaller cities, but in the larger ones they soon wear unevenly and require replacing. Granite block paving is by far the most durable, lasting under ordinary wear in cities 30 years, and should be used where the street traffic is at all heavy. The blocks should be hard, but not liable to become slip-nery by use, the average size being 4 × 8 × 12 ins. I advocate small blocks, even as low as 3 × 6 × 10 ins.

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*Abstract of a paper presented at the convention of the American Street Railway Association at St. Louis, Mo.

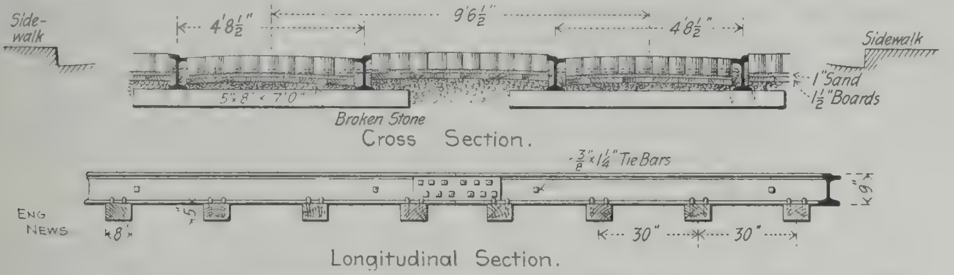
**Superintendent, Chicago City Ry. Co., Chicago, Ill.

The cost of one mile of double track with paving for 18 ft. in width of right-of-way, as above specified, based on Chicago prices, would be as follows:

283 gross tons 9-in. 90-lb. rails, at $33	$9,339
4,224 white oak ties, 5 ins. × 8 ins. × 7 ft., at 38 cts.	1,605
352 cast-welded joints, at $3.50	1,232
1,760 tie-rods, at 15 cts.	264
33,792 spikes, ½ × ½ × 4½, at 1 ct.	338
42,240 ft. of wood filler, at ½ ct.	2,112
Labor, at $1 per 1 ft. of D. B.	5,280
10,560 sq. yds. cedar block, at 30 cts.	3,168
146 sq. yds. sand, at $1.25	183
445 cu. yds. crushed stone, at $1.50	668
10,560 sq. yds. gravel and dressing, at 8 cts.	845
10,560 sq. yds. hemlock boards, 2-in., 8 cts. sq. yd.	845
	$25,879

If granite had been used instead of wood block the cost would have been $12,708 more.

The question as to the right time to reconstruct a track is one of the greatest importance as it often involves the expenditure of thousands of dollars. The task of solving this question was brought before me not long ago concerning the State St. cable track, which had reached a deplorable condition. From an examination I guessed that it was time to rebuild the track. This involved a very large expenditure, and to make sure of my guess I had run over the line a car weighing 8,665 lbs., attached behind a grip car by means of a recording spring balance or dynamometer. This test car was then run over a track newly made at the same speed as over the old line; the dynamometer showed that it took 13.75 lbs. more pull per ton to haul cars over the old line than over the new. The average speed of cars on this street is 12 miles per hour. The excess power required to haul one ton was 0.44 HP., and the excess cost of hauling one ton one hour was $0.0088. The number of tons hauled one mile per year on this track was 45,147,537, and the time required to haul one ton one mile was five minutes; and 45,147,537 tons hauled at a given speed for five minutes is equal in work done to 3,762,295 tons hauled at the same speed for one hour; 3,762,295 multiplied by $0.0088 equals $33,108, which is the excess cost per year for hauling cars on account of bad track. It is estimated that the new track with cast joints will last 12 years, and as there will be no low joints the draw bar pull will not increase much until the rail is worn down sufficiently to allow the wheel to run on the flange, so the annual saving will be nearly $33,108, during the life of the rail, and the total saving will be $397,276, which in 12 years will pay principal and interest on $293,444, which is the amount we could profitably expend in repairs. The actual cost of rebuilding this track was $61,670.



Cross Section.

Longitudinal Section.

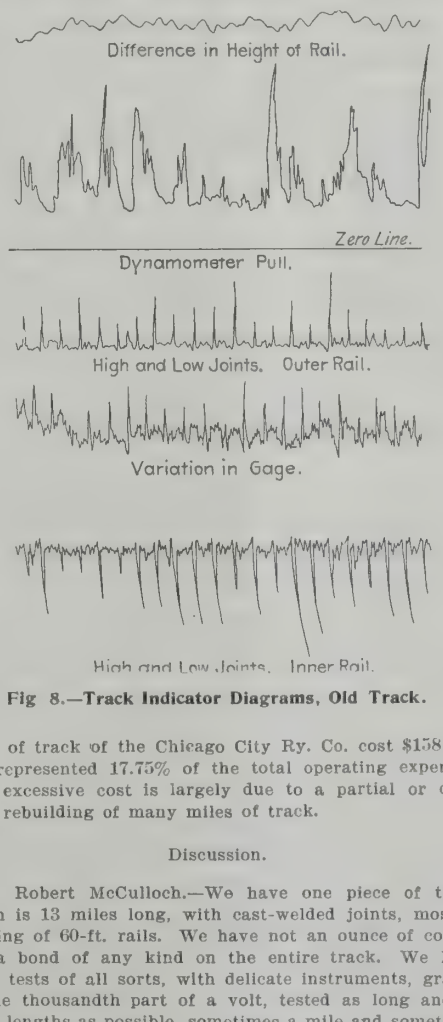
FIG. 7.—STANDARD TRACK CONSTRUCTION; CHICAGO CITY RY.

This caused me to plan a scheme by means of which dynamometer or power ratings could be taken and automatically traced on paper, showing the condition of the track at all points, faults of gage, level or joints; and excess power in consequence of defects, side by side. Further, instead of representing defects in inches and the excess of power in foot-pounds to make the instrument show them in dollars and cents per ton of load when capitalized, which would show, multiplied by the ton miles on any road tested, the amount that could, with good management, be expended on track reconstruction, or rebuilding. The apparatus devised for this purpose is what we call an indicator car. I do not know of another in use by a street railway company, and have found only one other (very dissimilar) in existence on a steam road, after I had the plans of mine finished.*

This car shows graphically high and low rails, low joints and variations in gage, drawbar pull and track level. The car consists of a platform, 8 × 10 ft., mounted on a single truck, no springs being used. Midway between the two end axles is one which is fitted with wheels which record defects of joints or gage. After use and calibration of instrument it will be more valuable and the dynamometer will not be required, as any man using this car constantly will become so accustomed to the value of defects that a glance at the profile will tell him what money he may, with economy, spend for rebuilding a track or repairing it. The dynamometer consists of two draw bars, one at each end of the car, and extending beneath the platform to within a distance of about 1 ft. of each other. Between the two adjacent ends of the draw bars a spring is placed, and the amount of pull required to draw the car along the track in either direction is recorded by a recording arm, which is connected to the spring with a wire. The apparatus for showing the variation in the level of the tracks is mounted on the platform and consists of two cups of mercury (having a connection between them by means of a pipe) and into which dip two plungers connected to a recording arm. The paper on which the record is taken unwinds at a uniform speed of 1 ft. per 1,000 ft. of track. The car is fastened to an ordinary car, which is drawn over the tracks by horses (or any motor car) made to go at as even a speed as possible. The results shown by a recent test trip are very interesting to campare.

Fig. 8 is from an old track—the joints were the ordinary ones, and were spread far apart, and the rails are low at each joint; this is distinctly brought out by the record. The gage is also uneven. It would appear from the record that the rails spread at each joint. The dynamometer pull is very unsteady, showing the effect of low joints and uneven gage. Fig. 9 is a record from a new track; here we can observe hardly any joints or variation in gage, and the dynamometer pull is more steady. Occasionally high points are observed, but they are due to unsteadiness of speed. A person riding on this track will not be able to detect any joints. This track has the cast-welded joint. We find from the data obtained by use of this car that we could afford to expend $7,383 per mile to repair the old track. The estimated cost of repairing this track, leveling and casting new joints, is $1.740 per mile.

The track maintenance during the year 1895 for the 184 miles of track of the Chicago City Ry. Co. cost $158,217, and represented 17.75% of the total operating expenses. This excessive cost is largely due to a partial or complete rebuilding of many miles of track.



Difference in Height of Rail.

Dynamometer Pull.

High and Low Joints. Outer Rail.

Variation in Gage.

High and Low Joints. Inner Rail.

Fig 8.—Track Indicator Diagrams, Old Track.

Discussion.

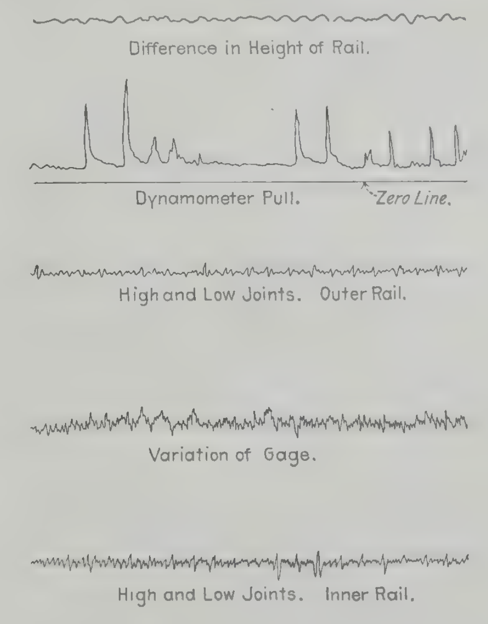
Mr. Robert McCulloch.—We have one piece of track which is 13 miles long, with cast-welded joints, most of it being of 60-ft. rails. We have not an ounce of copper nor a bond of any kind on the entire track. We have made tests of all sorts, with delicate instruments, graded to the thousandth part of a volt, tested as long and as short lengths as possible, sometimes a mile and sometimes a single joint, and have found in most instances that the carrying capacity of the joint was greater than that of the rail at any other place. We have found no necessity for bonding, our contact is perfect at the extreme ends of the rail; and I do not believe it is necessary to bond a welded track. The oldest joints we tested were about six or eight months old.

Mr. Bowen.—For a small road it would be better to let the contractors repair any broken cast-welded joints. For a large system it would probably be better to keep a cupola; you are always building more or less track and doing a considerable amount of repair work. A large system is generally building new track, and you could use a machine and make it pay for itself. The joints that failed, failed on account of contraction, due to very cold weather, in mid-winter. With the first cold snap, the contraction of the rails pulled 154 joints apart. The joints were then repaired, and since then they have gone through the summer the same as the other joints. They were cast in mid-summer, during the night hours. When the joints do part, it is for two or three inches, so that you can see them readily. If there is any oxidation between the joint and the rail, I hardly imagine it would do any harm unless it was sufficient to loosen the cast-iron from the rail proper. In that case it would come apart 3 ins. In repairing a break with a space of 3 ins., we saw a piece of rail and put it in, and recast around the entire two joints.

Mr. Goff.—I have in mind a track which was made up with cast joints in the winter, and in the summer time it seems to be out of line all the time. The car has a waving motion over the track. Do you have any trouble of this nature?

Mr. Bowen.—That comes from the casting. You will find as you put your mold on to cast the joint that the rails have contact at the ball and not at the flange at all. If you are not careful the rail will go out and go up, on account of the majority of the iron being underneath the rail. The contraction in cooling will push it up and push it out. In order to prevent that we put a clamp on the rail when casting it and push it in ¼ in. and down ¼ in. We like to cast at a temperature of between 40° and 50°. There were one or two cases of rails pulling apart. Instead of the fracture being just at the joints, it was some little distance back, probably where the difference between the extreme heat and the ordinary temperature of the rail left a partial fracture.

Mr. Littell.—We have no welded joints in Buffalo. We have the ordinary track laid with 9-in. rail, 94 lbs. per yd. Summer before last we put down some 9-in. rail in hot weather, forcing the rails just as close as we could, leaving them uncovered over night. In the morning we drove the rails up as close as we could, and put them together with a 12-bolt splice bar, 1-in. bolts. We got along very nicely for a time, but winter before last we had one of the 30-ft. rails pull in two 13 ft. from the joint.



Difference in Height of Rail.

Dynamometer Pull.

High and Low Joints. Outer Rail.

Variation of Gage.

High and Low Joints. Inner Rail.

Fig. 9.—Track Indicator Diagrams, New Track.

Mr. Seely.—We have had 90-lb. girder rails pull in two, on grade of about 5%. We have this occur every winter; the rails break right in the center. The joints are driven too close together. We also find that with the high carbon rails we are using it is almost impossible to cut them with the ordinary tools; we require special devices for sawing rails in two. In sawing rails, if you have to turn them over, they will crack all the way down the center, and we are compelled to handle them with the greatest care.

Mr. McCormack.—Our company in Brooklyn put in 2,000 cast-welded joints on the 94-lb. 9-in. girder rail, and out of that number there was only one which pulled the rail apart; the rail broke about 4 ins. from the end.

Mr. Bowen.—We have 32,000 cast-welded joints, and pay the Falk Co. a royalty for each joint.

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*The most complete track indicator, or dynagraph car, is that of Mr. P. H. Dudley, but the Pennsylvania R. R. and some other lines have indicator cars for a similar purpose.—Ed.

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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

We give a considerable part of our space this week to the papers and discussions at the annual convention of the American Street Railway Association, held at St. Louis last week. The Association is to be congratulated on the excellence of the papers which were read at St. Louis, which seem to us to be distinctly superior as a whole to those which have been read at any preceding convention of this Association. The progress and changes in electric railway engineering have been so rapid in every department during the few years since the electric railway came into general use that it requires vigilance to keep pace with them. Existing literature on electric railway engineering that is of real value to the engineer engaged in actual practice is far from abundant. We believe, therefore, that the papers in this issue on overhead work, power-plant design, and especially the notable features of track construction, will be appreciated by our readers.

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In the October advance sheets of "Consular Reports," Commercial Agent H. C. Carpenter, of Furth, Germany, gives some very sensible advice to American manufacturers seeking a broader market for their goods. He tells them that there is such a market in Germany; but it can not be secured by sending catalogues, circulars and other advertising matter to U. S. Consuls abroad under the expectation that these officials will act as their agents. Mr. Carpenter says that the leading industry about Furth is the manufacture of looking-glass plate, and over $1,000,000 worth of this product is annually exported to the United States. But the German manufacturer goes after his market, exhibits his goods, in person or through trusty agents, and by this personal and persistent effort he sells his manufactures. It is pointed out that this rule would work both ways, and Mr. Carpenter shows that there is a fruitful field in Germany for the American manufacturer who will more closely follow German methods in the development of foreign trade. In the line of furniture particularly, there is abundant room for the sale of the well-made solid wood furniture that the United States produces so cheaply. Mr. Carpenter paid $150 for a German dining set, of pine, thinly veneered with a poor quality of oak, which split so badly in six weeks that it had to be repaired. A finer and more durable set could have been purchased in this country for $60. He says that every piece of furniture made in Germany, even down to the plainest, costs from two to three times the price of a better article made in the United States. Farming implements and machinery, house building machinery, boots and shoes are all referred to as products for which Americans could surely find a market in Germany. But the goods themselves must be shown to the Germans, agencies must be established and the American dealer must "hustle for business," to use the expressive remark of Mr. Carpenter. The German leaves the home market to regulate itself while he personally seeks the markets of the world; and we must do the same to extend trade beyond our own boundaries.

◆

The well-known firm of Yarrow & Co., of London, builders of steam yachts and torpedo boats, are said to be considering the establishment of a new works on the Continent with a view, if the result be as satisfactory as is anticipated, of closing their English yard. "Engineering," of Sept. 25, devotes its leading editorial to the subject. The principal reason given is that "foreign countries evidently offer to an astute and successful English manufacturer better opportunities of conducting his business than does his own land." Mr. Yarrow, it is stated, formed one of the party of the Institution of Naval Architects who last spring paid a visit to Germany and inspected many of the shipyards there. "Not a few of the members," says "Engineering," "came back with the unhappy conviction that they would like to exchange yards with at least one they saw during their travels, and that if British builders were to maintain their supremacy they must scrap a good deal of their plant and spend thousands of pounds on new machinery." The chief advantages in favor of a location in Germany as compared with England, are, apparently, the greater cheapness of labor and the greater freedom from obstruction by the action of labor unions.

◆

SPECIFICATIONS FOR WATER-TUBE BOILERS.

The city of St. Louis recently advertised for bids for eight water tube boilers for its No. 3 pumping station, at Baden, and the result of the bidding shows some remarkable features which we deem worthy of comment. From the printed specifications issued by the Water Commissioner, upon which bids were asked, we extract the following:

> 1. The work to be done consists in furnishing designs and plans, materials, tools and labor and building, transporting and erecting complete in place in the boiler house at High Service Pumping Station No. 3, Baden, eight boilers with furnaces, settings, valves, gages, breeching and smoke flue to core of stack.
>
> 2. The contractor shall submit, with his bid, evidence in writing, satisfactory to the Board of Public Improvements, of having obtained with boilers similar to those proposed to be furnished under this contract, an efficiency with common Illinois coal of not less than 65%.
>
> Design.
>
> 3. The boilers shall be of the water tube type, having straight tubes, removable from the front and accessible and open at both ends, and no tube shall make a greater angle than 45° with the horizontal, except front and rear connecting pipes between drums and headers. No stays or obstructions of any kind shall be placed inside the water tubes.
>
> The boilers shall be designed and built with special reference to the easy removal of the tubes and access for repairing and cleaning all external and internal surfaces. No part of the boilers or fittings shall extend more than 21 ft. above the boiler room floor.
>
> The furnaces shall be designed to develop the specified capacity of the boilers, without producing smoke, when burning common Southern Illinois coal, and shall have ample combustion chambers.
>
> Furnaces using steam jets in the fire box or combustion chamber, will not be permitted. Mechanical stokers, or furnaces operated by means of a secondary engine, will be tested to ascertain the amount of steam thus used, and this amount of steam will be charged against the boilers in determining the capacity and efficiency.
>
> 4. The boilers to be designed for the natural draft of the smoke-stack now under contract, and shown on plans on file in the office of the Water Commissioner.
>
> 5. The boilers shall be designed for a working steam pressure of 150 lbs. per sq. in., with a factor of safety of five on minimum sections.
>
> 6. Each boiler shall have an evaporative capacity of 9,000 lbs. of water per hour from a temperature of 100° F. into dry steam at 70 lbs. gage pressure, or the equivalent of this capacity.
>
> 7. The boilers shall be set in four independent batteries having passage-ways of about 6 ft. in width between them. Each boiler to be provided with walls, settings, valves, gages, smoke-breeching and dampers necessary for operating or repairing it independent of the other boilers in the house.

The clauses of the specification following those above quoted relate to fire-fronts, dampers, valves, steel for drums, settings, tools, quality of material, workmanship, foundations, etc. These clauses number 44 in all, and are given in considerable detail, but they contain no requirement especially difficult to fulfill. After these are the following:

> Test for Capacity, Efficiency and Smoke Record.
>
> The boilers shall be tested for capacity and efficiency by the Water Commissioner. One or more boilers shall be tested at a time as may be directed. All boilers under fire in the house shall be tested.
>
> The contractor shall furnish firemen at his own expense during all tests, and shall be given opportunity to make preliminary trials before submitting the boilers for formal tests.
>
> The coal burned during the official tests shall be Mt. Olive Illinois coal, having a calorific value of 11,000 B. T. U. per lb., furnished by the city of St. Louis, and delivered to the contractor in the coal house. Contractor will be allowed to pick, air-dry or fork coal if he so desires.
>
> Coal will be sampled and weighed as it comes into the boiler room. Calorific value of coal shall be determined with a Thompson calorimeter, with no correction for moisture.
>
> No allowance shall be made for unconsumed carbon in ashes, nor for temperature of air entering furnace.
>
> During the preliminary testing of the boilers by the contractor, observations on smoke will be made, and until the record thus obtained is satisfactory to the Water Commissioner, the contract tests for capacity and efficiency shall not be made.
>
> Repairs.
>
> One year after the test for efficiency, and before the final estimate has been given, the Water Commissioner will make an examination of the boilers and furnaces and any part or detail found to be defective or injured through bad material or faulty design, shall be replaced by the contractor at his own cost and expense, to the complete satisfaction of the Water Commissioner.

Then follow stipulations in regard to time of completing the work, agreement that the contractor will not sublet the work, and that he will protect the city from demands for patent royalties, damage suits, etc. The guarantees of capacity and efficiency and the premium and penalty clauses are as follows:

> The party of the first part shall further agree that each boiler furnished under this contract shall have an evaporative capacity of 9,000 lbs. of water from a temperature of 100° F., to steam at 70 lbs. gage pressure in one hour, or the equivalent of this capacity. Steam generated under the above conditions shall not contain more than ½ of 1% of moisture. The capacity to be determined by the Water Commissioner.
>
> The party of the first part hereby agrees that the boilers furnished under this contract shall attain, during a test of 24 hours or more, an efficiency of 70%; i. e., they shall utilize in heating and evaporating water, 70% of the total heat units contained in the coal as determined with the Thompson calorimeter.
>
> The party of the first part further agrees that in case either of the eight boilers fails to attain an efficiency of 70% during the efficiency test he will pay to the party of the second part, as an agreed measure of damages for lack of efficiency, an amount to be determined in the ratio of $500 for each per cent. which the efficiency of each boiler falls below 70%.
>
> In case any boiler, during the efficiency test, exceeds an efficiency of 70%, the party of the second part agrees to pay the party of the first part, as compensation for the superior efficiency of the boilers, an amount to be determined in the ratio of $250 for each per cent. which the efficiency of each boiler exceeds 70%.

The eight-hour labor ordinance of the city of St. Louis, approved Dec. 22, 1891, is then made part of the contract, as follows:

> All contracts hereafter entered into where the city of St. Louis is a party, for the doing of any kind of work or labor for the city of St. Louis, including work on all public buildings, works and enterprises, shall contain the following terms and conditions: (a) That the men, persons or laborers who may be employed in the doing, prosecuting or accomplishment of such work done by the contractor with the city of St. Louis, or any one under him, or any person controlling the said men, persons or laborers, shall not be required to work more than eight hours per day; (b) That in case of the violation of such provisions of such contracts, the Mayor shall immediately declare such contracts cancelled and forfeited, and the work being done under such contracts shall be relet in the manner provided for the letting of such work, and such contractor shall thereafter be ineligible to bid upon such work under such reletting, and the difference in the cost of doing such work under such contract so cancelled and forfeited, and under such reletting, shall be sued for on the bond of such contractor so violating such contract.

It will be observed that there is not a word in the specifications concerning the size of the boilers or furnaces, the areas of grate and heating surface, nor the dimensions of any of the parts. Instead of specifying how large a boiler and how large a furnace is desired, the specification merely states that each boiler shall have an evaporative capacity of 9,000 lbs. of water per hour from feed water at 100°F. into steam at 70 lbs. pressure, that the furnaces shall be designed to develop the specified capacity of the boilers without producing smoke, and shall have "ample" combustion chambers, and that during a test they shall utilize 70% of the heat units contained in the coal, as determined by a Thompson calorimeter, The result of the advertising for bids was that only four bids were received, as follows:

Water Department, Letting No. 5034, Sept. 8, 1896.
Abstract of Proposals for Eight Water Tube Boilers at Baden:

Heine Safety Boiler Co., St. Louis, Mo.	$24,950
John O'Brien Boiler Works Co., St. Louis, Mo.	22,300
Geary Water Tube Boiler Co., Oil City, Pa.	50,000
Abendroth & Root Mfg. Co., New York city	52,000

With the bids there was received a protest from the Heine Safety Boiler Co., dated Sept. 8, stating that it had reasons for believing that the boiler tendered by the John O'Brien Boiler Works Co. were "to all intents and purposes Heine Safety Boilers, and as such directly infringe our patents."

In response to this the O'Brien company filed, on Sept. 10, an opinion by Knight Bros., patent attorneys, dated Nov. 25, 1895, to the effect that a boiler made according to a certain blue print furnished by the O'Brien company could be built without infringing any one of three Heine patents, because all the patents had expired. The Heine company then, on Sept. 12, wrote a letter to the Water Commissioners, in which they say:

> We have two suits against the city of St. Louis connected with its use of the Geary boiler. The more important one and the one which will chiefly warrant the consideration of your Board is that one which is brought upon our patent No. 529,741, issued on Nov. 27, 1894, to E. D. Meier, and by him duly assigned to this company.

Mr. M. L. Holman, M. Am. Soc. C. E., Water Commissioner of the city, to whom we are indebted for copies of the specifications and of the correspondence relating to the Heine company's protest, now writes us:

> As the city desires to purchase boilers and not law suits all bids were rejected. The department is now at work on plans and specifications for boilers preparatory to a new letting.

Mr. Holman also furnishes us the accompanying table, which he says contains all the data which could be obtained from the drawings and descriptions submitted with the bids:

bid; but, according to the dimensions of the thing offered, the O'Brien company's bid would have been by far the lowest, because for a little more money it offered boilers 48% larger. No such question arose, however, for the O'Brien company not only offered boilers 48% larger, but its price for them was $2,650 less, or 10½% lower than the Heine bid.

The element of guesswork appears to have been an important one in the calculations of one, if not of both, of these bidders, for, having the same performance to guarantee, one bidder offers 6.94 sq. ft. of heating surface per HP., and the other 10.27. Dividing the 9,000 lbs. of water to be evaporated per hour by the area of heating surface offered, one bidder expects to evaporate 4.93 lbs. of water per sq. ft. of heating surface and the other only 3.14 lbs., although the second provides 25% more grate surface, which should be capable of burning, with equal economy, 25% more fuel. The horse-power of each boiler (30 lbs. of water from 100° F. to 70 lbs. pressure being taken as a horse power), is 300 in both cases, or 2,400 HP. for the eight boilers. One bidder offers his boilers at $10.40 and the other at $9.29 per HP., both very low figures for water-tube boilers, including settings. Figuring the price per square ft. of heating surface, one bidder offers 16,677 sq. ft. for $24,950, or $1.50 per sq. ft., while the other offers 24,668 sq. ft. for $22,300, or $0.90 per sq. ft. The other two bidders, whose bids do not give the dimensions of their boilers bid, respectively, $21.67 and $20.83 per HP., or more than double the figures named by either of the two lower bidders.

Perhaps the premium and penalty clauses of the specifications, in connection with the element of guesswork, had something to do with the fixing of prices by the several bidders. The penalty is $500 for each per cent. which the efficiency of each boiler falls below 70%, and the premium is $250 for each per cent. which the efficiency of each boiler exceeds 70%. For the eight boilers one per cent. falling off from an efficiency of 70% would mean a penalty of $4,000, and one per cent. excess of 70% would mean a premium of $2,000. One bidder might reason as follows: "The fair price for my boilers is $30,000, but as water tube boilers with Illinois coal, the coal being tested with the Thompson calorimeter, have in some tests shown 75% efficiency, I can obtain $10,000 premium, and therefore I can afford to bid as low as $20,000, but will put on a few thousand more to cover the risk." Another bidder might reason thus: "While water-tube boilers have shown 75% efficiency, both Illinois coal and Thompson calorimeters are apt to be very erratic, and there is always a likelihood of slight differences of condition making a variation of several per cent. in a boiler test. I had better not be too confident that I can obtain 70% efficiency, but will assume only 65% as a fair margin. The fair price of my boiler is $30,000, but 5% falling off in efficiency would subject me to a forfeiture of $20,000, so, to be safe, I must bid $50,000."

Data on Boilers for High-Service Pumping Station No. 3, Baden, Compiled from Drawings Submitted with the Several Bids.

		Heine.	Root.	Geary.	O'Brien.
Grate surface:					
Upper	sq. ft.	37.125	Not shown.	Not shown.	46.25
Lower	“ “	40.55	“ “	“ “	50.875
Per HP. (upper)	“ “	.1256	“ “	“ “	.154
Heating surface:					
(Tube)	“ “	1,822.[1]	“ “	“ “	2,863.
(Shell and header)	“ “	155.7[1]	“ “	“ “	110.6
(Grate)	“ “	106.9[1]	“ “	“ “	109.9
Super-heating surface	“ “	None.	“ “	None.	None.
Heating surface per HP.	“ “	6.94[1]	“ “	Not shown.	10.27
Steam space	cu. ft.	117.[1]	“ “	“ “	238.1[2]
Water space	“ “	323.[1]	“ “	“ “	523.8
Number of tubes		115.	“ “	“ “	171.
Tubes, diameter	ins.	3½[1]	....	“ “	3½[1]
Tubes, length	ft.	16.[1]	18[1]	“ “	16.[1]
Shell, diameter	ins.	48.	Not shown.	48[1]	36.[1]
Shell, length		18 ft. 6 ins.[1]	“ “	22 ft.	19 ft. 3 ins.
Ratio, heating surface to grate surface		56.2 to 1[1]	“ “	Not shown.	66.7 to 1[1]
Ratio, air space to grate surface		2.89“ 1	“ “	“ “	1.99“ 1
Area of single opening to flue	sq. ft.	11.8	12.5	6.18	Not shown.
Area of opening to stack fr. flue	“ “	45.	90.	50.	“ “
Eight water tube boilers, complete)		$24,950	$52,000	$50,000	$22,300

[1] These figures are scaled from the drawings—all others are taken from dimension figures.
[2] Steam space given for the O'Brien boiler includes a steam-drum 30 ins. diameter × 7 ft. long.

From the above table it will be seen that two of the four bidders did not furnish with their bids the dimensions of the boilers and furnaces, upon which they bid, and from the specifications of the Water Commissioner it does not appear that there was any necessity for the other two bidders to give the dimensions of their boilers. From the figures given by these two bidders, however, we are enabled to form an idea of what they proposed to furnish. According to these figures both of these bidders intended to furnish a double grate, consisting of upper and lower portions, probably the Hawley down-draft furnace. The O'Brien company offered 24.6% more upper grate, 25.4% more lower grate, 48.7% greater number of water tubes, and 47.9% greater extent of heating surface than the Heine Co. The O'Brien and the Heine boilers being practically of the same type, as stated in the Heine protest, and the rating of boilers of the same type being proportional to their heating surface, it appears that the O'Brien company offered about 48% more boiler than the Heine company. If the O'Brien company's price had been a little more than the Heine company's it would have been an interesting problem to determine which was the lowest bid.

According to the letter of the specifications, had the Heine boilers been offered at the lowest price, the Heine company's would have been the lowest

Another remarkable thing about these bids is that only four bidders of water-tube boilers are represented. The specifications exclude those forms of water-tube boilers in which the tubes are not straight, or in which the tubes are at a greater angle than 45° with the horizontal, but they appear to be sufficiently wide to allow bids from the builders of the Babcock & Wilcox; Cahall (horizontal); Edgemoor; Gill; Campbell & Zell; National and Standard boilers, and since a water-tube boiler may be built under the specifications without infringing any unexpired patents, it would appear that they might be met by any boiler maker who has the proper facilities for manufacturing a water-tube boiler.

There is no mysterious property in any one of the several makes of water-tube boiler of the common form, in which the tubes are straight and inclined at an angle of less than 45° to the horizontal, when of approximately the same dimensions of heating and grate surface, supplied with the same kind of furnace, say, the Hawley down-draft, and using the same coal, which should cause one to give any higher efficiency than another. Differences in the apparent efficiences are undoubtedly obtained when the dimensions are different, and when there are differences in the furnaces, in the coal, in the calorimeter by which the coal is tested, in the fireman, and in accidental conditions of the test, such as thickness of bed of coal carried and force of the draft. But none of these difference are due to the type of boiler, and none of them would seem to justify the inclusion in specifications of premiums and penalties based upon "efficiencies" which are calculated from tests of a few grains of coal in an imperfect calorimeter, and the exclusion of what should be the most important feature in a moiler specification, the dimensions of the heating and grate surface.

In saying this, we by no means wish to be understood as condemning the premium and penalty feature in specifications in general. On the contrary, we have in the past advocated this feature in specifications as eminently calculated to stimulate good work on the part of the contractors, and at the same time avoid any difficulty or litigation in case the completed work does not fulfil the contract guarantee. But where a performance is specified in a contract and premiums and penalties are fixed for exceeding or falling below it, that performance should actually indicate the value that the contractor is giving and the purchaser is receiving. The performance of a boiler based on the per cent. of calorific value in the coal burned in its furnaces which is used in making steam, is subject to such large percentages of error in its determination that it does not fulfil this requirement, as we showed in our issue of June 11, 1896. The result of the bidding at St. Louis seems to fully justify what we then said.

According to the letter of Mr. Holman, already mentioned, it appears that the Water Department has learned a lesson from the results of the bids on these boilers, and instead of re-advertising for boilers on the same specifications, it is preparing plans as well as specifications preparatory to a new letting. If the plans are to be of a general character, showing the more important dimensions, but leaving particular details of connections of parts, etc., open for each manufacturer to bid upon those for which he has patterns and tools, well enough, but if the plans show details for which new patterns will have to be made or which can be made only by one or two builders, on account of patent restrictions, then we fear the Department will go to the opposite extreme from that of the first specifications, and by limiting the number of possible bidders prevent the city from obtaining low bids. In any event the results of the second letting will no doubt show a great contrast with those of the first, and one which should make an interesting chapter in the history of engineering specifications.

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LETTERS TO THE EDITOR.

A New Mississippi River Dredge.—Correction.

Sir: We note in your usually accurate journal that the capacity of the dredge we are building for the Mississippi River Commission is only "800 cu. yds. per month." As that is the minimum capacity per hour, the discrepancy is startling. In general we may state that it is a machine of just about one-half the intended capacity of the enormous dredge "Beta," whose design and performance were noticed at length in your columns some months ago, and the capacity of 800 cu. yds. per hour will probably be largely exceeded. One special feature of the design is that it is so far different from all usual arrangements of suction dredges with mechanical excavators as to be entirely outside of the principles claimed by A. B. Bowers as his invention. Yours truly,

New York Dredging Co.,
By H. S. Wood, Engineer.
World Building, New York City, Oct. 23, 1896.

◆

The Cement for the Melan Bridge at Topeka, Kans.

Sir: In view of the discussion created by the specifications for the Portland cement for the large Melan arch bridge over the Kaw River, at Topeka, Kansas, the information in the fourth of the "Industrial Notes," on p. 131 of the issue of Engineering News of Oct. 15, 1896, may be misleading. Aalborg Portland cement has been chosen under the specifications alluded to, for all parts of the work in which Portland cement will be used, and much of the 5,600 barrels required is now on the ground.

Yours very truly,
Geo. M. Newcomer,
Agent Aalborg Portland Cement Works.
66 Maiden Lane, New York city, Oct. 26, 1896.

(In the "Industrial Note" referred to it was stated that the Diamond brand of cement will be used. This is a natural cement, and according to the specifications published in our issue of April 2, 1896, this cement may be used in the foundation up to a level 1 ft. below low water mark. For all other parts of the work Portland cement will be used, and the very rigid specifications for it were discussed in our issue of May 7.—Ed.)

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Noisy Brick Pavements.

Sir: In your issue of Oct. 15 I noticed an article asking for possible explanations of the cause of the noise produced by the passage of vehicles over the brick pavement on McDonough St., Brooklyn. I think that you will find upon inquiry that the joints between the bricks in this pavement are filled with cement instead of sand or pitch. I have, as Borough Engineer, at Plymouth, Susquehanna Co., Pa., had a similar experience with a piece of brick pavement, in which the joints between the bricks for half the length of the street were filled with pitch. The joints between the bricks for the remainder of the street were filled with neat Portland cement. I have often noticed that a vehicle passing along the street would make considerable more noise in passing over that portion of the street that was cemented than it did in passing over that portion with pitch joints. I also know of a piece of pavement in a neighboring city where the joints between the bricks were cemented with like results.

Respectfully yours, Edward H. Post.
Wilkes-Barre, Pa., Oct. 21, 1896.

(Since making the query referred to we note a similar explanation from Mr. E. Adam, Engineer of the Board of Street Commissioners, of Newark, N. J. In this case the rumbling noise occurred in brick pavements with grout filling, and not on pavements with sand filling between the bricks, Mr. Adam was disposed to ascribe the cause of the noise to the slight lifting of the whole pavement from its foundation, by expansion. At the same meeting of the American Society of Municipal Improvements, Mr. N. P. Lewis refers to the experience in Brooklyn, and attributes the cause to the thawing out of the sand cushion, the bricks having been laid in cold weather. This thawing action left voids under the pavement, which would naturally increase the reverberatory effect. As the general experience points to the fact that the noise is much less when the joints are filled with sand or pitch, another explanation might be offered. The use of cement grout practically makes the covering of the street surface a monolithic sheet, fairly well adapted for the transmission of vibrations from traffic and the accumulative effect of sound waves. The use of sand or pitch in the joints acts as a deadener to the sound waves originating in any one brick, and consequently some considerable portion of the sound is absorbed or lost, and the resultant noise is decreased.—Ed.)

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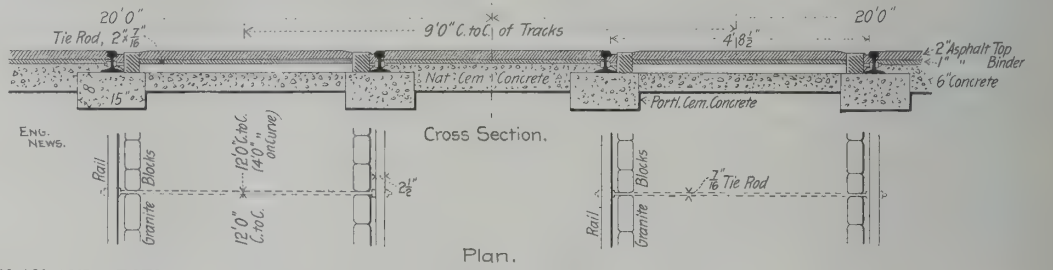
A PERMANENT STREET RAILWAY TRACK.

In discussing editorially "The Street Railway Track of the Future," in our issue of Oct. 15, we called attention to the anomaly which at present prevails in street railway construction of placing a mass of perishable timber beneath the pavement and at the same time using lavishly concrete filling, between, around or under the ties, according to the fancy of the engineer.

Since the publication of that article we have been favored by Mr. Geo. L. Wilson, M. Am. Soc. C. E., with drawings of a method of permanent track construction which has been adopted the past season by the Twin City Rapid Transit Co., operating all the street-car lines of St. Paul and Minneapolis. We print Mr. Wilson's letter with the accompanying plans as follows:

> Sir: The subject of street railway track is one of vital interest to all engineers connected with the maintenance of city streets as well as to the street railway companies themselves. As a method of permanent track construction has been adopted, the past season, by the Twin City Rapid Transit Co., that promises to solve the problem as outlined in your editorial of Oct. 15, I send you the accompanying plans, thinking they will prove of interest to engineers engaged in municipal work.
>
> The accompanying drawing is a partial cross-section of an asphalt paved street, with the track construction shown in detail. The rails are laid and brought to grade and line while supported on temporary wooden ties. As the work progresses, after the spaces between the cross ties and under the rails are concreted, the ties are removed and all holes are filled with concrete. The granite blocks along the track are set in place and then left from 10 to 14 days for the cement to thoroughly set, after which the asphalt surface is laid in the usual manner and traffic is resumed. It is an important matter in this construction that sufficient time be given for the concrete to harden before the track is put in service.
>
> The rail used with this construction is a T-rail, weighing 80 lbs. per yd., with a height of 5 ins. and a 5-in. base. The top corner of the head has a radius of 5-16-in. This rail gives good results for a T-rail, except that the depth is not sufficient to allow a proper depth of granite blocks. With a depth of 7 ins. much better results would be obtained in the writer's opinion. The rails are laid in 60 ft. lengths on tangents and 30 ft. on curves. All joints are cast welded.
>
> About six miles of track have been laid the present season, with this construction, by the company referred to, and it is believed that the work will prove a success. For the concrete beam under the rails, Portland cement is used and natural cement for the balance of the work.



PLAN AND SECTION OF PERMANENT STREET RAILWAY TRACK CONSTRUCTION, ADOPTED BY THE TWIN CITY RAPID TRANSIT CO.

We trust that all our readers in any way interested in street railway track construction will give this design the study it deserves. We have seen no more intelligent attempt anywhere to solve the problem of street railway track construction, and the results of experience with it will be awaited with much interest.

A comparison of this track with the very expensive track of the Chicago City Ry. Co., illustrated and described by its Superintendent on another page of this issue, gives rise to many interesting questions. We are without figures as to the cost of the Twin City construction, but we should judge it to be considerably cheaper than the Chicago construction. The former employs a considerably lighter rail, and one which can be bought for considerably less per ton than the girder rail with tram-head used on the Chicago City Ry. It dispenses entirely with ties, and with wooden construction of every sort. As for the relative durability of the two, there is nothing in the Twin City construction to wear but the rail, there is nothing perishable underneath to decay, and if the foundation is solid there appears to be no chance for the track to get out of surface, while the paving holds it absolutely in line. A comparison of the cross-sections will show that a T-rail laid in this way is actually less obstruction in the street than the girder rail with its broad head.

We cannot leave this subject without calling attention to the astonishing feature of the laying of hemlock boards underneath the pavement on the Chicago City Ry. tracks. This sort of paving construction by municipalities was given a black eye long ago; and it is surprising to see a street railway company building track at a cost of $25,000 per mile, and laying hemlock boards as a paving foundation between the rails.

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THE MODERN STREET RAILWAY POWER HOUSE.[*]

By Richard McCullough.[†]

The cost of power on a large road is only about 10% of the total operating expenses, hence while fuel economy is important, it is far more important that every machine shall be so designed as to insure absolutely reliable service and reduce the liability to break-downs to a minimum.

Location.

A large power house should be placed on a railway track so that coal may be cheaply delivered, and it is also desirable that the location should be where condensing engines may be used, unless the conditions will warrant the use of self-cooling condensers. If a location fulfilling these conditions may be found somewhere near the electrical center of distribution it is an ideal spot for a power house, but if in order to secure coal and water it must be moved from this point, it should, if possible, be moved in the direction of future extensions of the street railroads. The only excuse for not locating on a steam railway is where the interest on the cost of copper feeders running from the steam railroad tracks to the center of distribution would greatly exceed the cost of hauling of coal in wagons.

Building.

There is no reason why anything combustible should enter into the construction of a power house. The walls may be brick, the roof of slate, tile or iron, and the floors of concrete or iron. This obviates the necessity of carrying insurance, the saving of which will in a few years pay the extra first cost. In erecting the building it is advisable to decide first on the style, size and arrangement of the machinery so that no part of the building will interfere with the proper repairs, renewals and inspection of the apparatus. It is a common oversight for railway companies to let the contract for the erection of the power house building, and then find themselves hampered in the use of some particularly desirable form of apparatus by the shape or contracted area of their buildings.

Steam Generating Apparatus.

The proper fuel to use is that which will evaporate the greatest quantity of water per dollar's worth of fuel. It does not pay to burn too poor a quality of fuel, however, because slack containing a great quantity of ash and sulphur will cake and clinker on the grate bars, make a great deal of work for the firemen, and much ash to be removed. In cities where several competing grades of coal come to market, it would probably pay to have expert tests made to determine what grade of coal or what mixture is most economical for the work. In power houses handling large quantities of coal, where the coal is all delivered at the same place, as by rail or boat, the installation of coal and ash handling machinery will generally pay. The advantage of this form of apparatus is its saving in labor, and its disadvantages are its great first cost, its expensive maintenance and the fact that it is desirable for the best service that the coal should be fairly uniform in size, which is a requirement not always easily fulfilled.

In the East the use of mechanical stokers has grown to such an extent that no large power house is considered complete without them. In most of the Western cities, however, and especially in St. Louis, the mechanical stoker has not been a success.[*]

Boilers may be divided into two general classes, fire tube and water tube. In most of the more recent power houses, some form of water tube boiler has been adopted, as this type possesses some marked advantages over the fire tube. They are non-explosive, they may be operated at a higher pressure and consequently are more suitable for use with compound engines, they have a large heating surface and are quick to respond to calls for power, they occupy less floor space and are usually more intelligently designed than the other class. On the other hand, their first cost is greater, there is a greater number of joints to be looked after and the cleaning is more difficult, especially in those forms which use a curved tube. It has usually been considered that the efficiency of water tube boilers was much higher than the fire tube, but there is now a form of fire tube boiler being made consisting of a shell of large diameter and extra length, containing a large number of flues, which approaches the water tube boiler very closely in efficiency. The high efficiencies obtained in boiler tests are seldom reached in actual practice as they usually result not so much from excellence of design in the boiler itself as from careful and intelligent firing during the test.

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[*] Abstract of a paper read before the St. Louis Convention of the American Street Railway Association.

[†] Electrician of the Cass Ave. & Fair Grounds Ry. Co., St. Louis, Mo.

[*] Recent information we have received from St. Louis contradicts this statement.—Ed. Eng. News.

The usual methods employed in heating the feed water are, first by the heat of the exhaust steam, and second by the heat of the escaping flue gases. There are numerous devices for utilizing the heat of exhaust steam, either by passing the exhaust through a number of pipes surrounded by the feed water, or by spraying the feed water across an opening through which the exhaust steam is admitted. Most of these devices are very simple in their construction. Care should be taken that the opening for the exhaust steam is never contracted, so that any possible back pressure on the engine is avoided.

The method of heating feed water by the heat of the escaping flue gases has been applied in apparatus under the general name of economizers. In the use of any device in which feed water is heated by the flue gases, care should be taken that the escaping gases will still retain sufficient heat for the maintenance of the necessary draft after part of their heat is taken from them by the feed water. In the case of power houses using natural draft, economizers should not be used where the draft is not already sufficiently strong, or is just barely strong enough for the work to be done. There are in operation, however, many plants using natural draft, discharging flue gases at a very high temperature, much higher than is necessary to maintain the required draft. Economizers used in such cases would result in a marked gain in economy.

Whatever system of heating feed water is used, the apparatus should be made abundantly large for the work to be done; first, that the water should pass through slowly and receive the full benefit of its contact with the heated gas or steam; second, that a large store of water may be kept on hand, which is of great service in case of a sudden demand on the boilers; and third, that the feed water heating apparatus may act as a water purifier.

With condensing plants the waste from the condensers is never at a greater temperature than 100° F., and if hot feed water is desired, the use of an economizer becomes almost a matter of necessity as the water from the pumps and the other non-condensing machinery would not have sufficient effect in heating the feed water of a large plant.

Several of the large power houses built during the last few years have abandoned the use of stacks for producing draft, and are operating by means of an induced draft produced by fans placed in the flue or short stack. In this case the stack is just high enough to clear the roof. This system has many advantages. First, there are no stacks to blow down or fall down, and this point is of special importance in a region subject to tornadoes. The second and most important advantage, however, is the absolute control which it affords in governing the fires, and this point will appeal especially to those power houses subject to sudden and rapidly changing loads. As an illustration of this may be cited the power house recently erected to operate the Baltimore Tunnel Road. A great part of the time there is no load on the power house as it is only operated when there is a freight train to be hauled through the tunnel. The manner in which the load is handled is as follows: The boiler room is supplied with blowers in place of stacks, and a slow fire is kept constantly under each boiler. When a telegram is received that a freight train is approaching, the blower is started, and on the arrival of the train, steam has been raised in sufficient quantity to supply the great demand put upon the boilers.

The Steam Piping.

In regard to the general plan of the piping, opinion is very much divided. Some favor a single-header with leaders to the engines. Others claim that a complete duplicate system is necessary, so that a failure in any part of the system need not cause a serious stoppage. The objection to a duplicate system is the greatly increased cost. In the installation of a duplicate system, it is only natural that the material and workmanship employed will be cheaper than if a single system were employed, because it is reasoned that if one side breaks down, there is always the other to be depended upon. The other side, however, is often never used until a case of necessity arises, and on account of this very lack of use, the valves and joints are apt to be found leaky and in bad condition when suddenly put in operation. A compromise system has been used in some cases in which all pipes are duplicated, each side, however, having only one-half the capacity required, necessitating the use of both sides at all times. In case of accident to one side the other half of the system may be used, at a disadvantage, of course, by increasing the steam pressure. The best plan, however, seems to be to use a single header divided at convenient intervals by valves, according to the size of the plant and the number of units employed, and to use only the best valves, material and workmanship. The power houses having the least amount of trouble with their piping are those having a simple system. All steam and hot water pipes should be covered so as to prevent as much as possible loss of heat by radiation and consequent condensation of the steam. And in this connection it should be noted that there is a great difference in efficiency in the different kinds of pipe covering. Tests have shown that the magnesia plastic and sectional coverings and the asbestos fire felt covering give the best results. ("Journal of the Association of Engineering Societies," January, 1895.) A water separator should be placed in the leader to each engine. It should be large in size and placed as close as possible to the engine.

Steam Consuming Apparatus.

During the past four years, the street railway generator has undergone a radical change. In the spring of 1893, there were installed in this city in the power house of the Cass Avenue & Fair Grounds Ry. Co., then being built, the first large, direct driven generators of the type which has since become so common. Soon after this the Intramural power house, at the World's Fair, was put in operation, containing one generator of the same size as those in St. Louis and another of twice the capacity. Since that time there have been few large power houses built in which direct driven generators have not been installed, and some of the large railway systems have found that economy of operation required a change from the belt, counter-shaft and unit of small size to the large direct-driven generator. At the present time, the West End Railway Co. of Boston, which may be considered the pioneer in this country in electric traction, is changing its central power station, which had originally been equipped with a very complete and elaborate system of belting and countershafting, to a direct-coupled plan.

The first cost of the direct-coupled generator is about 35% more than the belted generator in the 500 K-W. size, which is the largest standard size in which the belted generator is made; but when the expense of the belt, belt-tightening device, and the floor space is taken into account, the direct connected generator will be found the cheaper. Besides obviating the necessity of the costly and cumbersome belt, the direct connected generator offers the following advantages; in large sizes and in connection with large engines it has a much higher efficiency than the belted unit, it requires a small floor space, it aids supervision by bringing the working parts of the engine and generator close together, it reduces danger, it is almost noiseless in operation, and it may be installed in a larger unit than the belt-driven generator, which is limited in size by the width of the belt and pulley which may be employed. The main objection which was urged against the direct connected generator was the fact that the shocks resulting from overhead loads were thrown directly on the engine and that there was none of the cushioning effect that a belt connection might supply. While this is undoubtedly true, the best argument which may be submitted against it is that none of the installations of direct driven generators can trace any trouble to this source. The large, slow speed, multipolar, direct-driven generator has become perhaps the most prominent feature of the modern power house, and while there may be special services which would necessitate a belted arrangement, it is difficult to imagine a power house thoroughly up to date without direct-driven generators.

By varying the number of poles and the number of armature conductors in the construction of a dynamo, the machine may be designed to run at almost any reasonable speed, the slower the speed, however, the greater being the cost of the dynamo. In the matter of speed it is necessary for the dynamo maker and the engine builder to effect some sort of a compromise, because it is not good practice to run such a large engine at too high a speed. The speeds which are most common are 75 revolutions per minute for the 1,500 K-W. dynamo, 80 to 120 revolutions per minute for the 800 K-W. dynamo, and speeds running from this to 150 revolutions per minute for the smaller sizes. These speeds are what would have been considered, four years ago, quite out of the range of the Corliss valve gear, but the makers of this type of engine have risen to the occasion and now there are numbers of large Corliss engines driving generators at speeds up to 100 revolutions per minute and some have even higher speeds than this. Several other types of engines have been adapted to this work and are running quite successfully. Outside of the question of valve gear, most engines made for this work possess the same characteristics; the heavy bed-plate, the solidly constructed fly-wheel, now being made of steel-plate, the wide cross-head, the large connecting rod and the mammoth main bearings.

The choice between horizontal and upright engines is chiefly one of space. The horizontal engine is the cheaper, the simpler, the easier to inspect and the easier to repair. Outside of the advantage of requiring less space, the upright engine has the advantage of less wear on the cylinder, and a more direct strain upon the foundations.

The usual practice in most modern power houses is to install compound engines. Most of these plants are so favorably situated that condensers may be operated in connection with the engines. This is undoubtedly good practice, but in case condensers are not used the cost of fuel must be very high for the gain in compounding to pay for the extra investment. Where power houses are favorably situated on bodies of water, condensing becomes a very simple problem, but in case the power house cannot be built on a body of water, as in this city, for instance, in order to use condensing engines, some sort of arrangement must be designed to cool a quantity of water so that it may be used over and over again for the purpose of condensing the exhaust steam. Devices of this kind have long been in use in the City of San Francisco and in Cuba, and lately several of the large manufacturing companies have put on the market complete apparatus for the purpose of cooling water after it has condensed the exhaust steam so that it may be used again for the same purpose. Besides the gain in power by using condensing engines it is claimed that by the use of this apparatus, actually less water is used than if the steam is exhausted directly into the atmosphere without condensing.

In the use of large direct-connected units a great deal of the economy to be gained depends upon the selecting of the proper sizes of units. The efficiency of a generator will be good when it is operated at more than 75% of its capacity but the efficiency of an engine drops off very rapidly when it is running below its rated load. In order to achieve the best economy from the use of large direct-connected units, the sizes of the different generators should be so proportioned that it is always possible to operate one or more units at their rated capacity. The railway generator as at present built will stand an overload of 50% for several hours without trouble and at a maximum efficiency. This should be taken into account in the estimate of the dynamos required, but it should always be the aim to have at least one idle machine to throw on the line in case of failure of any of the others. The actual size of the unit depends upon the character of travel which the road possesses and the number of cars, and this must be determined for each road independently. In choosing machines, however, standard sizes should always be adopted as this obviates any trouble in obtaining supplies and repair parts.

The railway generator switch board has become standardized to the extent that it consists of a panel for each generator, each panel containing the usual automatic circuit breaker, ammeter, field rheostat, field switch and main switch. Switch boards as now erected usually contain a recording watt-meter and an ammeter which shows the total output of the power house.

The modern method of line construction is to divide the trolley line into sections and connect each section separately to the main bus bars through feeder panels, each of which contains an automatic circuit breaker, an ammeter and a switch. This method confers the advantages that trouble on the line is always indicated on the proper section, and that in case of short circuits on the line, the main circuit breakers are protected by the section circuit breakers and the load is not suddenly thrown off the engines by the opening of the main circuit breakers. Most of the generator and feeder boards are supplied with devices for preventing damage to the station machinery by lightning, but a very simple and effective arrangement is to connect a large water rheostat between the positive bus bar and a good ground. This is either left in circuit continuously with a small current running through it, or is cut into circuit on the approach of a storm.

Besides those machines which are absolute necessities in a power house, there are various devices which may be added to secure convenience and regulation. An overhead crane is installed in the engine room of most of the large modern power houses and adds greatly to the speed with which heavy repairs may be executed. An oiling system of some sort by which the oil is either pumped or flows by gravity to the different bearings obviates the necessity of manual labor in oiling and insures a steady feed at each bearing. A recording steam gage is found useful in checking up the firemen. An air pressure system is beginning to be used in many of the power houses by means of which the carbon dust may be blown out of the armature windings. With this apparatus an armature may be kept thoroughly clean, and the danger lessened of short circuits occurring on account of the collection of carbon dust between its conductors.

A number of power houses operating long lines are now equipped either with boosters or with high voltage dynamos. Long lines usually have a booster constantly in circuit. This machine is automatic in its action and raises the voltage with every increase in the load. Some power houses operate a high voltage dynamo for use on sections which are subject to excessive loads. The feeder boards in this case are equipped with an extra bus bar so that any section may be thrown on the high voltage machine.

While each individual engineer has his own ideas concerning power house construction and while each road building a power house may purchase different apparatus, there is one general design which has been followed in many of the plants recently installed. It might almost be called the Modern Power House. The engine room and boiler room are divided by a brick wall and under different roofs; both are brick buildings covered with an iron truss roof; the boiler room is set on the grade of the street and the engine room 10 or 12 ft. above this grade, the space below the engine room being utilized for the piping and condensers; the engine and boilers are set at right angles to the wall between them, with the engines next to the boiler room so that the piping is made as short as possible and the condensation lessened; the switch board and feeder board are set on the opposite side of the room from the boiler room, so that the length of the dynamo cables is equalized as much as possible. The general features of this design may be summed up as follows: It is compact, to save real estate and buildings and to minimize the number of employees and the superintendence. Large units are used for the sake of economy and to save the number of working parts.

Figures as to cost of operation, collected from some of the large modern power houses, show that less depends upon the refinements of the machinery than upon the condition in which the apparatus is kept and upon the supervision to which it is subjected. The lowest results are about ¾ ct. per K-W. hour, some records running slightly below this, while the results from some of the large stations are as high as 1¼ cts. per K-W. hour. These figures include the cost of coal, water, supplies, repairs and all labor, but do not include anything for taxes, insurance, interest or depreciation. The cost of operation depends largely upon the cost of coal and upon the relation of the average load to the total capacity of the power house, the higher this ratio the less being the cost of operation.

The modern electric railway power house, although it has been developed entirely within the past ten years, represents the thought and the experience of many men. It has been developed carefully, detail by detail, until it is now a work both of reliability and efficiency. No one man and no one company can claim the credit for this achievement, but no class of men hold a stronger claim to recognition than the managers and owners of street railroad properties, who have ever been ready to encourage with their patronage each improvement, who have freely distributed the information gained by their experience, and who even in the most radical departures have ever acted with the courage of their convictions.

Discussion.

Mr. Rossiter.—I ask if any of the members have had occasion to use the storage battery; and if so, with what success?

Mr. Richard McCulloch.—There is one installed somewhere in Pennsylvania, and the Union Traction Co. of Philadelphia have one installed at the end of one of the long lines for the purpose of regulating the voltage at that point; but there is a storage battery in operation in parallel with the dynamos, I think at Easton, Pa.

Mr. B. J. Arnold, Chicago.—During the last year I have had installed in the Chicago Board of Trade plant, as the consulting engineer for that corporation, a battery auxiliary. In my opinion the work of the plant is more severe, if anything, than electric railroad work, because it operates electric elevators in conjunction with constant potential arc and incandescent lights. The elevators take a starting current varying from 0 to 800 amperes, and back again almost instantly, corresponding in abruptness to the load on an electric railway operating three or four cars. In the Board of Trade plant, the battery auxiliary acts as an equalizer and takes the surplus load delivered into the bus bars, when the demand on the line is less than the capacity of the generator, and takes three-quarters of the overload when the pull comes. The result is that with a 75-K-W. generator, running from 7 in the morning until 11 o'clock at night, at its absolutely normal economic load, it produces sufficient energy to operate fifty 2,000 c. p. arc lamps, 600 incandescent lamps, four 30-HP. electric elevators and six 10-I. HP. motors, all running from this one unit, and the unit constantly loaded. That is my experience with the battery, and it is working perfectly satisfactorily, having been running nearly a year and has cost practically nothing for repairs. We have increased the plant by putting in additional plates, because we required additional capacity, but there was no charge for repairs and I am convinced that the battery auxiliary, when there is sufficient lead installed to do the work, is an eminent success for regulating work and economical operation of power stations operating on variable loads. You must get lead enough in the battery to do the work, and having that, you will get good results. I used a battery made by the Electric Storage Battery Co., of Philadelphia, with the Manchester type of positive plate. It makes all the difference in the world if the plate is built for regulation or for slow discharge. This particular type is for regulation and also performs the function of slow discharge, if necessary. The engines and generators stand idle from 11 o'clock at night until 7 in the morning, and the battery does the work through the night. That enables the engine to operate 16 hours a day, with two shifts of labor, at its economic normal load and shut down at night until morning. The same thing can be done in a large number of electric railway plants in this country with success. It is only a question whether the increased economy will be more than the interest on the investment of the cost of the battery. I am installing now three different stations, part railroad, and part lighting, in which it is my idea to use batteries, by which I will find it necessary to put in one-third less capacity of engines and generators than would be otherwise necessary.

Mr. Hawken.—What is the life of the plate under constant use?

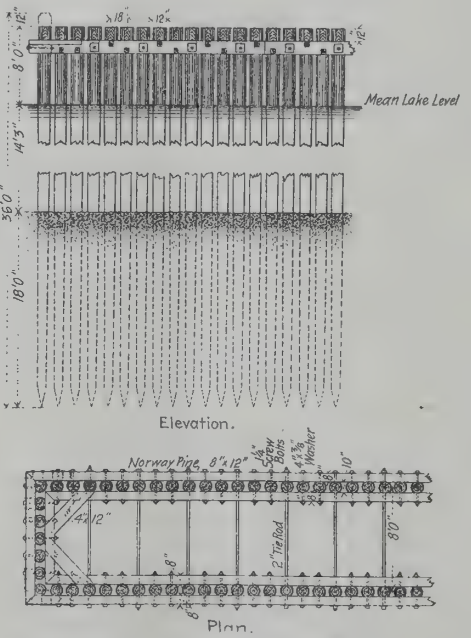
Mr. Arnold.—The plant has been running only about one year, but the depreciation is guaranteed at 7½% per annum. On that basis I figure out a marked economy and feel that we are safe because the company behind the battery will stand up to the guarantee. As a matter of fact it has not cost 1% this year; probably it will cost something next year, and so on each year, but the battery company stands behind it.

We use a booster in the station which consists of a motor generator to charge the batteries, if it ever becomes necessary, while the generators are running on the lines, because then the voltage must remain constant at 125 volts. Then if we wish to charge the batteries we use the auxiliary booster to charge the end or regulating cells, while the shunt winding of the generator is working in parallel with elevators and about 60 of the cells. The elevator service is such as to allow the battery to be charged and discharged in about equal proportions through the day, so that it is practically fully charged at the end of the day's run, and at night if they are slightly discharged we charge them up with the booster by placing the generator end of it in series with the main generator, and at 11 o'clock shut down the engines and run the lights until morning with the batteries. In a railroad power station it would be necessary to use the booster to increase your voltage on your long feeder. If the battery was located at the end of the line you would have to use the booster to overcome the pressure at the battery, or else run a separate high voltage generator.

Mr. Harrington.—I understand from the experience of a large number of railway engineers that on the ordinary size plant, running from 40 to 250 cars where the load constantly changes, by reason of trouble on the line, the standard forms of multipolar generators flash from brush to brush, and cause a great deal of trouble in the commutators of the machine. That is a common occurrence in the Philadelphia Traction Co.'s plant. We have had it in our own plant with both Westinghouse and General Electric machines. The storage battery would be an excellent thing to avoid that form of breakdown or delay, due to the burning of the commutator.

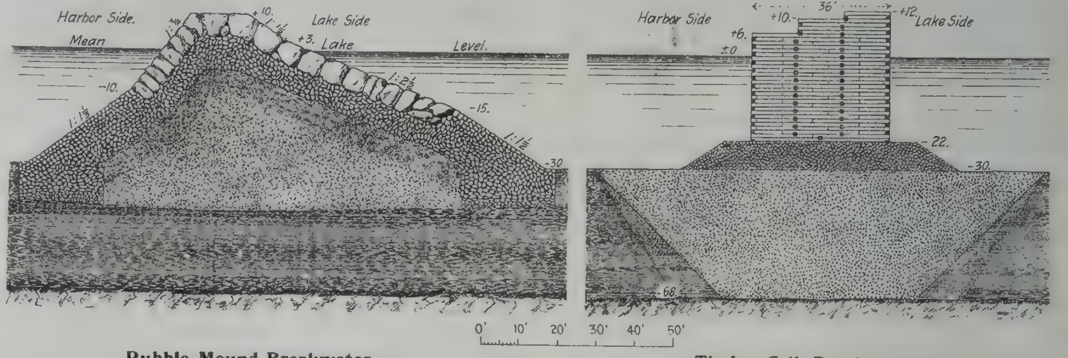
THE BREAKWATER EXTENSION AT BUFFALO, N. Y.

Proposals are now being invited by Major T. W. Symons, Corps of Engineers, U. S. A., for the construction of 12,500 ft. of breakwater extension and for a sand-catch-pier extension at Buffalo, N. Y. At the present time a breakwater, about 8,000 ft. long, lies parallel to and about 3,000 ft. off the shore, at that city, with its northern end and main entrance about opposite the Erie Basin. This breakwater lies in water about 31 ft. deep and encloses a narrow harbor with about 20 ft. of water. It is now proposed to extend this structure directly south to Stony Point; with a middle and south entrance, and with the breakwater constructed partly of rubble mound work and partly of timber crib.



Sand-Catch Pier Extension, of Buffalo Harbor.

The illustrations, taken from the government specifications, show the general construction of both the rubble and timber work; and show it so plainly that little explanation is needed. The length of the rubble mound will be about 5,000 ft. and that of the timber crib about 7,500 ft.



Rubble Mound Breakwater.

Timber Crib Breakwater.

TYPICAL CROSS SECTION OF NEW BREAKWATER FOR THE HARBOR OF BUFFALO, N. Y.

The rubble mound breakwater will consist of a core of gravel, or other specified material, covered with ordinary rubble stone and capped by large stone. It will extend 10 ft. above mean lake level and have a top width of 15 ft. with a harbor slope of 1 on 1⅓, from the lake bottom to 10 ft. below mean lake level, and a slope of 1 on ¾ from that point to the top. On the lake side the slopes will be 1 on 1½ from the lake bottom to a point 15 ft. below lake level; 1 on 2½ from this point to 3 ft. above lake level, and 1 on 1½ from the latter point to the top. The gravel core is to have a base of 100 ft. and a general height of 26 ft. above the lake bottom when the material has settled. The rubble stone used is to be as nearly cubical as possible, and at least one-fourth of the volume must be in pieces of 300 lbs. and over in weight. The stone will be dumped from scows on lines established by range-piles and buoys, and the total amount required is estimated at 320,000 cu. yds. The amount of gravel required is about 640,000 cu. yds., scow measure. The capping stones must not be less than 2 ft. thick, and delivered in blocks weighing from 3 to 10 tons and upward; at least one-half the stones must weigh 5 tons and none less than 3 tons.

For the timber cribwork a trench, 50 ft. wide at the rock bottom, must first be excavated through the soft material. On parts of the location the water is 30 ft. deep, and the mud deposit averages 38 ft. in thickness. The rock along the greater length of the pier lies from 59 to 77 ft. below the water surface, and the bottom deposit varies from 27 to 49 ft. in depth. The trench excavated must be backfilled to the level of the lake bottom with gravel, or other acceptable material, as a stable foundation for the cribwork. Upon this gravel will be deposited a layer of rubble stone, 50 ft. wide on top and 22 ft. below mean lake level. At least 10 days must be allowed for the settlement of the trench filling before the rubble foundation is put in place. The amount of this rubble is estimated at 126,000 cu. yds.

The timber cribs will be 36 ft. wide and 22 ft. high, with the tops, as sunk, at mean lake level. The three top courses and the upright posts in each crib will be made of white pine, and the remainder of hemlock timber, with the timbers varying in length from 10 to 36 ft. Each crib must be 60 ft. long, or as much longer as the contractor can make it, under the specified conditions. Each crib will be built with a grillage bottom, solid outer walls and tiers of cross and longitudinal stringers, and finally filled with stone and solidly decked over, as indicated in the cut.

A continuous timber superstructure is to be built over the cribs, 12 ft. high on the lake side for a width of 12 ft.; 10 ft. high in the middle for a width of 12 ft., and 6 ft. high on the harbor side for 12 ft. in width. This superstructure must be built of white pine sticks, 12 ins. square and from 10 to 36 ft. long, bolted and drift-bolted and made with solid outer walls and cross and longitudinal stringers. The superstructure is also to be completely filled with stone and decked over with white pine planking.

The sand-catch pier will connect the shore with the established pier-head line, and will be made up of two rows of close piling, 8 ft. apart between centers, and secured by waling strips 8 × 12 ins. along the inner and outer faces of each row. These rows of piling will be joined by iron tie-rods. This work is under the charge of Major T. W. Symons, Corps of Engineers, U. S. A., and proposals are to be received until Nov. 30.

THE MOSKOWITZ INDEPENDENT SYSTEM OF CAR LIGHTING BY ELECTRICITY.

The application of electric lighting to railway cars has many desirable features to recommend it, and numerous experimental and actual applications have been made on railways in this and other countries, but in many cases the cost of operation has been such as to deter the railway companies from introducing this means of lighting, except on a limited number of high-class trains. In the attempt to devise a commercially practicable system, the most encouraging direction has been that of making each car independent of the others in the train, and various patents have been taken out on methods of driving the generator from one of the car axles. A system of this kind, which appears to possess many practical advantages, is that invented by Mr. Morris Moskowitz, which has been under experimental development for some years. The system comprises a dynamo driven from one of the car axles, a storage battery in two sets, a switchboard and a lamp circuit in the car. It is entirely automatic, requiring no special attendant, and only requiring inspection at intervals of about a week. The system is now being introduced by the National Electric Car Lighting Co., 30 Broad St., New York city, and we are indebted to Mr. Max E. Schmidt, M. Am. Soc. C. E., of that company, for blueprints and information used in this article.

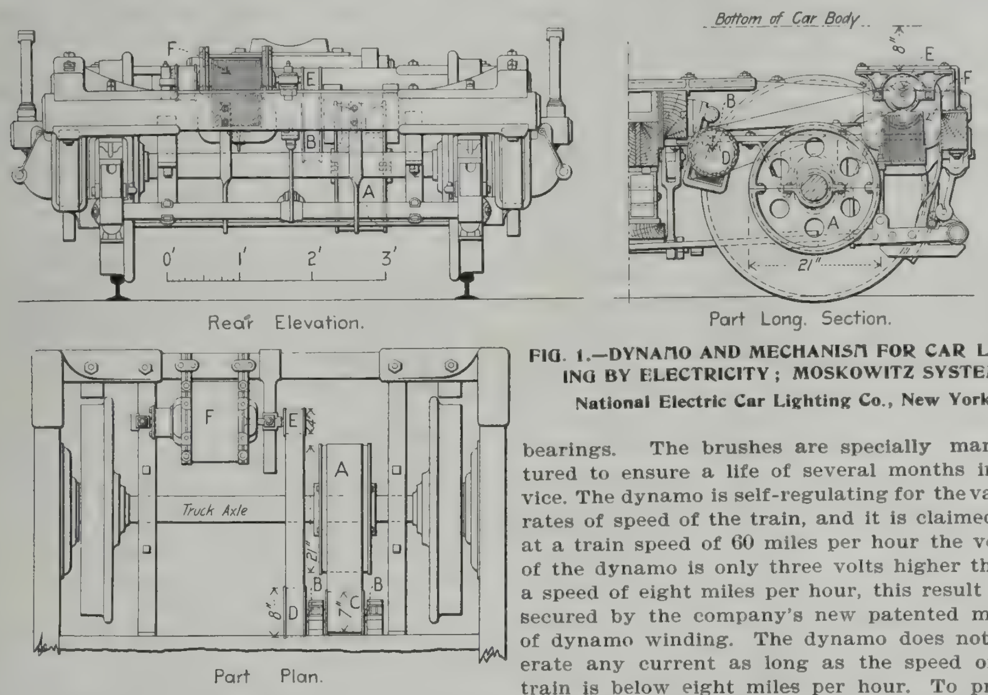


FIG. 1.—DYNAMO AND MECHANISM FOR CAR LIGHTING BY ELECTRICITY; MOSKOWITZ SYSTEM.
National Electric Car Lighting Co., New York.

The general arrangement of the apparatus is shown in Fig. 1. On the truck axle is clamped a split pulley, A, which is made of wood specially prepared to be impervious to atmospheric effects, and weighing 35 lbs. The cast-steel countershaft B carries two pulleys, C and D, the former of which is driven by a belt from the main pulley A, while a belt from the latter drives the pulley E, on the dynamo shaft. The countershaft B is carried in spring-cushioned bearings on the inner side of the transverse member of the truck frame, near the king bolt, and the weight of shaft and pullies is 80 lbs. The belts are of a double thickness of leather specially prepared so as not to be liable to be affected by changes of weather or by dampness, snow or ice. The dynamo, which weighs 300 lbs., is attached to the outer end of the truck frame, so that it can be readily inspected, it is enclosed in a dust-proof and weather-proof steel cylindrical casing. The vibrations from the car axle are taken up by a pair of powerful spiral springs, attached to the countershaft B. The bearings of this shaft are interchangeable, and are lubricated about once a week with a heavy lubricating grease. Oil wells (with a supply for one week) and several self-oiling rings are attached to the dynamo shaft bearings. The brushes are specially manufactured to ensure a life of several months in service. The dynamo is self-regulating for the varying rates of speed of the train, and it is claimed that at a train speed of 60 miles per hour the voltage of the dynamo is only three volts higher than at a speed of eight miles per hour, this result being secured by the company's new patented method of dynamo winding. The dynamo does not generate any current as long as the speed of the train is below eight miles per hour. To provide for the movement of the car in opposite directions, it is necessary that the dynamo should generate the current in either direction, and to effect this the electric poles are automatically changed in accordance with the direction in which the car is moving, so that the dynamo generates current at all times when the speed exceeds eight miles per hour, no matter in which direction the car is moving. This pole changing device is one of the special features of the Moskowitz system.

All the time the train is running, and also when the train is at rest or moving at slow speed, as in stopping or starting at stations, the current for the lights is supplied by storage batteries of a special type, owned by this company. These batteries are carried in two wooden boxes under the car, and while one set is furnishing light the other is disconnected and is being charged from the dynamo. If the batteries are first charged sufficiently to furnish light for six hours, the plant will furnish light for from 10 to 15 hours every night, as long as the car is kept running. When put on the sidetrack the batteries are shut off, and the stored batteries are ready to furnish light at a moment's notice.

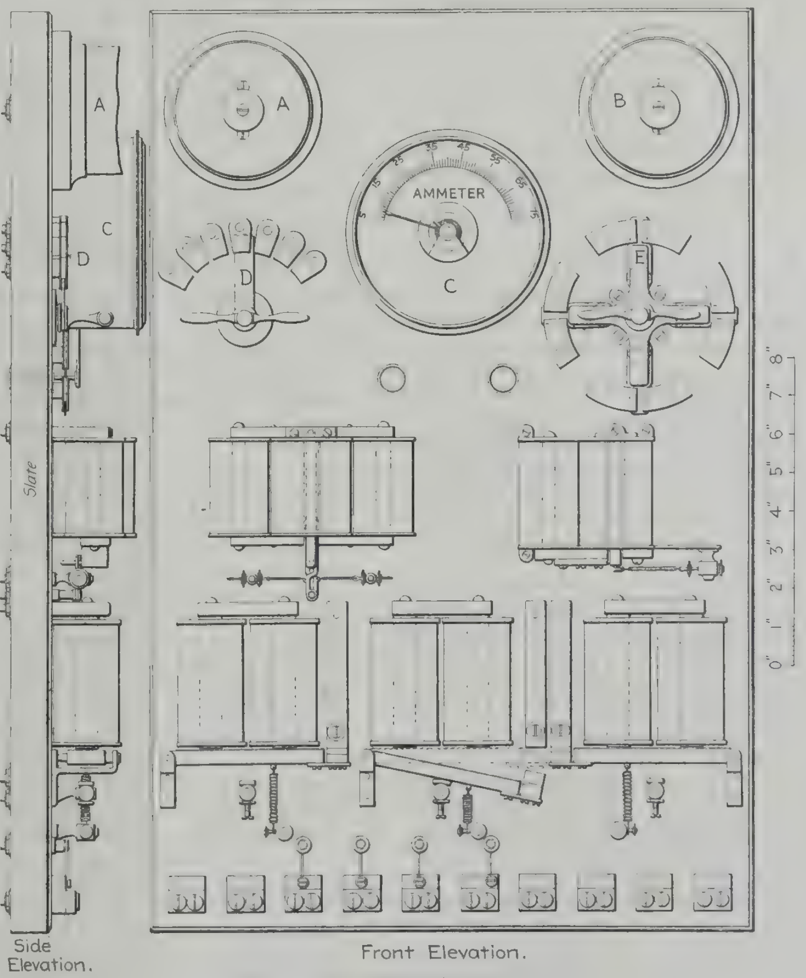


FIG. 2.—SWITCHBOARD FOR CAR.

The switchboard in the car is shown in Fig. 2, and includes the electro-magnetic devices for charging the electric poles automatically when the motion of the car is reversed, and also several other novel automatic devices. The main switch, A, controls all the circuits, and is kept closed, while the dynamo is generating current. The switch of the main light circuit is at B; the ammeter, C, shows the quantity of current generated, and D is a small resistance coil for the light circuit, which can be used if desired, but is not necessary. The main circuit between the dynamo and the storage battery is automatically opened and closed by means of the difference of pressure between them. The twelve-point switch, E, controls the connections between the two sets of storage batteries. When the battery that is furnishing light is exhausted, the switch is turned, throwing the charged battery into service and connecting the exhausted battery with the dynamo for re-charging. The switchboard can be attended to by a brakeman. The lighting equipment for an ordinary passenger car is 14 incandescent lights of 16 c. p., 12 of these (in four three-light groups in the roof, or else separately alongside the edge of the monitor roof) being in the body of the car and one over each platform. Owing to the use of the batteries the light is maintained quite steadily, there being no direct current from the dynamo to the light circuit.

One car equipped with this system is now running on the Pennsylvania R. R., between New York and Philadelphia. This car has 15 lights; 12 in the main part of the car, 1 in the hood over each platform, and 1 at the switchboard in the brakeman's closet; either of the last three lights can be turned on or off at will, and the last named is removable, with flexible cord attachment so that it can be used under the car when oiling or inspecting the dynamo. The car is an ordinary Pennsylvania R. R. day car, with a wide shallow monitor roof, the lamps being placed along the lower edge of the monitor roof. The lamps have short bulbs and filaments, and the bulbs are set in ornamental glass holders. They are 32-ampere lamps of 16 c. p. The batteries are in a box under the car, and the two sets comprise 32 cells weighing 45 lbs. each, or 1,440 lbs. in all. The cells have watertight rubber covers, and the only loss of the acid is by evaporation, which is very slight. The batteries will supply the car with light for 15 hours. This car is run on the westbound express train leaving New York at 6 p. m., and arriving at Philadelphia at 8.30 p. m., making only two regular stops. The return trip is made with the eastbound "owl train," leaving Philadelphia at 12.01 a. m. (midnight) and reaching New York at 3.53 a. m.; this train makes 26 regular stops and 5 extra stops on order. The westbound run tests the efficiency of the mechanism, while the eastbound run tests the electrical efficiency in securing steadiness of light. A chair car for the Atchison, Topeka & Santa Fe R. R., to run between Chicago and Kansas City, is now being equipped with this lighting system at the Newark works of the company.

The principal claims made for the Moskowitz system are as follows: High efficiency, moderate first cost, small operating expense, simplicity of design, easy and infrequent inspection, and the absence of skilled or special attendants on the cars.

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A TEST OF SLOW-BURNING WOOD AND PLASTER CONSTRUCTION.

An interesting test of a partially fireproof construction for halls, stairways, partitions, etc., manufactured by the New Jersey Adamant Co., of Harrison, N. J., took place in a lot in the rear of No. 112 Ocean Ave., Jersey City, on Oct. 26. A member of the staff of this journal was present by invitation. The construction consists in the substitution for ordinary lath and plaster of a "plaster board" made of plaster of paris cast around a core of wood excelsior. The boards are made 48 × 27 ins. in size, by ⅝-in. thick. Two of the four edges are rabbeted for an inch, to allow for overlap of adjoining boards, and the other two edges have cast in them a strip of burlap, which, when placed in the rabbeted joint and caused to adhere by running in liquid plaster, makes a joint which is not liable to crack. In applying the construction to the studding of a partition, the studs being placed 16 ins. apart as is usual, strips of plaster board of the same width as the studs are nailed upon their inside surfaces, then horizontal strips are placed across the space between the studs at intervals of 2 ft., and the whole is then enclosed between plaster boards nailed on both sides of the partition with large-headed nails.

For the purposes of the test a furnace was built of 3 × 4-in. wooden studding and plaster boards, its size and shape being that of a 4 ft. cube. One end of the cube was left open, and at the other was built a chimney 20 ins. square inside and 12 ft. high, of the same construction. The whole structure was plastered over, inside and out, with a thin coat of hard finish. The furnace, after being dried by a slow fire for a week, was half-filled with firewood, which had been wet with kerosene, and the fire was lighted at 2:30 p. m. About a cord of wood was used in all during the test, which lasted an hour and a half, the fire being replenished with wood at frequent intervals. Every effort was made to get as hot a fire as possible. During part of the test the open side of the furnace was partly closed by a wooden door protected by plaster boards, but as it checked the draft to some extent the fire was apparently no hotter than when the door was left off. The fire seemed to have no effect whatever on the structure for the first half hour, except to make a network of fine cracks all over the plastered wall of the inside of the furnace chamber. One hour after starting a crack appeared at the corner of the inside of the furnace and the chimney, but none of the plaster board fell off, and the studding was not exposed more than the thickness of the crack. At 4 p. m. or 1½ hours after starting, the first serious damage to the structure was observed. A portion of the plaster board on the inner side of the roof of the furnace fell in, exposing one side of the studding. The other three sides being protected by the plaster board, however, the studs burned very slowly, and they would probably have lasted half an hour longer if exposed to the same fire, before burning through to such an extent as to drop the roof, but the test was not continued further as all the firewood on hand had been used. It should be said that the inner side of the roof was supported to some extent by thin sheet iron strips besides being nailed to the studs. On the whole the test was a highly satisfactory one, and the resistance of the plaster board to a strong fire for an hour and a half was remarkable, when we consider that plaster of paris alone when exposed to such a fire for 15 minutes becomes so friable as to be easily broken by the fingers.

The construction tested was patented Feb. 12, 1895, by Mr. Jas. D. Baker, of Montreal, Canada. It is manufactured by the New Jersey Adamant Co., Harrison, N.J. (J. Wesley Dey, president); and by the Hudson Plaster Board Co., 130 Fulton St., New York city.

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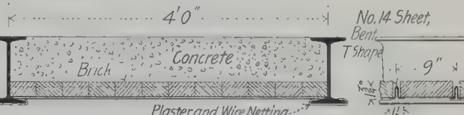
TEST OF THE RAPP FIREPROOF FLOOR CONSTRUCTION.

The fourth test in the series of tests of fireproof floors, which is being conducted by the Department of Buildings of New York city, was made at 68th St. and Avenue A, on Oct. 26. The test was made in a similar manner to those described in our issues of Sept. 17 and Oct. 1, by making a section of the floor serve as a roof to a brick building 15 ft. long × 12 ft. wide, inside measurement, and 12 ft. high. A floor of grate bars was placed near the bottom and cord wood piled on it. A small chimney was built at each corner of the roof. The fire was started at 10 a. m., and was kept up for five hours, when the door was opened and the roof suddenly cooled by a stream of water from a fire engine. The floor tested was Mr. J. W. Rapp's patent, built by the Rapp Sheet Metal Works, Nos. 309-319 East 94th St. Its construction is shown in the accompanying cut. The I-beams 10 ins. in depth are placed 4 ft. apart between centers, and the lower flanges support a series of light bearers made by bending sheet iron of No. 14 gage into a T-shape, 1¾ ins. high × 1½ ins. wide. These bearers are placed 9 ins. apart, being held in position by light sheet iron strips or separators, and they support a flooring of common red brick, as shown in the cut. On top of the brick is laid a bed of concrete, made of 1 part of Portland cement and 8 parts of cinders, to the level of the top of the I-beams. The under side of the floor was plastered with a thin coating of hard finish plaster.



Fireproof Floor Construction. Patented by J. W. Rapp, New York.

Within an hour from the starting of the test the temperature under the floor had reached 1,800° F., as shown by the Uehling & Steinbart pyrometer, when a piece of the plaster fell on the platinum tube of the pyrometer and damaged it so that it could no longer be used. Shortly afterwards a piece of copper wire placed in the building was melted, indicating a temperature of from 1,900 to 2,000° F. The fire was maintained at a high heat by frequent additions of cord wood, until 3 p. m. One of the panels of the floor was loaded with pig iron to 150 lbs. per sq. ft. Readings of deflection were made by an engineer's level from time to time. At noon the deflection was 1.35 ins.; at 12:45 p. m., 1.72 ins., and at 3 p. m., 2⅜ ins. After throwing the stream of water on the under side of the floor it was found that the iron strips holding the brick floor had sagged two or three inches, and some of the brick had fallen out in the center, but the bed of concrete remained intact and apparently uninjured.

The whole floor showed a maximum deflection of 2⅜ ins. when the heat was the greatest, but as when cooled the deflection was found to be only 1.2 ins., the maximum deflection was probably due to the lower flanges of the beams being heated more than the top flanges. Apparently, however, the lower flanges were not heated to such a degree as to be seriously weakened, for if this had occurred they would have stretched under the load and would not have gone back when cool.

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INDURITE, OR NAVAL SMOKELESS POWDER.

In an interesting address on the development of smokeless powder, delivered before the Washington Section of the American Chemical Society, Mr. Charles E. Munroe describes the result of his own experiments in producing a smokeless powder for the United States Navy. He recognized at the outset the impossibility of obtaining absolute uniformity and constancy of composition in physical mixtures like gun powder and determined to produce a powder which should consist of a single substance in a state of chemical purity. This had never been done before, and has not been done since, so far as Mr. Munroe can ascertain.

He began by purifying dried pulped military gun-cotton by extracting it with hot methyl alcohol, in a continuous extractor, and then drying the insoluble cellulose nitrate remaining. The highly nitrated cellulose was then mixed with a quantity of mononitro-benzine, which scarcely affected its appearance and did not alter its powdered form. This powder was then incorporated upon a grinder by which it was colloidized and converted into a dark translucent mass resembling india rubber. This sheet was cut into flat strips or grains, or it was pressed through a spaghetti machine into either solid or perforated cords of required dimensions, which were then cut into grains. The granulated explosive was then immersed in water, boiling under the atmospheric pressure, by which the nitro-benzine was carried off and the cellulose nitrate was indurated; the mass became light yellow to gray in color and as dense and hard as ivory. It was by this physical change in state, varied within limits by the press, that the material was modified so as to pass from a violent rupturing explosive to a slow-burning propellant. This is the powder called Indurite by Mr. Munroe and popularly known as naval smokeless powder.

On testing, this powder gave remarkably regular pressures and uniform velocities. The powder called for by the naval authorities was required to give a velocity of 2,000 ft. per second, with but 15 tons pressure to the square inch. In two successive rounds, with a 6-in. rapid-fire gun, using 26 lbs. of Indurite and a 100-lb. projectile, the pressures were 13.96 and 13.93 tons and the velocities 2,469 and 2,456 ft. per second respectively. This powder stored for six months, part of the time being very hot, showed absolutely no change in a firing test. All smokeless powders, except Indurite, are mixtures of one or more of the cellulose nitrates, or admixtures of these bodies, with nitro-glycerine, or some other oxidizing agent, like varium nitrate, and a restrainer; and all are condensed or hardened into a rubber-like or celluloid-like form, and are expected to undergo combustion at a moderate and regular rate.

In the same paper Mr. Munroe reviews the history of gun powders from A. D. 1346, and that of smokeless powder from 1845. Any of our readers especially interested in the subject will do well to obtain a copy of Mr. Munroe's paper which may be obtained from the Chemical Publishing Co., Easton, Pa.

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AN ENGLISH VIEW OF AMERICAN COMPETITION.

American competition in the cycle trade is announced. A Birmingham correspondent who has business connections on the Continent has recently been staying in Berlin, and on his way visited a few Dutch towns. Whilst traveling, he was much struck with the rapid and increasing sales of American cycles in Germany and Holland, and in Berlin especially a very large number of American machines is to be seen, whereas six months ago they were comparatively speaking unknown. He was told that at nearly all the cycle depots the sales of American machines were on the increase. The correspondent continues: "If wooden rims and very light machines are the demand on the Continent, it surely behoves those engaged in the cycle industry to go with the times." A friend—the representative of a large house dealing in agricultural implements—once told him, and it is more true now than ever, WEATHERTABLE FOR SEPTEMBER, 1896. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.)				Wind.			Precipitation—rain or melted snow—inches.		
		Average.	Max.	Min.	Range.	Velocity in miles per hour.		Direction at time of max. velocity.	Total.	Heaviest in 24 hours.	No. of rainy days.
						Average.	Max.				
Northern Cities	Northfield, Vt.	55.0	90	29	61	8.3	28	N	3.48	1.15	13
	Portland, Me.	57.7	79	36	43	7.3	30	S	9.57	5.28	14
	New York City	64.8	86	43	43	13.7	56	SE	3.04	1.16	9
	Pittsburg, Pa.	65.2	92	39	53	4.9	24	SW	4.17	1.70	10
	Chicago, Ill.	60.6	88	40	48	16.5	42	N	6.70	2.42	13
	Omaha, Neb.	61.6	88	37	51	7.1	28	S	3.97	1.44	7
	St. Paul, Minn.	56.5	81	32	49	7.3	29	SW	2 45	1.44	8
	Duluth, Minn.	54.6	78	34	44	10.4	38	NE	1.00	0 52	11
	Bismarck, N. Dak.	54.4	93	22	71	9.1	36	NW	1.42	0.53	11
	Average	58.9	86	35	55	9.4	35		3.98	1.74	11
Southern Cities.	Washington, D. C.	67.8	94	42	52	6.0	66	SE	3.18	1.17	12
	Louisville, Ky.	68.8	97	40	57	6.9	36	SW	4.12	2.74	11
	St. Louis, Mo.	68.2	95	45	50	9.8	31	NE	2.42	0.70	12
	Savannah, Ga.	77.4	97	53	44	6.8	70	SE	2.08	1.53	6
	Kansas City, Mo.	64.8	94	42	52	7.9	29	NE	2.81	0.79	11
	Jacksonville, Fla.	79.2	96	58	38	6.9	70	SE	2.19	0.95	11
	Chattanooga, Tenn.	73 1	98	43	55	5.6	34	NE	2.01	1.20	8
	New Orleans, La.	78.9	91	56	35	7.5	30	N	5.26	3.73	6
	Memphis, Tenn.	72.8	96	41	55	8.4	38	NW	3.21	1 12	5
	Palestine, Tex.	79.2	104	47	57	6.2	26	S	2.01	1.58	5
	Average	73.0	96	47	50	7.2	43		2.93	1.55	10
Western Cities.	Helena, Mont.	51.8	85	32	53	6.3	30	SW	2.54	0.68	10
	Port Angeles, Wash.	52.6	78	36	42	4.2	23	W	0.91	0.67	4
	San Francisco, Cal.	59.6	81	52	29	10.9	33	SW	0.52	0.41	5
	Salt Lake City, Utah.	64 0	90	36	54	7.0	44	E	0.52	0.25	8
	Santa Fe, N. Mex.	61 2	84	34	50	6 2	25	E	1.39	0.43	12
	Denver, Colo.	61.2	91	37	54	7.1	40	NE	1.81	1.03	8
	Yuma, Ariz.	84.0	108	55	53	5.1	33	S	0.31	0.31	1
	Average	62.1	88	40	48	6.7	33		1.14	0.54	7

that the American makers of agricultural implements had almost completely ousted the English manufacturers of reapers, binders, etc., in Germany, Russia, Austria and Hungary. The English firms would not listen to the advice tendered them by their agents in great cities and centers, and would not adopt the methods of the Yankee makers, with the consequence that orders were lost, and the trade went to the States. It is to be hoped that this will not be the case with the cycle indusry.—The Engineer (London).

ANNUAL MEETING OF THE AMERICAN STREET RAILWAY ASSOCIATION AT ST. LOUIS, MO.

The fifteenth annual meeting of this Association was held Oct. 20 to 23, at St. Louis, Mo. At the opening meeting, with the President, Mr. H. M. Littell, in the chair, the proceedings were opened with prayer by Rev. P. G. Robert, and Mr. Charles Nagel, Acting Mayor of St. Louis, delivered an address of welcome, after which the president delivered the annual address. In his remarks he dealt mainly with the growing disposition of state and municipal governments to increase the burden of taxation imposed upon street railway companies, which is due largely to a popular prejudice against corporations, and the only remedy for which is a gradual enlightening of the public mind and the cultivation of a broad and conciliatory management by the roads. Another severe strain is that of the high penalties imposed by the courts upon the companies for the negligence of their employees. Remedies for this are the education of the public and the employees to the exercise of more care in the use of the streets and the handling of the cars. He closed his address by referring to the great public importance of street railways.

The report of the Executive Committee was then presented, and showed that the membership in October, 1895, was 173 companies; 8 new companies had joined the association; 3 had become consolidated; 1 company had withdrawn, and 13 companies had been dropped for nonpayment of dues, leaving the present membership 164 companies. At the beginning of the present fiscal year the Association was in debt $6,000; this indebtedness has been cancelled, and the income during the forthcoming year will be about $6,500, which will enable the Secretary to enlarge the scope of the work of the Association. It is proposed to issue a monthly bulletin containing information of value to the members.

The report of the Secretary and Treasurer was next read, and the following is a summary of the figures there given:

Receipts	$12,044
Expenses	10,278
Balance	$1,766
Liabilities	381
Net assets	$2,530

The first paper on the list was that by Mr. M. K Bowen, Superintendent Chicago City Railway Co., on "Track and Track Joints, Construction, Maintenance and Bending," an abstract of which, with the discussion upon it, is given in another column.

At the meeting on Oct. 21 the first paper presented was one by Mr. John N. Akarman (Worcester Consolidated St. Ry.), on "Street Car Trucks," and this was followed by a paper on "The Modern Power House," by Mr. Richard McCulloch (Citizens' Ry. and St. Louis Ry.). Abstracts of both of these are published on another page of this issue. A paper on "How Can the Revenues of Street Railways be Increased," was then read by Mr. G. Densmore Wyman (Milwaukee St. Ry.), in which he took into consideration the collection of fares, methods of registering fares, transfers, the use of tickets or cash fares, attractions along the line of the road, etc. He considered that motormen should have some experience in the repair shops before taking charge of cars. After the appointment of a nominating committee the meeting adjourned.

On Oct. 22 the greater part of the morning was spent in examining the extensive exhibit made by manufacturers of and dealers in street railway supplies. When the meeting was called to order a paper by Mr. B. Willard (New Orleans City & Lake Ry.) on "Modern Overhead Electric Construction," was read in the absence of the author. An abstract of this is also printed separately.

The committee on nominations then submitted its report, and officers for the ensuing year were elected as follows:

President, Robert McCulloch, Vice-President and General Manager, Cass Ave. & Fair Grounds Ry., St. Louis, Mo.; First Vice-President, Charles S. Sergeant, General Manager, West End St. Ry. Co., Boston, Mass.; Second Vice-President, D .B. Dyer, President, Augusta Ry. Co., Augusta, Ga.; Third Vice-President, C. F. Holmes, General Manager, Metropolitan St. Ry. Co., Kansas City, Mo.; Executive Committee, H. M. Littell, Vice-President and General Manager, Metropolitan St. Ry. Co., New York city; H. P. Bradford, General Manager, Cincinnati Inclined Plane Ry. Co., Cincinnati, O.; Charles H. Smith, Superintendent, Troy City Ry. Co., Troy, N. Y.; Harry Scullin, Vice-President and General Manager, Union Depot Ry. Co., St. Louis, Mo.; George B. Hippee, General Manager, Des Moines City Ry. Co., Des Moines, Ia.; Secretary and Treasurer, Thomas C. Penington, Treasurer, Chicago City Ry. Co., Chicago, Ill.

The report of the committee recommending Niagara Falls, N. Y., as the place for the next meeting, in 1897, was also adopted. On motion of Mr. I. A. McCormack (Gen. Supt., Brooklyn Heights Ry.) a committee of five members was appointed to consider the propriety of the association adopting a standard code of rules and regulations for the government of employees, similar to that in use on steam railways. The annual banquet was held Thursday evening. At the meeting on Oct. 23 the first business was the reading of a paper on "The Selection and Management of Employees," by Mr. W. F. Kelly (Columbus St. Ry.), in which particular stress was laid upon the necessity of exercising greater care in the employment of men, of properly educating and instructing them, and of properly treating them. This paper brought out an extended discussion, in which reference was made to the provisions now made by several companies for the comfort and convenience of the men, in the way of reading rooms, waiting rooms, baths, gymnasiums, etc. It was also pointed out that punishment by suspension is liable to cause much ill feeling by making the man's family suffer for the period of his enforced idleness, besides tending to injure his character.

After the passing of resolutions of thanks to various persons and associations the meeting adjourned. The convention was well attended, over 1,000 persons being present, and a very good set of papers was presented, but the discussions were not very extended for the reason that the meeting room, in the corner of the Auditorium, was not heated, and the members were therefore not anxious to remain long to talk.

ANNUAL CONVENTION OF THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

The sixth annual convention of the Association was held at Chicago, Ill., Oct. 20, 21, and 22, 1896, and a programme of twelve special committee reports was presented for discussion. This programme was decreased considerably, however, by the failure of three of the committees to present reports, a request by a fourth for more time, and individual reports by a single member only of two other committees. The reports actually presented were as follows: "Different Methods of Numbering Bridges;" "Drawbridge Ends, Methods of Locking;" "Protection of Trestles from Fire;" "Local Stations at Small Towns and Villages;" "Tanks, Frost-Proofing, Size, Style and Details of Construction;" "Best and Uniform System of Report Blanks for Bridge and Building Department;" "Mechanical Action and Resultant Effects of Motive Power at High Speeds Upon Railway Structures;" "Best and Most Economical Railway Track Pile Driver;" "Span Limits for Different Classes of Iron Bridges." Five of these reports were printed and distributed in advance of the convention, and the others were read from the manuscript.

During the opening session the time was taken up with the usual addresses, reports of officers and other routine business. The secretary's report showed the financial condition of the society to be good, there being a balance in hand above all expenditures of $233. The total membership of the society is 221, of which, however, only about 30 members were present at the convention. Applications for membership from 20 new men were received and the applicants elected. Two members were lost by death during the year.

The first work of the second session was the appointing of committees on nominations, auditing, resolutions, obituary and subjects for discussion. The reports of the special committees were then read in the order outlined above, but as, according to the usual practice, their discussion was postponed until the second day, they will be considered in the proceedings of that day. The review and discussion of the committee reports presented at the preceding year's convention was the next order of business. These reports have already been printed in full in the Association's proceedings for 1895, and in abstract in Engineering News of Oct. 24, 1895, and need not be repeated here. Only three of these reports, viz., "Methods and Special Appliances for Building Temporary Trestles Over Washouts and Burnouts;" "Best Method of Erecting Plate Girder Bridges," and "Sand Driers, Elevators and Methods of Supplying Sand to Locomotives," were discussed at any length, and this discussion consisted largely of a relation of the practice of different members.

In regard to repairing washouts and burnouts, Mr. W. M. Noon (D., S. S. & Atl.) stated that his practice was to keep always a large stock of timber on hand. Immediately a burnout was reported he examined his records to ascertain the character, dimensions, etc., of the destroyed structure and from this knowledge he selected and loaded his material. The force was divided into separate crews to carry out the following duties: Clearing up wreckage; sawing off old piles; unloading material; getting material in place by push-cars; framing; erecting; track construction. Mr. James H. Travis (Ill. Cent.) stated that the main supply yard of the road was at Chicago, where material was always on hand for a 400-ft. or 500-ft. opening. His first concern after getting his material under way was to establish a good commissary, if the work was likely to last more than 24 hours. Work on the repairs was divided into two shifts, one gang commencing very early in the morning and continuing until noon, the other working from noon until 8 or 10 p. m. Pile and frame bents were used to fill the break, the bents being placed 14 ft. c. to c., the caps were 12 × 12-in. timbers and the stringers 12 × 16-in. timbers. When possible piles are always used. The pile driver has a reach of 26 ft. and in first work the pile bents are placed that distance apart, but after trains are running a bent is placed midway between each pair of those first erected. He considered it advisable to work only by daylight when possible, but if work was done by night he preferred a bonfire for lighting to anything else and always carried two or three car loads of wood for that purpose.

Except for difference in detail the methods described by other members varied but little from those of Mr. Noon and Mr. Travis, and those described in the committee report. The discussion on both the other reports mentioned above was brief and added but little new information. The concensus of opinion seemed to be in favor of erecting plate girders on false works along side of the old structure and sliding them into place when this could be done conveniently, but it was considered that in almost every case the best method would vary with the local conditions. As an example of rapid plate girder erection, Mr. M. Riney (Chicago & Northwestern) mentioned the Merrimac River bridge. This work was described in Engineering News, July 9, 1896. In relation to sand driers, Mr. Walter G. Berg (Lehigh Valley) called attention to the increased use of compressed air for elevating the sand. He considered the practice good in large plants, but doubted the advantage of its extension to small sand houses.

Wednesday's Sessions.

The second day's work of the convention was devoted to the discussion of the special committee reports read the first day. The first report considered was that of the committee on "Different Methods of Numbering Bridges." The report brought out the fact that a great variety of practice existed in regard to numbering openings in the track. Some railways numbered all openings, some only those above a certain length; some numbered bridges but not culverts, and some did not number anything. A similar variety of practice was shown in the systems of numbering preferred, but generally they were all modifications of the "consecutive" and the "mileage" systems. In the consecutive system the structures were numbered consecutively from unity upward, beginning at one end of the road, and this method was recommended as best by the report. In the mileage system the structure received the number of the mile of line on which it was located with affix letters or fractions for second, third, fourth, and additional structures on that mile. The gist of the report was that bridges and culverts should be numbered and that the consecutive system was preferable.

Mr. Walter G. Berg (Lehigh Valley) opened the discussion by asserting his preference for the mileage system, which he considered more easily comprehended by all classes of employees, and more elastic to admit of the addition and throwing out of structures. Mr. Onward Bates (C., M. & St. P.) stated that he numbered consecutively by divisions, each division having an initial letter. Everything above 6-ft. span was classed as a bridge, and all openings covered by ballast as culverts. Bridges received even numbers and culverts odd numbers, but when a structure was changed from one class to the other it retained its original number. He preferred the mileage system but did not deem it advisable to renumber the 16,000 openings on his line for the advantage. For bridges he used a numbered board, 2 × 12 ins., which was nailed to the end tie, but for culverts the board was fastened to a near-by fence post or telegraph pole where it could be easily seen from a hand-car. Mr. A. McNab (Chic. & W. Mich.) stated that he used the mileage system, with prefix letters to denote branch lines. The number post was driven into the ground 4 ft. or 5 ft. away from the bridge. Besides mile posts his road had station numbers every 500 ft. Cattle guards and culverts were designated as being so many feet from station. Mr. J. H. Travis (Ill. Cent.) stated that all structures were numbered, the numbering being by divisions and by the mileage system. For example, a structure, 565 ft. beyond the 50th mile of division A would be numbered A 50 + 565. The number posts for bridges were sawed diagonally, or from corner to corner, from 6 × 8-in. ties, and painted white with black letters. For culverts a similarly painted 6 × 6-in. cypress post was used. Mr. J. H. Cummin (Long Island) stated that he numbered all bridges consecutively from 1 to 300, all culverts consecutively from 300 upward, and used enameled iron number plates. Mr. Aaron S. Markley (Chic. & Ea. Ill.) preferred the mileage system and used it. Mr. W. M. Noon (D., S. S. & Atl.) used the consecutive system and preferred it to the mileage. Mr. J. O. Olmstead (Cent. Vt.) stated that he numbered all openings over 6-ft. span with 10 × 16-in. board placed on a post 8 ft. from the track. The system was the consecutive but he considered the mileage system preferable. Mr. N. W. Thompson (P., Ft. W. & Chic.) stated that he numbered all openings, but put number plates only on those over 24-in. span. He numbered consecutively, and affixed a letter to the number when additions were made. A cast-iron number plate 2 ft. long and with 6-in. figures, set on a 1½-in. gas pipe post was used. He considered the mileage system to be the better. Mr. W. A. McGonagle (Dul. & Iron Range) stated that he numbered all openings, using the mileage system with affixed letter for second and additional openings, and in case the structure was on a branch he prefixed to the number an initial letter designating that branch. The discussion showed that the majority of opinion was against the preference of the committee report for the consecutive system.

Mr. C. C. Mallard (So. Pac.), a member of the committee on "Draw Bridge and Turntable Ends, Methods of Locking," presented a short report on the subject, the committee as a whole not reporting. The report gave illustrations of a number of such constructions for swing bridges, all of which were of common form, but made no recommendations. In the discussion which followed attention was turned entirely to the locking devices for turntable ends. The principal objection to the ordinary locks was that they could be snapped into place while the table was in motion, thus subjecting it to injurious shocks. A majority of those discussing this point seemed of the opinion that the only good lock was one that could not be closed until the table had been brought to a full stop.

The committee on "Protection of Trestles from Fire" presented no report, but Mr. G. W. Hinman (L. & N.), one of the members, described a system of iron plate protection used by himself with success. In this construction the caps and rail joints were covered with No. 20 galvanized iron plates having their edges lapped down at angles of 45°. With this construction he adopted also the usual precaution of clearing away the grass and weeds from the feet of the trestle bents. In the discussion which followed Mr. Wm. O. Eggleston (Chic. & Erie) stated that he used an iron plate protection, but all of the others, eight in number, who made remarks, stated that their only protection consisted in clearing away grass and weeds and providing water barrels and occasionally watchmen.

The next report was that of the committee on "Local Stations for Small Towns and Villages," and it consisted of 39 plans of actual stations of this type constructed by various railways. The discussion turned upon the best form of platform construction and the advisability of having separate waiting rooms for men and women. For platforms, plank was the most common material, but brick, cinders, stone dust and concrete were also used quite extensively. The general opinion was that the platform should be at rail level or at most only a few inches above the rail. In regard to the number of waiting rooms Mr. J. H. Cummin (Long Island), spoke strongly in favor of the single "combination" waiting room, and stated that this form had been adopted on the Long Island R. R. In these stations the agent's room was separated from the main room by a wire netting or sometimes grill work, so that he could see everything that took place. Smoking and lounging were forbidden. Several other members stated that they used both combination and separate waiting rooms, the choice depending upon the size and conditions. Mr. J. H. Travis (Ill. Cent.) stated that in the Southern states at least two waiting rooms were required by custom and in some states by law, one for colored and another for white people.

The committee report on "Tanks; Frost-proofing, Size, Style and Construction" was next considered, and was substantially as follows:

> After considerable correspondence with different members of this association we find that most roads use the standard 16 × 24-ft. tank, with a capacity of 50,000 gallons. These tanks are placed on various styles of substructures, some of which are oak, others pine; but the most up-to-date substructure is that made of steel, which we find quite a number of roads have adopted or are about to adopt. As for frost-proofing, some roads box up their pipes with brick-work, others use lumber, which is considerably cheaper and answers the purpose nearly as well. Where it is exceedingly cold during the winter it is good policy to house in the substructure and keep a fire under the tank, allowing the smoke and heat to pass through a pipe near the valve in tank and out through the roof of the tank. In this case it may be necessary to ceil over the upper joists in order to hold the heat from the stove as much as possible. There is an old saying that "The best is the cheapest," and it will hold good in this case, and your committee desire to offer the following: That a first-class white pine tank, placed at an elevation of 25 ft. above rail on a steel substructure and stone foundation and connected with a 12-in. pipe to a 10-in. stand-pipe, is the most economical and modern structure of the kind at the present time.

The report also presented itemized figures of cost of three standard tanks. A 16 × 24-ft. white pine tank and tower on the Chicago & West Michigan R. R. cost $973.80, of which $228 were for stone foundation, $161.37 for labor of erecting, $25.50 for labor of painting and the remainder for material. A 20-ft. cypress standard Lehigh Valley R. R. tank cost $896.77, of which sum $280 were for masonry and $175 for labor. The Chicago, Rock Island & Pacific R. R. standard tank costs as follows:

16 × 24-ft. tank with 12 hoops, 3 lugs each	$275.00
1 indicator	5.00
1 set 7-in. fixtures	68.00
12 iron post caps	24.00
Rail joists, at $5 per ton	18.45
Substructure, frost proofing, etc.	198.36
Paint	14.51
Foundation stone	68.75
Labor in foundation	116.00
Labor, painting	24.24
Labor, erecting tank	164.72
Total	$973.03

The discussion which followed was quite extended, but few facts differing from those in the report were presented. Mr. W. A. McGonagle (Duluth & Iron Range) stated that in a climate which often presented a temperature of — 56° F. to — 60° F. he used a 16 × 24-ft. tank made of 3-in. cypress, with timber tower and masonry piers on an 18-in. concrete foundation. The tank was placed at the extreme edge of the right of way and a stand-pipe was used. The pipe from the pump to the tank was boxed in and carried on a trestle above ground. The pipe box was made of boards and tar paper with three dead air spaces, and through it passed a ¾-in. steam pipe from the boiler. With this construction no trouble was had from freezing. Mr. M. Riney (Chic. & N'wn) gave the costs of three 16 × 24-ft. white pine tanks recently built as: (1) labor $352, material $955, total $1,307; (2) labor $433, material $1,671, total $2,104; (3) labor $467, material $1,715; total $2,182. These figures included cost of everything.

The next report considered was that of the committee on "Best and Uniform System of Records for Bridge and Building Department." It was in abstract as follows and was not discussed:

> We have received from a number of roads copies of forms used by them, and find that with the exception of time books, there is a great diversity of forms and methods of reporting. In many cases the forms are for general use of the various departments of the system, and seem to be prepared to suit the general accounts, and also indicate that the statements required of expenditures on bridges and buildings differ in almost every instance. Therefore, on account of the various conditions under which bridge and building department work is performed on the different systems, and by reason of the fact that in many cases the forms are adapted to general use, and that any change might affect the general accounts, we have deemed it best to recommend only the following forms, and have arranged and classified all the other forms submitted so that they may be examined by the members and notes taken of such as are suited to their respective roads. The forms recommended are: Time Book to be 4½ ins. × 7 ins., and the number of leaves to be varied in accordance with the size of the crew. Covers to be oil boards with cloth back. This book is recommended because it shows the over-time. It is intended that it shall be in use one month only, and retained in the office of the person making the distribution of time. For reporting material used, Mechanics' Diary, U. P. system, the number of pages in the book to be determined by the road using it. Bridge and Building Record Account Book, the C., M. & St. P. Ry. system, which is to record in an ordinary journal-ruled book the charges to the work as they appear in the monthly distributions of labor and material, and when the structure is completed to analyze the cost. In our opinion the above forms are the best, and can be adopted by any of the roads submitting forms without any serious alteration in their methods of reporting.

No discussion followed the next report, which was that of the Committee on "The Mechanical Action and Resultant Effects of Motive Power at High Speed on Bridges." The committee announced its inability to present anything new on the subject, but briefly summarized some of the experiments made in the past and already familiar to the readers of Engineering News.

Mr. G. W. Hinman (L. & N.) presented an individual report upon the "Best and Most Economical Railway Track Pile Driver," the committee as a whole not reporting. Mr. Hinman described the pile driver used on the Louisville & Nashville R. R. The driver is of a pendulum form and capable of driving piles either plumb or at any batter. It has two centers so that piles can be driven close to either end of the car or 15 ft. from the forward end of the car. A double-action 7-in. cylinder Lidgerwood engine with two friction drums and two winch heads operated a 3,300-lb. hammer by the frictions. The hammer rope is a 2½-in. manila and is made fast to the hammer. On the driver is a water tank of 300 gallons capacity and a coal box of 25 bushels capacity. Accompanying the driver is a locomotive and tool car. One end of this car is boxed in for 24 ft., but the remaining 10 ft. is left open for a hand-car, pile rings, and coarse tools. The cost of running this driver per day is as follows:

Foreman and ten men	$22.00
Engineer, fireman and watchman	6.80
Conductor and flagman	7.00
Coal, oil and waste	2.50
Use of locomotive	12.00
Use of driver and tools	2.50
Total	$52.80

For long trestles of from 3,000 ft. to 4,000 ft. the gang is enlarged to a foreman and 14 men.

In the discussion which followed a number of members spoke in favor of the self-propelling pile driver made by the Bay City Industrial Iron Works, but Mr. N. W. Thompson (P., Ft. W. & Chic.) stated that it had proved unsatisfactory on his road. The general opinion was that manila or "stevedore" rope was better for hammer lines than iron or steel wire cables. This discussion was followed by several business committee reports which concluded the proceedings of the second day's session.

Thursday Morning Session.

The session of the association on Thursday morning was devoted to the election of officers, selection of next place of meeting, adoption of resolutions and the discharge of routine business. The following named officers were elected: President, James Stannard, Wabash R. R., Kansas City, Mo.; First Vice-President, W. G. Berg, Lehigh Valley R. R., Jersey City, N. J.; Second Vice-President, J. H. Cummin, Long Island R. R., Long Island City, N. Y.; Third Vice-President, A. H. Markley, Chicago & Eastern Illinois Ry., Danville, Ill.; Fourth Vice-President, R. M. Peck, Missouri Pacific Ry., Pacific, Mo.; Secretary, S. F. Patterson, Boston & Maine R. R., Concord, N. H.; Treasurer, N. W. Thompson, Pittsburg, Ft. Wayne & Chicago R. R., Ft. Wayne, Ind.; Executive Committee, W. N. Noon, Joseph M. Staten, W. O. Eggleston, M. Riney, C. P. Austin and G. J. Bishop.

Resolutions were adopted expressing the obligations of the convention, for favors shown by the Illinois Central and Santa Fe railways, the Pullman and Wagner companies, the mayor and the city of Chicago, the Western Railway Club, the Patterson-Sargent Co., the Sherwin-Williams Co., the technical press, and the local committee of arrangements. At noon the convention adjourned to meet in Denver, Colo., on the third Tuesday in October, 1897.

Excursions and Entertainments.

On Thursday afternoon a visit was made to the Burnside shops, Illinois Central R. R. (Eng. News, June 18, July 16 and 23, 1896), and to the town of Pullman. On Friday a number of the members made a trip along the Chicago Drainage Canal. A theater party and other entertainments were provided for the members by the Patterson-Sargent Co., of Chicago, and the Sherwin-Williams Co., of Cleveland, O.

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ELECTRIC SWITCHING OF CARS on the Brooklyn Bridge cable railway will soon be in operation. The 20 motor cars built by the Pullman Palace Car Co., are now being delivered, and are being fitted with the General Electric Co.'s motors and equipment. The cars and the system of operation were fully described in our issue of Feb. 26, 1896, but since then the plans have been somewhat changed. The current will not be taken from an overhead wire, but from a third rail, for which purpose each truck will have on each side a collecting shoe, mounted between the axle boxes. The cars are of the usual type employed on the bridge, each having two four-wheel trucks, and each motor car will have four 50-HP. motors. There are two circuit breakers, a magnetic fuse box, 12 resistances and a magnetic blow-out. The motor car of each train will do the switching at each terminal, and will be able to propel the train load of 120 tons over the bridge (on emergency) at the same speed as the cable, 11.3 miles per hour, and to ascend the grades of 3.78%, which are 1,000 ft. long. The trucks for the new cars were made by the McGuire Mfg. Co.

A LOCOMOTIVE FOR THE SOUDAN RAILWAY, in Egypt, has been built by Manning, Wardle & Co., of Leeds, to the orders of John Birch & Co., of London. It is a tank engine, with outside cylinders, Walschaert valve gear, six coupled wheels, and leading and trailing pony trucks. The railway is a military expedition line of rough construction, with sharp curves and grades up to 2%. The leading dimensions of the locomotive are as follows:

Gage	3 ft. 6 ins.
Fuel	Coke.
Driving wheels	3 ft.
Truck wheels	2 ft.
Driving wheel base	6 ft. 6 ins.
Total wheel base	18 ft. 8 ins.
Cylinders	14×18 ins.
Tubes, diameter outside	1⅞ ins.
Boiler pressure	140 lbs.
Grate area	9.25 sq. ft.
Heating surface, tubes	545.00 sq. ft.
Heating surface, fire-box	62.00 sq. ft.
Heating surface, total	607.00 sq. ft.
Capacity of tanks	1,080 gallons

THE NEW FREIGHT TERMINALS of the Illinois Central R. R., at New Orleans, La., were formally opened Oct. 28, with some ceremony. In the evening Mr. Stuyvesant Fish, president of the railway, gave a dinner to the mechants of the city.

AN UNDERGROUND RAILWAY IN PARIS, about 11,054 ft. long, is to be built to transfer the terminal station of the Compagnie d'Orleans from the Place Valhubert, some distance up the Seine, to the Quai d'Orsay, opposite the gardens of the Tuileries and in the heart of Paris. The new line will follow the left bank of the Seine and will be, for the greater part, in a double track masonry tunnel, with the floor just above the level of the water in the river. About 2,027 ft. near the present station will be a sunken track, open above. The total estimated cost is about $4,600,000.

AN AMERICAN-CHINESE SYNDICATE, says a news item from Pekin, has promised to advance 30,000,000 taels, or less than $15,000,000, for the construction of the Han-Kow & Peking railway, a line 700 miles long, and crossing 27 rivers, including the Hoang-Ho. Rumors of similar Chinese railway construction with American money are, unfortunately, abundant; and whether this will result in anything more substantial than a news item remains to be seen.

A DEVICE FOR RAISING SWING BRIDGES for the purpose of renewing the roller system and making other turntable repairs has recently been tested with very successful results at Chicago, Ill. This device is the invention of Mr. J. E. Roemheld, Engineer of Bridge and Viaduct Repairs, Chicago, Ill., and it was first used in raising the Clark St. bridge, which is a double roadway, three-truss structure 220 ft. long, 58 ft. wide, and weighs 800 tons. Work was begun at 10 a. m. and finished at 5:30 p. m., during which time the set of 80 rollers was replaced, engine and boilers overhauled and sundry minor repairs made. No falseworks or jack screws were used and the labor force was 20 men. The raising device consisted of a series of interlocking cast-steel wedges so arranged that the bridge is turned up onto them and thus raised. In a future issue a full illustration and description of these wedges will be given, but at present it can only be stated that they worked with absolute success.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a collision between a fast freight train and three loaded oil tank cars standing on the track at Wapakoneta, O., on the Cincinnati, Hamilton & Dayton R. R. The engineman, fireman and one brakeman were killed, and the wreck caught fire; 12 freight cars and the pumping station of the Manhattan Oil Co. were destroyed by fire. ——An express train on the Eastern Division of the Boston & Maine R. R. ran into the open draw of the bridge over the Saugus River, near West Lynn, Mass., Oct. 30, The train was the "Flying Fisherman," from Boston to Rockport, and the drawbridge had been almost closed when the train reached it. Gates were closed across the track 500 ft. from the bridge, and red lights were displayed, and this was admitted by the engineman, but he claimed that the brakes would not hold the train. The engine went through into the river, with its rear end resting upon the abutment. Nobody was hurt.

A GAS EXPLOSION IN A MINE occurred at Wilkes Barre, Pa., Oct. 29. The explosion occurred in No. 3 shaft of the Lehigh & Wilkes Barre Coal Co., killing four men, while two men of the rescue party were suffocated by the after damp.

DEFECTIVE BUILDING WORK IN NEW YORK has again been detected. A 7-story building for manufacturing purposes is being erected at 508 and 510 Broome St., and on Saturday it was noticed by an inspector of the Building Department that the walls were bulging. Mr. Constable, Superintendent of the Department, made a personal inspection, and sent for contractors to shore up the walls and secure them by wire cables. It is said that defective construction, undue haste in the erection of the three top stories, and the jarring from the engine used to hoist material, contributed to the failure of the work.—— Building inspectors have also found a dangerous building at 158 Leonard St., which was in use as an Italian school. The building had settled so that the walls were cracked and had bulged out, while the floors had sagged down considerably. Steps were at once taken to shore up the building.

CIVIL SERVICE EXAMINATIONS will be held by the New York City Civil Service Board as follows: Enginemen, Nov. 11; sanitary inspector for the Health Department, Nov. 12; instrument maker for the Fire Department, Nov. 16; bacteriologist, salary $1,200 per year, and assistant bacteriologist for the Health Department, $600, Nov. 24; second deputy superintendent of buildings ("competent architects or builders of at least 10 years' experience"), Nov. 30. Particulars may be obtained of Mr. Briscoe, Secretary of the Commission, Criminal Court Building.

EXTENSIVE IMPROVEMENTS TO THE WATER SUPPLY of Baltimore are proposed, in accordance with plans outlined in a report by Mr. Samuel M. Gray, M. Am. Soc. C. E., of Providence. The estimated cost of the work is $1,985,700, divided as follows: 75,000,000-gallon reservoir and land for same, $450,000; two 17,500,000-gallon pumps in place, $130,000; one 10,000,000-gallon pump, $35,000; five 150-HP. boilers in place, $15,000; pumping station, $90,000; pipe system, $1,059,700; screens and accessories, $12,800; high service improvements, $193,200. Bids for 26,000 tons of cast-iron pipe will be received until Nov. 16, as stated in our advertising columns. It is reported that the other contracts will not be let until next spring. Mr. W. L. Kenly is Chief Engineer of the Water Department.

THE NAVAL BUREAU OF ORDNANCE, says Capt. Sampson, Chief of the Bureau, in his annual report, has built 450 guns of large caliber, has 89 partly built and has only condemned two out of this number in official tests. All of the 6-in. guns on hand are to be converted into rapid-fire guns, and the appropriation of $250,000 for reserve guns is being utilized in constructing two 8-in., two 12-in. and two 13-in. guns. Smokeless powder is on hand for all guns up to 6-in. caliber. During the year 2,262 tons of armor have been delivered, 684 tons of this being reforged plate. The two armor-making companies now claim an annual capacity of 8,400 tons. As auxiliary cruisers the department has inspected and accepted 19 American steamers on the Atlantic coast and 9 on the Pacific coast. These ships will require 46 6-in., 27 5-in., 104 4-in., 54 6-pdr. 8 1-pdr. and 112 machine guns. The estimates for the next year aggregate $9,164,620, the largest item being $7,720,796 for the armament of vessels authorized.

THE UNITED STATES NAVY, says Chief Constructor Hichborn in his annual report, now contains 110 vesesls of all classes; of these 30 are armored, including 8 battleships, two cruisers, one ram, 6 double-turreted monitors and 13 single-turreted monitors. Three other battleships are under construction. There are now in commission 25 new steel cruisers, with 16 iron and wooden cruisers.

FOREST DESTRUCTION AND FRESHETS in mountain streams are discussed in the annual report of Mr. T. Jefferson Coolidge, Treasurer of the Amoskeag Cotton Mfg. Co., of Manchester, N. H. For some years past there have been heavy spring freshets in the Merrimac River (that of 1896 compelling a general shutting down of the mills at Manchester), while in summer the water is lower than in former years. This alternation of very high and very low water is attributed by Mr. Coolidge to the cutting down of forests around the headwaters of the Merrimac, the Pemigewasset and other affluents. The woods held back the water, but now that they have been largely destroyed the rain, running rapidly over the surface of the ground, which is baked by the sun or frozen hard by the winter cold, pours all at once into the streams, turns them into roaring torrents, and finds its way all at once into the Merrimac, sweeping everything before it. In a few days the river sinks rapidly and becomes in time of drouth an insignificant stream.

THE PENNSYLVANIA FORESTRY COMMISSION, Wm. F. Shunk, Engineer, reports that there are in that state 13,973,737 acres of cleared land, and 9,099,817 acres of woodland. Both Mr. Shunk and Prof. Rothrock, the Forestry Commissioner, recommended the purchase of forest reserves by the state, both to better protect standing timber from fire and to perpetuate our forests. They say that unless something of this kind is done at once the state will be denuded of valuable timber within the next 15 years. During recent years one firm of lumbermen has lost 150,000,000 ft. B. M. of timber by forest-fires. In the past season one tract of 125,000 acres was thus devastated.

DURING THE CONSTRUCTION OF THE MELAN arch bridge, at Topeka, Kansas, the remains of another bridge were encountered in the foundation, a bridge forgotten by nearly everyone now living in Topeka, though it was only built late in "the fifties." Topeka was then a village, and a bridge was built across the river, with pile-piers and a swing-span for the accommodation of passing steamboats. The bridge fell almost immediately after its completion, and the wreck was soon buried in the sand by a shift in the channel and forgotten. The oak piles in the foundation of the old pivot-pier, which were encountered in founding the Melan arch, were in an excellent state of preservation, and they are being withdrawn for use under the new piers.

PANAMA CANAL WORK, says a Panama news item, is being "pushed" on the Culebra Section with a force of 150 negroes. The American system of handling earth by towers, endless chain of buckets, etc., copied from some of those used on the Chicago drainage canal, has been introduced on the Empire Section, and is said to work well. M. Belin, the Director-General for the new canal company, has arrived at his post. He is not an engineer, but a lawyer, formerly connected with the administration of the old canal company.

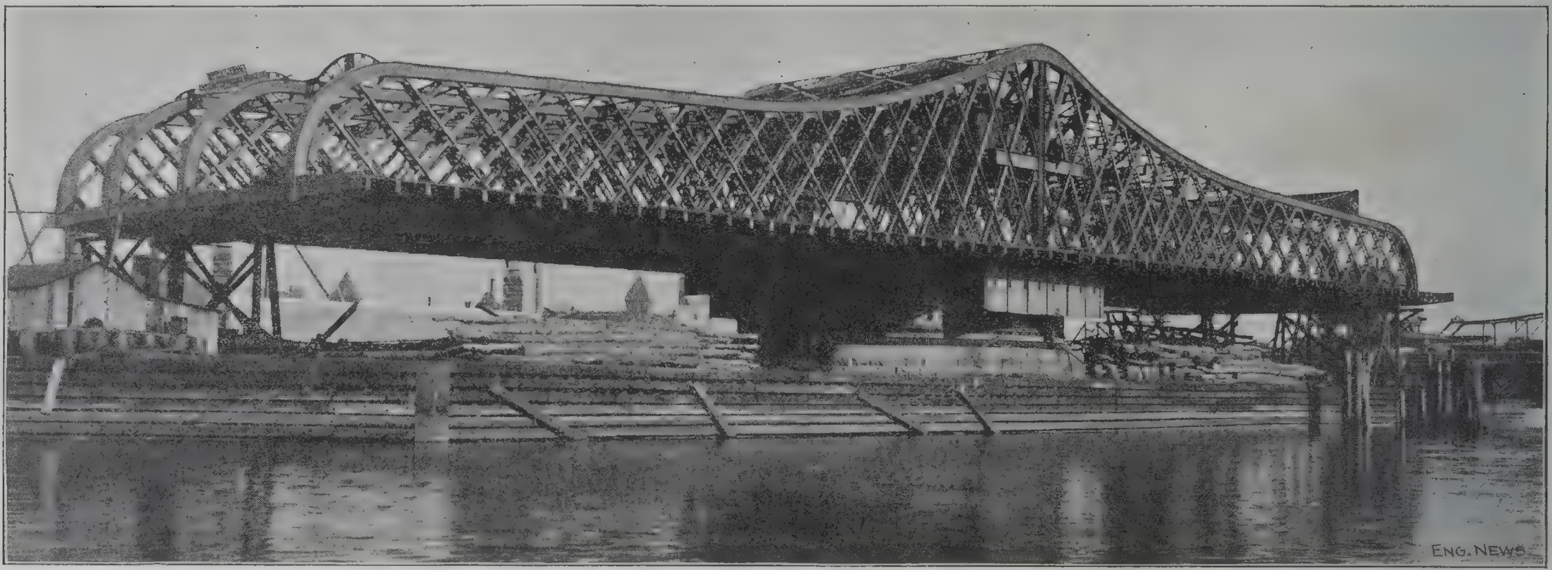
WOODEN PAVEMENTS seem to have little connection with politics, other than in the contract stage of their existence; but the authorities of Chicago, through the Chief of Police, have forbidden the use of the wooden blocks for making election bonfires. Boys have been caught tearing up the blocks on Jackson Boulevard and storing them away for this purpose.

BRICK PAVING FOR COUNTRY ROADS is being tried near Monmouth, Ill. About 3,000 ft. of brick pavement have been laid in Monmouth township (Warren county), there being a single course of brick laid on 6 ins. of sand, while a strip of 30 ins. of broken stone paving is laid on each side of the brick. The cost is said to be less than $5,000 per mile.

THE THIRD AVE. DRAWBRIDGE OVER THE HARLEM RIVER; NEW YORK CITY.

We illustrate herewith the drawspan for the new Third Ave. bridge over the Harlem River, New York city, which is now completed, and will be opened to traffic as soon as the approach spans are finished. This is one of the largest and heaviest drawbridges ever built, and it is notable not only for its size, but for the attempt which has been made to improve its appearance. While the truss is of the general form which has become a standard for swing spans of this class in America, curved outlines have been adopted for the top chord in place of the angular outline which such a truss usually presents, and the top chord has been emphasized in the construction.

There may be some things in the field of engineering construction which are more awkwardly ugly than the ordinary swing span truss as usually constructed, but we do not now recall what they are. The attempt to remedy this by the introduction of curved outlines which has been made in the present case is a most interesting experiment, and opinions will doubtless differ as to its success. We are inclined to believe that a more radical departure must be made from conventional forms if the swing span is to be made a thing of beauty.



DRAWBRIDGE OVER THE HARLEM RIVER AT THIRD AVE., NEW YORK CITY.
Thomas C. Clarke, M. Am. Soc. C. E., Engineer. Phœnix Bridge Co., Builders.

As an engineering structure the bridge is especially notable for its use of multiple-intersection lattice trusses in a structure of such magnitude. These, with the curved top chord, have made necessary great care and accuracy in the shop and field work.

The span is 300 ft. long and 87 ft. 6 ins. wide over all. The Act of Congress authorizing the rebuilding of the Third Ave. bridge, requires a clear headway of 24 ft. above high water. The limited space available for approaches on the south side of the river made it necessary to design the draw with a very thin floor, not over 20 ins. deep, in order to keep the approach grades down to 3%. This made it necessary to place the trusses near together, and the bridge is therefore built with four trusses, dividing the floor into two carriage roadways and a roadway for a double track electric railway, the latter being between the middle trusses. The three roadways are each 20 ft. wide, and two sidewalks 9 ft. wide are carried on cantilever brackets outside the trusses. The depth of the trusses is about 38 ft. at the center and 18 ft. at the ends. The floor system is of buckle plates, covered with concrete and an asphalt pavement for roadways and sidewalks. The weight of the draw is 2,500 tons, and this is carried on a turntable of 60 ft. diameter, which is said to be the largest ever built, that of the 400-ft. four-track drawbridge carrying the New York Central R. R. across the Harlem River being 54 ft. diameter. There are 80 wheels, 24 ins. diameter and 12 ins. wide, running on a track 60 ft. in diameter. The bridge can be turned easily by hand power.

The traffic over the bridge and on the river is very considerable, being approximately equal to that of the Chicago River and the main bridges across it, and this traffic is rapidly increasing. The traffic over the temporary drawbridge at Third Ave., during the 24 hours between 12 p. m., July 9, and 12 p. m., July 10, included 4,996 vehicles, and the draw was opened 60 times during that period, the aggregate time of opening being five hours. The traffic on the Harlem River amounted to 5,910,376 tons in 1893, while foreign shipping from the port of New York amounted to 7,000,000 tons in the same year.

In view of this very heavy traffic it was therefore important to devise such machinery for operating as would swing the bridge quickly and would reduce to the lowest degree the liability to failure. The problem to be considered was the best method of swinging a bridge span weighing 2,500 tons through a quarter of a circle in two minutes, several times a day. This work can be done by a 50-HP. engine but in order to prevent closing the bridge for repairs or minor accidents, a duplicate plant is fitted, consisting of two 60-HP. boilers, and two double cylinder (7 × 10 ins.), inclined, oscillating engines, either of which can operate the bridge at half speed. The boilers also supply steam for the end locking gear, and for a 35-HP. dynamo for lighting purposes. The machinery is placed in a powerhouse between the trusses. In preparing to open the bridge, the engineman first signals the gatemen, who close the gates on the outer end of the fixed approach spans. He then simultaneously withdraws the central locking bolts, runs up the eight supporting nuts and eight hydraulic rams under the ends of the four trusses, and also raises the ten aprons (four for sidewalks, four for roadways, and two for electric railway) which cover the space between the draw and the fixed spans, while at the same time the rail connections of the electric railway tracks are also raised. These operations are performed simultaneously in about 10 to 12 seconds. The time occupied in swinging the span is such that the whole time occupied will not exceed two minutes for a full opening, and two minutes more for closing and locking the bridge.

There are two 117-ft. plate girder deck approach spans, one at each end of the draw, and these have a 50-ft. roadway paved with granite, and two 12-ft. sidewalks paved with limestone flags. Beyond these are masonry approach viaducts, that on the north side being in line with the bridge, while at the south end the approaches curve away in either direction, almost at right angles to the bridge. The north approach is 60 ft. wide, and the two south approaches are 35 ft. wide. These approaches have no sidewalks, the sidewalks of the bridge proper being reached by two stairways 12 ft. wide. A movement is on foot to have another approach from the Southern Boulevard, on the north side, and to extend one of the curved approaches on the south side to the west of Third Ave. All the stone work is rock-faced, except the cut granite balustrades, railings and curbs.

The detail bids for this entire structure were given in full in our issue of Sept. 7, 1893. The total cost of the bridge, including land, will be from $2,000,000 to $2,500,000.

The bridge was designed by Mr. Thomas C. Clarke, M. Am. Soc. C. E., and the machinery was also built under his specifications and direction. Mr. Geo. W. Birdsall is engineer in chief of the whole work by virtue of his position as Chief Engineer of the Department of Public Works. The general contractor was Mr. Isaac A. Hopper, of New York. The drawspan was built by the Phoenix Bridge Co., of Phoenixville, Pa., of which Mr. John Sterling Deams, M. Am. Soc. C. E., is Chief Engineer. The machinery was built by Joseph Edwards & Co., of New York city.

NOTES OF A TRANSCONTINENTAL TRIP.

IV.

The Great Salt Lake.

On July 12 I took a trip to this remarkable lake, which is about 15 miles from Salt Lake City, and has two pleasure and outing resorts reached by rail. Garfield Beach is reached by a branch of the Union Pacific Ry., and Saltair Beach (which was the place visited) is reached by the Saltair Ry. (a branch of the Rio Grande Western Ry.). This latter line has engines built by the Rhode Island Locomotive Works, of Providence, R. I., and they are painted in an unusually gaudy style, with brilliant red wheels and a liberal allowance of gold leaf and varnish. The first car of the train is a closed combination baggage and smoking car, the other cars are open-sided excursion cars with 20 transverse seats, resembling in style the cars of the Coney Island lines, so familiar to New York people. The train lands its passengers at the entrance of the great pavilion shown in Engineering News, Nov. 9, 1893, from each side of which extends a curved trestle with rows of dressing rooms for bathers. The water of the lake is remarkably clear, and the bottom is of fine sand as soft as a velvet carpet. It was also pleasantly warm and afforded a most enjoyable bath. The water has a specific gravity of 1.107 and contains 17 to 27% of saline contents (varying at different parts of the lake.) The bulk of the saline contents is common salt. The Dead Sea has a specific gravity of 1.116 and contains about 24% of saline contents, while ordinary sea-water has a specific gravity of 1.026, and contains 3 to 5% of saline contents. The lake is about 80 miles long and 30 to 50 miles wide, with an average depth of 20 ft. and a maximum depth of about 80 ft. It receives the Jordan, Weber and Bear Rivers, but has no outlet. There are two large islands, 12 and 16 miles long, with hills as high as 3,000 ft., and having good fresh water springs; besides these there are a number of smaller islands. On the south side are the mountains, while dry desert and salt marshes form the south and west sides, and irrigable lands are on the east side. The old water line is plainly visible on the rocky sides of the mountains.

Salt Lake City to San Francisco (So. Pacific Ry.).

I left Salt Lake City on the Pacific mail train of the Rio Grande Western Ry., July 13. The line follows mainly the course of the lake shore to Ogden, 37 miles, where the Rio Grande Western Ry. terminates by a junction with the Union Pacific Ry. There is a handsome station here, built beside the tracks and having no trainshed or platform sheds. The through cars for this latter line are here attached to the Overland Limited Express which runs over the Chicago & Northwestern Ry. and Union Pacific Ry. to Ogden, and thence over the old Central Pacific Ry. (now the Central Pacific Division of the Southern Pacific Ry.) to San Francisco. This train, on July 13, was made up of seven cars; a fast freight car, baggage and mail car, day car, tourist sleeping car, dining car and two sleeping cars. It was hauled by a ten-wheel engine, built by the Cooke Locomotive Works, of Paterson, N. J., one peculiar detail of which was a step attached to the crosshead, evidently to give the cleaners access to the running board without climbing up on the front end. On the Sacramento Division, running between Sacramento and Truckee, are some immense twelve-wheel engines with cylinders 22 × 26 ins., and weighing 173,000 lbs., with 145,000 lbs. on the eight driving wheels. These engines are reported by Mr. H. J. Small, Superintendent of Motive Power, to be giving remarkably good service on the heavy mountain grades over the Sierras.

Near the track, at Sacramento, were seen the works of Schaw, Ingram, Batcher & Co., manufacturers of riveted sheet, steel and iron pipe for mining, irrigation and power purposes.

Southern Pacific Ry. (Central Pacific Division).

The Central Pacific Ry. was one of the two great lines whose construction was assisted by the United States government in order to secure a transcontinental railway line. The total amount of subsidy issued to the Central Pacific Ry. was $27,855,680, and about 12,000,000 acres of land. The line was to extend from San Jose to Ogden. Work was commenced at Sacramento in February, 1863, and the connection with the Union Pacific Ry. was made on May 10, 1869. The communication with San Francisco was at first by steamer, until the Western Pacific Ry. was opened from Sacramento, and this was later superseded by the California Pacific Ry., which has a route 60 miles shorter, but includes a ferry crossing of the Carquinez Strait. The Central Pacific Ry. is now leased to the Southern Pacific Ry. for 99 years from April, 1885.

On leaving Ogden the railway at once begins to ascend from the level of the Jordan Valley, the grades being pretty heavy in places and combined with sharp curves. The valley here is composed of salt marshes and desert land, and high upon the hills is plainly visible the water line of the former level of the lake. For several hours the dark blue lake and its mountain islands are present to the view; in fact as far as Monument, 77 miles from Ogden. For many miles one sees on the south side of the line evidences of a partly graded roadbed, with cuts and fills, the grade being usually below that of the existing line, but running out into the latter at Promontory, Corinne, etc. This is part of the line built by the Union Pacific Ry. when the transcontinental line was under construction, and the point of junction of the Union Pacific Ry. (from the Missouri River) and the Central Pacific Ry. (from the Pacific Coast) had not been decided upon. Both companies built as fast as possible in order to gain the subsidies for length of line, and as many men were put on as could work without getting in each other's way. The graded lines overlapped for nearly 200 miles, but the actual meeting of the tracks was made at Promontory, on May 10, 1869. Ogden was afterwards settled upon as the junction point. At Kelton, 92 miles, is the water supply station for the westbound trains, which here strike across the northern edge of the Great American Desert for a distance of nearly 100 miles, the line being on an ascending grade and reaching an elevation of 5,975 ft. at Toano, on the western border of the desert. The general appearance of the desert is similar to that of the Utah Desert, already described, being a sand with sufficient loam to form a thin, flat scale like the cracked mud bottom of a dry pond, and to form a thin, slimy mud when wet by the occasional furious rainstorms, which are preceded by wind and sand storms. The train passed through one of these storms, the blinding sand being followed by a drenching rain, which effected a welcome cooling of the atmosphere.

From the desert the line ascends the Cedar Pass, climbing the Divide between the desert and the Humboldt Valley. Here the snow sheds and snow fences begin to appear, and the summit is reached at Moors, 6,167 ft. above sea level. Beyond this there is an almost continuing descent to Browns, 610 miles, the elevation of which is 3,929 ft. About 140 miles of this distance is across the desolate Nevada Desert, which, however, this train crosses at night. The speed is considerable at times, 40 to 50 miles per hour, but though the track is fairly easy riding for the Pullman cars, it was the least easy of any thus far encountered. Reno, 4,497 ft. elevation, is the junction for Carson City and Virginia City, in the great silver and gold mining district of which the Comstock mines are the most celebrated. Here begins the ascent of the Sierra Nevada, amid the scenery of pine-clad slopes and peaks which are characteristic of this region and which are a great relief after the sand and dust and glare of the Utah, American and Nevada deserts. For many miles the line follows the rushing and tumbling clear Truckee River, and, rising from it are seen the long, steep chutes of plank, down which the logs are sent from the hill tops to the river. Unfortunately, the snowsheds begin at Truckee and continue almost without a break for 40 miles, so that, as there is no outside line for summer traffic (as on the Canadian Pacific Ry.) much of the view is lost. Glimpses of snow patches are seen through the loopholes, however The station at Summit (elevation, 7,017 ft.) is in the snow shed, and at intervals the sheds are wide enough for a side track for passing trains, or for the water train for protection from fire. In view of the stifling fumes and gases from the engines in this 40 miles of tunnel, which are very trying to the lungs, it would seem as though in summer some of the roof boards should be removed for ventilation, which is not sufficiently provided for by the gaps between the boards forming the walls. This removal of boards is indeed carried out to some extent, but not enough to ameliorate the certain inconvenience and possible dangers arising from inhaling these fumes. From Summit the train goes coasting down the Pacific slope of the range at high speed, amid magnificent scenery, the descent being almost continuous from Summit (7,017 ft.) to Sacramento (30 ft. above sea level). The distance is 105 miles, and is made in five hours. A few miles east of Sacramento is the junction with the Southern Pacific Ry.'s main transcontinental line (through southern California and Texas), and its line north to Portland, Ore.

PIER AND TURNTABLE FOR THIRD AVE. DRAWBRIDGE.

The track is laid mainly with 75-lb. rails, having square suspended joints with 24-in. splice bars and pin bolts. Servis tie-plates are very extensively used, many of these being four-flanged plates with four spike holes for double spiking on curves. Redwood ties are used, and some old ones in the Sacramento station appeared to be in very good condition. Across the desert the telegraph poles are square sawed posts, with the insulators attached to the underside of the crossarm. The train of eight cars was hauled by two ten-wheel engines, and it was noted that some of the road engines have a hose reel and fire hose on the top of the rear end of the tender tank, while some of the switch engines have also a fire pump mounted on the boiler. The station at Sacramento is worthy of comment in that it is one of the few large stations provided with a trainshed.

The train now passes through the fertile Sacramento valley, with its extensive fields of grain dotted with numerous groups of fine oak trees. West of the city the line passes over flat swampy grass lands (the "tules"), over which thousands of birds are flying, and then again across more rich agricultural country with quantities of fine trees, the bright fresh green of which is most refreshing to the eyes after days of rocky scenery, desolate hills, barren desert, or even the dark pines of the Sierra Nevada.

At Benicia the railway is cut by the Carquinez Strait, an arm of San Francisco Bay, across which the whole train is ferried on the transfer steamer "Solano." At Port Costa the train again runs ashore, and continues its trip to Oakland, running out upon a pile and rock-filled pier nearly two miles long, in the bay. At the end of the pier is a trainshed and ferry house building 1,050 ft. long over all. The trainshed has a central portion 120 ft. wide and 60 ft. high, and two side portions 60 ft. wide and 40 ft. high, these latter portions being used for the suburban traffic. At the end of the central part of the trainshed is the headhouse building, containing a waiting room 120 × 120 ft., restaurant, offices, etc., and from the waiting room there is access to the upper deck of the large sidewheel ferry steamers running between Oakland and San Francisco.

Railway Ferry Steamer "Solano;" Southern Pacific Ry.

This is the largest car ferry steamer ever built. It plies between Benicia and Port Costa, across the Carquinez Strait, 12 miles from San Francisco, the total length of trip being about two miles and the time less than ten minutes from stop to start of train. The vessel was designed in 1884 by Mr. Arthur Brown, while Superintendent of Bridges and Buildings of the Central Pacific Ry., and it was required that it should have capacity for the longest freight trains on the line. Some idea of its size may be gathered when it is stated that the deck is 424 ft. long and 116 ft. wide, with four tracks having a capacity for 48 freight cars or 24 passenger cars, with locomotives. The hull is of wood, stiffened by four longitudinal Pratt trusses under the deck. It is divided into 12 compartments, and contains the quarters for the officers and crew. There are two vertical engines with walking beams, both placed on the center line of the hull, and each driving one of the side wheels, the shafts being 16 ft. apart c. to c. The engines occupy a superstructure in the middle of the vessel, while the four batteries of boilers (fore and aft of each paddlebox) are in the superstructures erected on the guards, or the overhanging portions of the decks. There are four smokestacks. The steering is effected by four balanced rudders, 11½ × 5½ ft. each, at each end of the boat, the set of rudders at the bow (in either direction) being fixed. The four rudders are coupled together and operated by hydraulic machinery, which, as well as the hand steering gear, is operated from either of the two large pilot houses on the end bridges of the vessel. The engines were built by Harlan & Hollingsworth, of Wilmington, Del. By means of the large rudders and the independent engine to each wheel this great craft can be easily handled in the current, which runs at the rate of eight miles per hour. At either end of the trip the boat runs into a slip formed by guard piles, while an apron 100 ft. long, having five combination bowstring trusses, is adjusted by hydraulic power to fit the level of the deck, being latched to the boat. This apron has four tracks. A full description of this interesting vessel with illustrations may be found in a paper on "The Railway Ferry Steamer 'Solano,'" by Mr. Robert L. Harris, M. Am. Soc. C. E., in the "Transactions of the American Society of Civil Engineers." The leading dimensions of the vessel are as follows:

Length on deck	424 ft. 0 ins.
Length between perpendiculars	406 " 0 "
Beam of hull	64 " 0 "
Width of deck, over guards	116 " 0 "
Draft, light	5 " 0 "
Draft, loaded	6 " 6 "
Height at centre	18 " 5 "
Height at ends	15 " 10 "
Camber of deck	2 " 4 "
Tonnage, registered	3,541 tons
Engines (2)	2,000 HP.
Cylinders (1 to each engine)	5 × 11 ft.
Boilers, number	8
" length	28 ft. 0 ins.
" diameter	7 " 0 "
Tubes, number	143
" diameter	4 ins.
" length	16 ft. 0 ins.
Heating surface, total	19,640 sq. ft.
Grate area, total	288 "
Wheels, diameter	30 ft. 0 ins.
" number of floats	24
" size of floats	17 × 2½ ft.
Apron at slip, size	100 × 44½ ft.
" weight	150 tons

STREET RAILWAY TRUCKS.*

By John N. Akarman.

The term truck, in this case, means the separate framework for holding the running gear of an electric car; namely, the wheels, springs, brakes, motors, etc. When motors were first placed upon street cars, it was believed that there was no necessity for special construction, or any marked departure from the prevailing horse-car practice. The idea of a separate truck was first conceived about 1885, but it was not until the latter part of 1887 that, in its concrete form, it was put into operation.

The first truck consisted of a continuous upper chord made of bar iron in the form of a rectangle. Its purpose was to support the car body, the sills of which rested on its frame. The sides of this upper chord were re-enforced by heavy oak sub-sills to which the chord and the pedestals were both firmly bolted. This form of frame kept the body square and took many of the strains on itself; but it has been abandoned, and in abandoning it and using separate bars, I think we have been drifting away from the best practice, for it had a very important advantage in preserving the squareness of the body and truck. In addition to this upper chord, there was a bar extending around the truck to which the bottom of the boxes were fastened.

Springs over the axle boxes were unsatisfactory, from their stiffness in the limited space available, but by widening the box at the bottom, or adding ears so as to form spring seats, it was found possible to give each box two springs, one on each side, and of ample diameter and length so that they would carry the load with ease and have sufficient motion. Thus placed, they had the advantage of carrying the box perfectly steady, preventing entirely the rocking and unsteady motion. It was soon found that brakes upon electric cars were a very much more important feature than they had been upon horse cars. The brakes were first suspended from the sills of the car, and the sinking of the car body under a load left the shoe so far from the wheels that in applying the brakes, the slack of the chains was increased and could not be taken up without considerable delay. Another difficulty was the longitudinal rocking or pitching of the car body, which is not only excessively unpleasant to passengers, but very destructive to the trucks, motors and track. The lengthening of the wheelbase as a remedy for this did not prove to be of much advantage. The first success as a remedy appears to have been made by extending the sides of the truck, and mounting elliptic or semi-elliptic springs on the ends of the extension pieces. This latter method with the semi-elliptic spring has been the most successful preventative tried.

The composite frame demonstrated its imperfections with the locomotive years ago, and has been found even less successful as a form of construction for a motor truck. This is due in a measure to the fact that on account of cost, first class workmanship is out of the question in building a low-priced truck. The truck frame consisting of a solid forged bar, of course, gives greater strength to resist strains thrown upon it from all directions than any form of a built up truss. I believe the ideal four-wheel truck for electric cars at the present time is the one having the fewest number of parts in its construction, in which the side pieces of the main frame are single forged bars connected across the ends by bars either bolted or welded on so as to make the frame one continuous piece. This frame is carried by springs from the journal boxes, and itself carries an upper chord, likewise, a continuous rectangular piece which has suitable seats for the springs. This upper chord is recessed to take the bolts and spring seats, leaving its upper surface flush. The ends are carried by the half elliptic springs, while the spirals are placed at the journal boxes. The brake should be hung by links. Diagonal bracing is out of the question in the construction of a truck on account of the motors, but the diagonal strength is usually increased by the introduction of transoms. Such a frame carries its machinery with a certainty of its always being in alinement with the driving axle, and as it is spring carried, it is as light on the rails as any form of single truck, while the longitudinal oscillation is prevented by the peculiar effect of the half elliptic springs which do not respond readily to rhythmic motion.

At its best, however, the four-wheel truck is an uncomfortable carriage and a track destroyer, and should only be used where cars are run at comparatively slow speed, and with moderate length of car bodies. Where it is desirable to run at higher rate of speed in suburban service, the damage to the track becomes so great that it should preclude its use. The only alternative is to use a double truck car with swivel or pivoted trucks, and this is easy on curves to a degree that would hardly be credited by those who have only been familiar with four-wheeled cars. The greater number of wheels not only reduces the weight on each wheel, but correspondingly reduces the blow when the wheels strike a joint or a low place in the track. This is still further diminished by equalizing the springs, so that each wheel in rising or falling in passing over any imperfection in track elevates the load a distance but half as great as its own rise. Oscillation, whether longitudinal or transverse, can be completely done away with by the use of double trucks.

The conditions, however, are not altogether in favor of the pivotal truck. As for instance, if all the weight is used for adhesion it is twice as expensive in use as a four-wheel truck. If two motors are used, it only has 50% of the propelling power. In its ordinary form, it makes a wide body necessary and hence is out of place in narrow streets or places where traffic is very heavy. It also has the disadvantage of putting the body at a greater height than is necessary with four wheels.

The "maximum traction" truck may be defined as a pivotal truck in which the load is eccentrically placed in relation to the four wheels of each truck. Two of them receive only a sufficient amount of weight (20%) to keep them upon the track, while the others take the remainder of the load. It was found that it was not necessary to have the wheels of equal size. The large pair used as driving wheels, being very near the pivotal point, have a comparatively small amount of swing, and can be allowed to rise within the floor timbers, while the small wheels moving through a much greater arc easily clear the sills. By this form of construction, the body can not only be brought down, but the frame can be made as narrow as in the ordinary street car body. This form of truck enables the car to be utilized for both street and suburban service. It is also found in its latest form utilized under long open cars. It carries the motors in a satisfactory manner, guides readily and answers nearly all the requirements of the service.

As inter-urban service is almost equivalent to service on steam railways; for this service, pivotal trucks having regular swing beams, equalizers, elliptic springs, and all the parts of the steam railway truck are entirely satisfactory. They take curves easily at a high rate of speed. But for trucks which must run not only on trams, but on T rails, some form of the maximum traction truck will give, all things considered, the best service.

An important question to be considered in connection with the adoption of single and double trucks, is whether the punishment to the track by single trucks is not so great as to more than make up for the cost of putting in and running double trucks under all cars, whether short or long.

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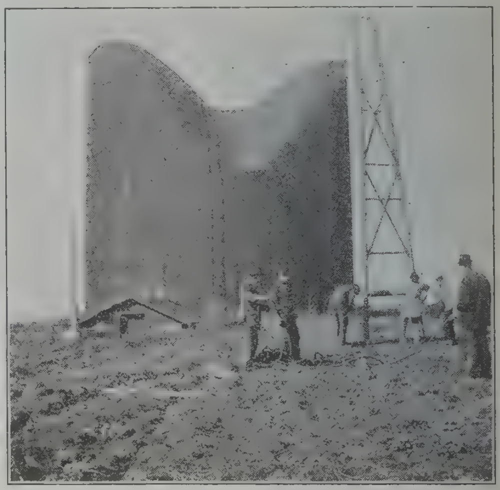
*Abstract of a paper presented at the Annual Convention of the American Street Railway Association at St. Louis.

A WIND-INDENTED STAND-PIPE AT CORTLAND, N. Y.

A partial wreck of a stand-pipe occurred at Cortland, N. Y., on Sept. 29, as shown by the accompanying reproduction of a photograph of the pipe after the accident. The accident seems to point to the necessity, at least in the case of so large a structure, of ample top stiffening.

The stand-pipe is on a hill about 150 ft. high. It is of ½-in. iron for the lower five sheets and ⅜-in. for the remaining distance to the top.

The accident occurred during the night of Sept. 29. A high wind wrecked many roofs in the village of Cortland and blew at an estimated velocity of 80 miles an hour for two hours. The recording gage showed 22 ft. of water in the pipe at the time of the accident, the water extending 2 ft. above the bottom of the bent portion.



View of Partially Wrecked Stand-Pipe; Cortland, N. Y.

Repairs were made by pulling the top back into place, attaching a 4 × 4-in. angle around the top, patching the hole at the break and guying the top by four 1¼-in. steel cables anchored to stone posts.

We are indebted to Mr. Wm. B. Landreth, M. Am. Soc. C. E., of Cortland, for the above information. The photograph from which the view was reproduced was kindly furnished Mr. Landreth by the Cortland Water-Works Co.

THE NEWTOWN CREEK BRIDGE COMPETITION.

(With inset.)

We present to our readers in this issue the designs submitted in the Newtown Creek bridge competition. The engineering problem presented for solution in this case is one of great interest, and one which is likely to come up very frequently for solution in the future. The various designs presented therefore are worth careful study.

Before describing the different designs, however, the principal facts in connection with this much discussed piece of engineering work may be set forth.

Newtown Creek is an arm of the East River which extends from a point about opposite 28th St., New York city, east and south a distance of nearly three miles. It is lined for a large part of its length with docks and wharves and manufacturing establishments, and in consequence a large traffic is continually passing in and out of it. The creek forms the boundary line between Brooklyn and Long Island City, and the Vernon Ave. crossing, only a quarter mile from the mouth of the creek, is the only means of direct communication between these two cities. The next crossing up the creek is on Greenpoint Ave., a mile further up the stream, and there is practically no means of reaching Long Island City

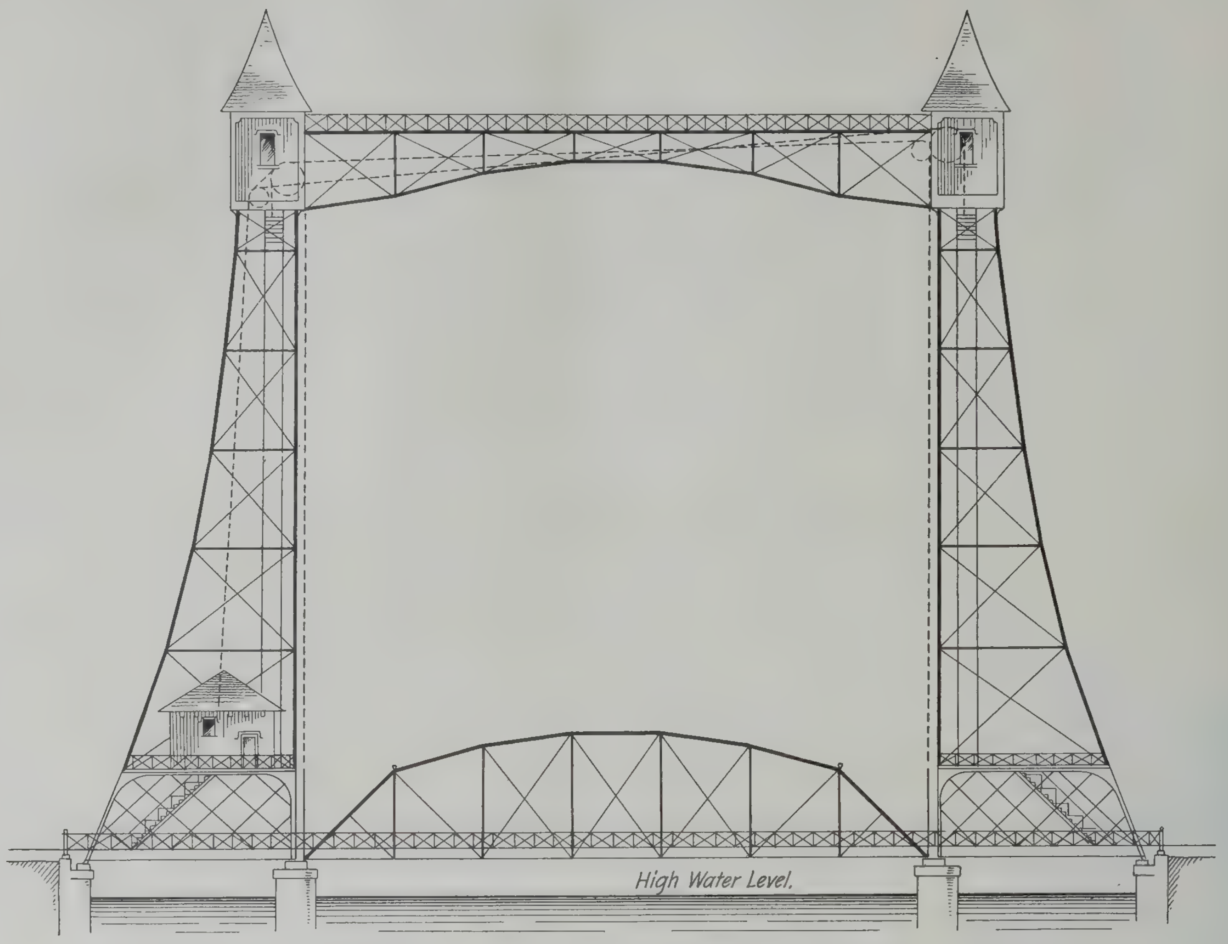


FIG. 5. DESIGN OF F. S. WILLIAMSON, M. AM. SOC. C. E. AND ALFRED LIEBMANN.

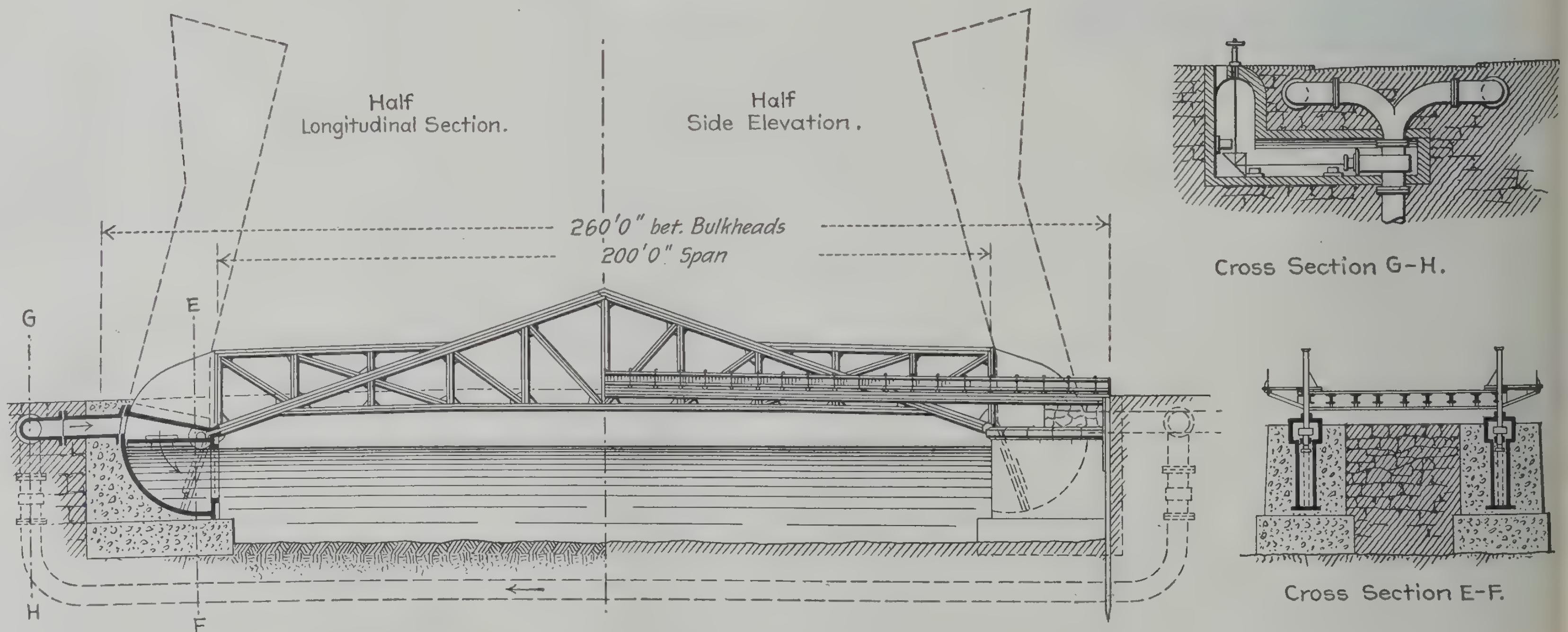
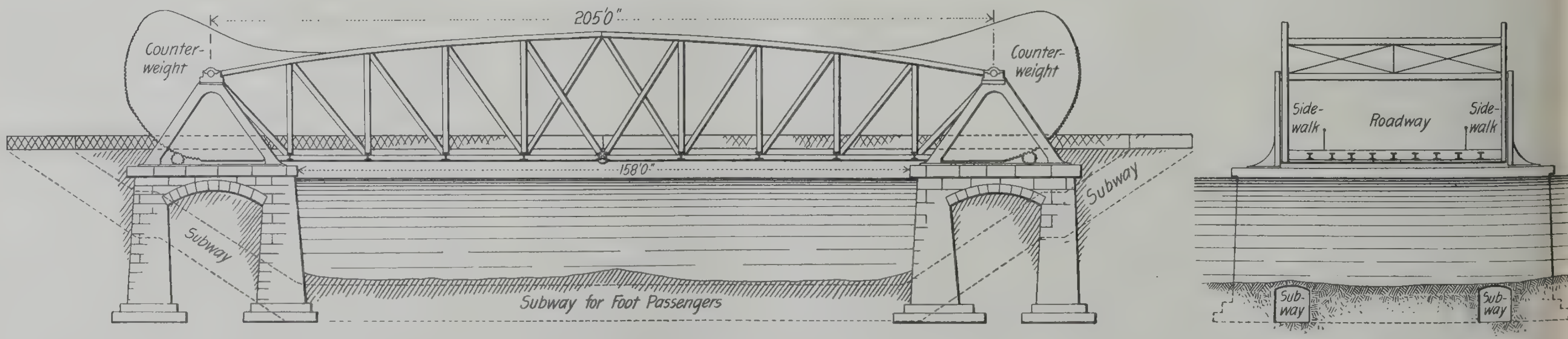


FIG. 6. DESIGN OF CHAS. STEINER.



Side Elevation.

Cross Section.

FIG. 4. DESIGN OF E. B. JENNINGS.

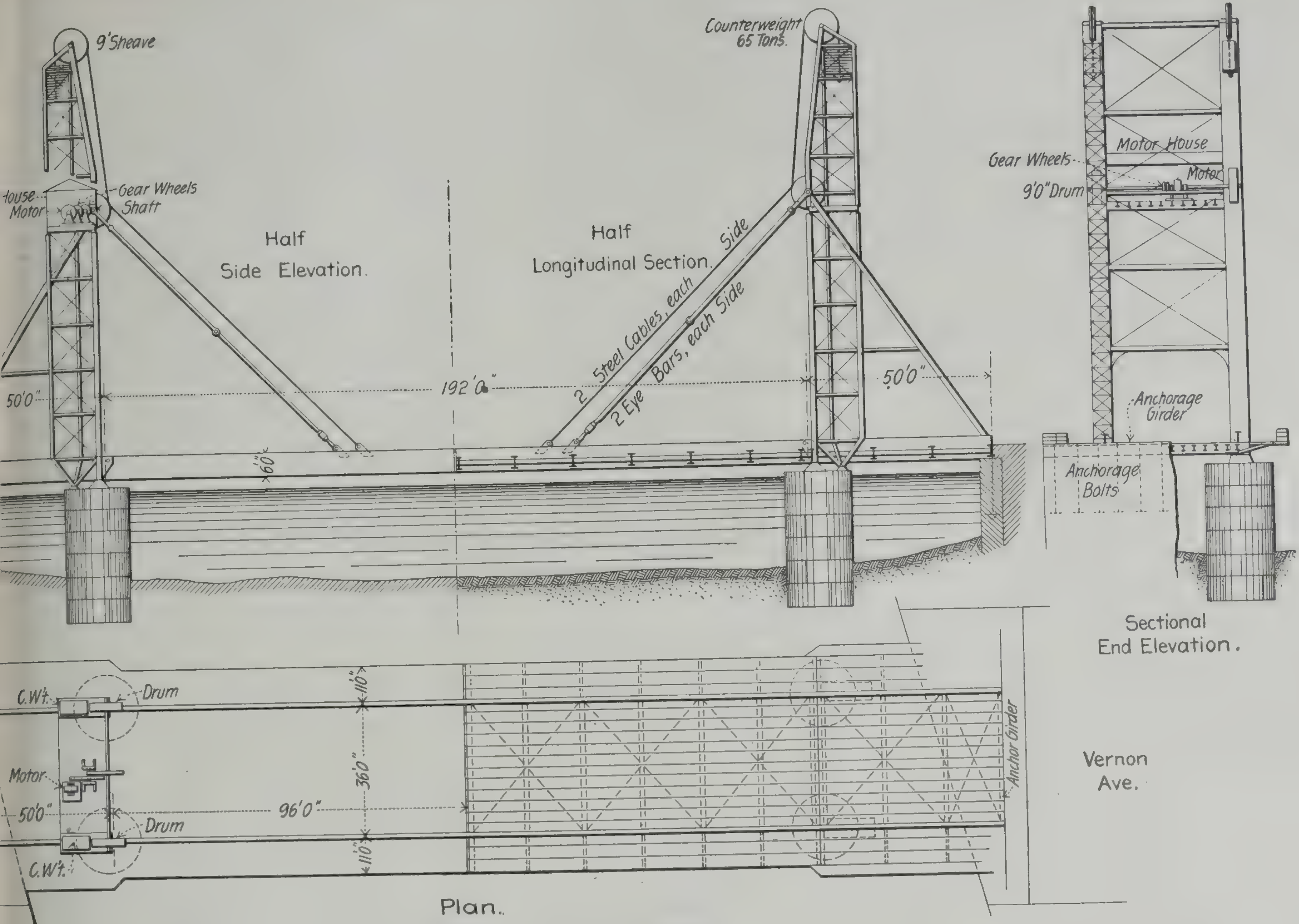
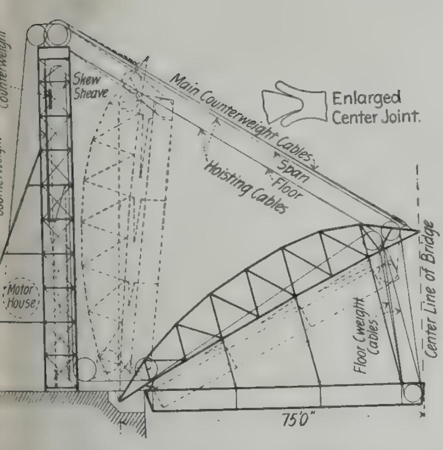


FIG. 3. DESIGN OF CHAS. E. BEDELL.



G. 2. DESIGN OF WM. H. BREITHAUPT,
M. AM. SOC. C. E.

DESIGNS FOR

VERNON AVE. DRAWBRIDGE

OVER NEWTOWN CREEK,

BROOKLYN,

N. Y.

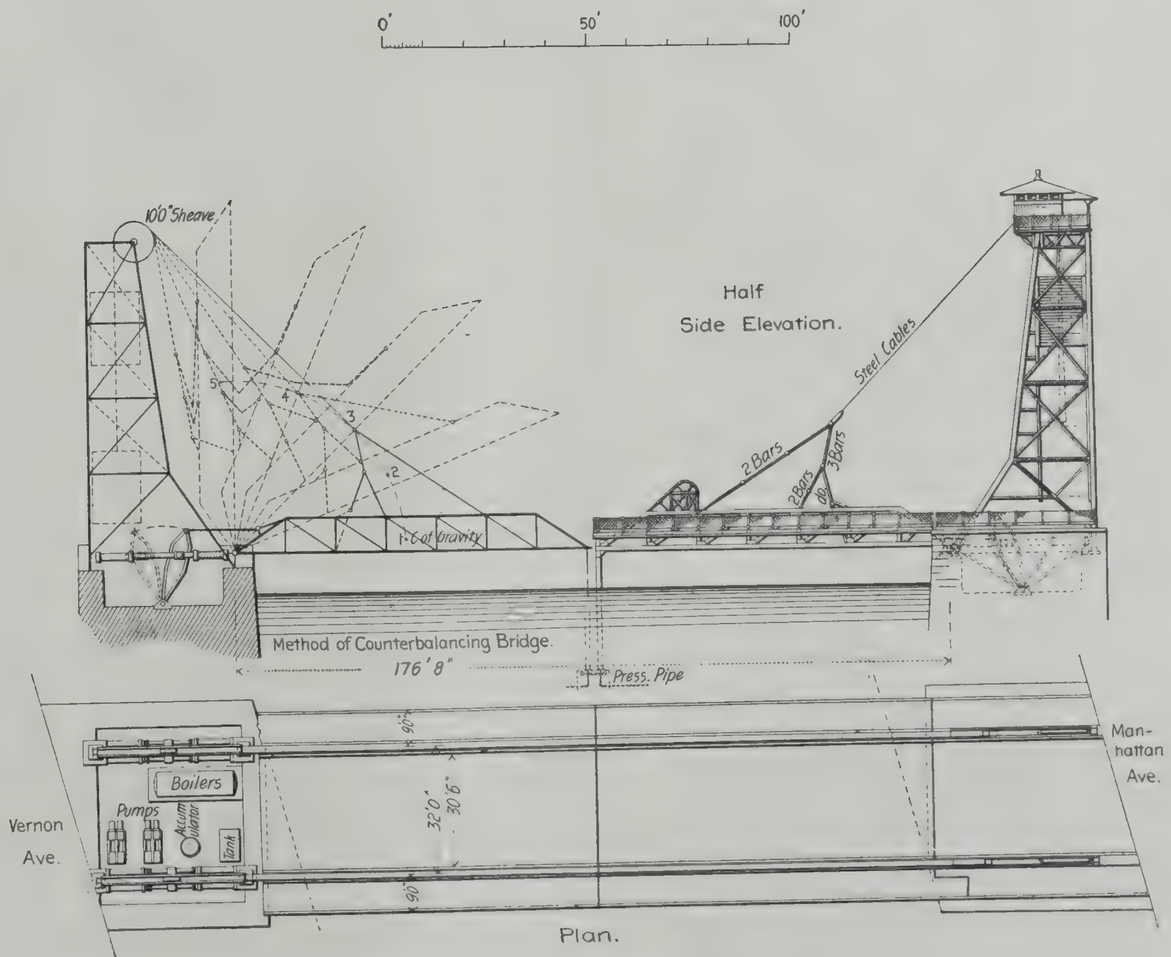


FIG. 1. DESIGN OF THOS. E. BROWN, JR., M. AM. SOC. C. E.

LIBR THE ILLIN
UNIV

from Brooklyn by this route except by a long detour.

For many years the old wooden bridge, operated by hand power, which has done duty at the Vernon Ave. crossing, has been the subject of severe criticism; and about two years ago, we believe, the U. S. Engineer Officer in charge of the district declared it an obstruction to navigation, and intimated that no center-pier draw-span would be permitted to replace it; some type of movable bridge must be chosen which would give an unobstructed channel the full width of the creek when the bridge was opened.

It may be remarked in passing that the provision of a new bridge at this point has been greatly complicated and without doubt delayed by the fact that Newtown Creek forms the boundary line between Kings County and Queens County, and the joint action of the Boards of Supervisors of the two counties was necessary.

After much discussion of various plans, it was decided to build a bridge similar to the Halsted St. lift bridge in Chicago, designed by Mr. J. A. L. Waddell, M. Am. Soc. C. E., and illustrated in Engineering News of April 19, 1894. The clear span was to be about 140 ft., and the total height of lift about 150 ft.

Bids for constructing the bridge were advertised for, and on July 29 seven proposals were opened. The contract was then awarded to the lowest bidder, the King Bridge Co., of Cleveland, O., at its bid of $418,000.

Subsequently the award of the contract was vetoed by the Supervisor-at-Large, on the ground that the contract price was excessive, being $100,000 more than the estimate made by the county engineer of Queens Co., Mr. John J. McLaughlin, M. Am. Soc. C. E.. Shortly after this, legislation took effect which abolished the organization of Kings county, as it had become coterminous with the city of Brooklyn. The Kings County Board of Supervisors thus ceased to exist and its powers were transferred to the Board of Aldermen of the city of Brooklyn. Joint action of this body and of the Queens County Board of Supervisors thus became necessary to any progress in the matter of the Newtown Creek bridge.

After several months' delay a new scheme was agreed upon, and in July of the present year engineers were invited to submit designs for a bridge on the Vernon Ave. site. A peculiar feature of this competition was that no prizes or compensation of any sort was offered.

Each engineer submitting plans was required to state their price, and was warned that no compensation would be given to any except the one whose designs might be approved and adopted, and he must agree in advance that the entire charge for all his work should not exceed the price submitted with his design. Further, the right to reject any and all designs was reserved.*

On July 23, the designs received by the committee were examined. It was found that eight competitors had submitted plans for a bridge; and one engineering firm which had examined the location and concluded that a tunnel was a preferable solution of the problem submitted a brief advocating that construction.

The designs submitted, with two exceptions, are shown upon our inset sheet. Following the date set for the receipt of designs, plans were also submitted by Mr. Albert H. Scherzer, of Chicago, for a structure similar to the rolling lift-bridge; designed and patented by the late Wm. Scherzer, and in use at Chicago by the Metropolitan Elevated R. R. at its crossing of the Chicago River, and by the City at its Van Buren St. crossing. As this type of bridge was illustrated in our issue of Feb. 21, 1895, and as the design was not presented during the time fixed by the committee, we do not include it on our inset sheet.

After the receipt of the designs, the committee visited Chicago and examined the various types of bridges in use there. As a final result of its investigations it first adopted a resolution approving the bascule type of structure as the most suitable for the conditions existing at the Newtown Creek crossing, and later adopted the plans submitted by Mr. Thos. E. Brown, Jr., M. Am. Soc. C. E., 38 Park Row, New York city.

Turning now to the drawings upon our inset sheet, it should be explained that we have redrawn all the designs to uniform scale and in uniform style from drawings and blue prints kindly furnished by the several competitors. Necessarily, most of our drawings show much less of the details of construction than was shown in some cases on the designs submitted to the committee; but we have endeavored in every case to show enough detail to make clear the important features of the design.

Fig. 1 shows the design submitted by Mr. Brown. It is a hinged-lift structure in two halves, supported by towers on each shore and operated by hydraulic power. More in detail the design is described by Mr. Brown, as follows:

"The bridge consists of two hinged spans 80 ft. 4 ins. long from center of hinge to center of river, or a total of 176 ft. 8 ins. between hinges, and two towers about 74 ft. high, surmounted by houses for the operators.

The outer ends of each span will rest on steel trestle bents, hinged to the lower chords of the trusses. These will rest on castings in a sub-pier at bottom of river. The trestle bents will rise with the bridge and fold parallel to the floor of the spans, leaving the full depth and 150 ft. width of stream clear of obstruction. This motion will be controlled by a positive automatic connection, independently of the weight of the bents.

Small hydraulic pressure pipes will be laid, as indicated, to the central sub-pier. Any silt drifting under the feet may be washed away by turning pressure on these pipes. The bents may be dispensed with if preferred, and the span supported by suspenders from the towers, as indicated on the plans.* This will increase the cost of the bridge.

Each span will be balanced by two cast-iron weights in steel frames running in guides in the frame work of the towers. These will be connected with the span by 12 1½-in. steel cables (six on each side), passing over two 10-ft. diameter steel riveted wheels, placed on top of the tower. The weights will be subdivided and the cables attached to them by equalizers with adjustable connections.

The cables will be connected to the spans by a system of links, so arranged that the counterweight, though constant, will balance the span in all positions, except near each end of the travel, where the position of the links is such as to cause the weight to act against the moving span and assist in bringing it to rest. This arrangement is shown by an explanatory diagram on the drawings.

On the ends of the spans are placed curved lattice buffers which will engage the cables should the spans pass the perpendicular line. These are so arranged that a wind pressure of over 30 lbs. per sq. ft. will not be sufficient to force spans against towers.

Each span will be operated by eight hydraulic rams, 12 ins. in diameter and about 8 ft. stroke, four for lifting and four for lowering. These will be supplied with pressure from a compound duplex pump. An additional duplex pump is provided to act as a relief for the compound pump and to increase the working pressure during high longitudinal winds. These will be automatically controlled by variable power hydraulic valves.

All hydraulic pipes, fittings and cylinders will be tested to 2,500 lbs. per sq. in., and will be so duplicated that the bridge will be capable of operation in the event of disabling of any two of either set of four rams or their connections. The rams are of sufficient size and strength to resist a longitudinal wind pressure of 30 lbs. per sq. ft. on the entire floor of the bridge. The arrangement of pumps is such that a range of hydraulic pressures may be obtained up to 1,200 lbs. per sq. in. Under average conditions the working pressure will be about 250 lbs. per sq. in. Mechanical automatic stops will be provided in connection with the operating valves, which will bring the bridge to rest gradually at the end of its travel. Hydraulic buffers will also be provided on the ends of the rams, for the same purpose, as an additional safeguard.

Hydraulic speed governors will be provided, by means of which the speed of the bridge will be controlled or limited independently of the operator. The operator may move the bridge as slowly as he may desire or stop it entirely at any point of its travel, but he cannot, nor can a puff of wind, increase the speed beyond the limit at which the governors are set.

The bridge may be operated in calm weather in 30 seconds and closed in the same length of time. Under average conditions the time would be about 45 seconds opening and 45 seconds in closing. The bridge may be operated directly by a man in the tower, or by signal bell to a man in the engine room, as may be preferred.

The plan includes suitable boiler and appurtenances, and the entire power apparatus is located in the foundations of the tower. If a supply of electric current is available, electric motors may be substituted for hydraulic rams and the boiler be dispensed with. We prefer a hydraulic plant for this class of work, considering it more reliable and certain in action, and less liable to derangement."

Fig. 2 shows a half-span of a structure designed by Mr. W. H. Breithaupt, M. Am. Soc. C. E, 71 Broadway, New York City. It is a three-hinged arch, made in halves, with the bridge floor suspended from it and hinged to it. The following is from the description submitted by Mr. Breithaupt with his design:

> The floor is in two parts and is hinged to the arch near its ends. The arch is made to part at the center point, and each half is arranged to revolve around its endpins. There are two towers, one at each end of the arch. Over the tops of the towers, and attached to the two halves of the arch at the center joint, are cables, by means of which the mid-stream ends of the floor and arch halves respectively are raised. The floor suspenders are stiffened pairs of eyebars, jointed at the center of their length so as to fold between the floor and the arch as the floor is raised. In opening the bridge the floor halves are first pulled up against the arch; then the arch parts, with the floor parts close against them,are raised to approach a vertical position against the towers. In many cases, such as to allow passage of single tugs or barges having no high projections, it will be necessary to raise the floor parts only, without disturbing the arch. When the bridge is open the roadway from either side is shut off by the bridge floor standing on end across it, and forming an effective barrier.
>
> There are two sets of counterweights, one for the floor, and a main set for the entire bridge. The floor counterweights are of constant counterbalance, consist of a single weight each, and operate, with the exception of a short-leverage pull afterwards, only in raising the floor against the arch. The main counterweights consist each of a chain of weights, suspended from the respective cables, and having its lower end attached to a fixed point. As the counterweight descends it gradually reverses and its weight is gradually and evenly, without shock of any kind, transferred to hang from the fixed point spoken of. This arrangement provides for uniform conuterbalance as the arch parts rise.
>
> The bridge is operated by means of electric motors, one in each tower, connected by a cable under water, and controlled from one switch by a single operator. The mechanism is so arranged that the two arms of the bridge move together and that one cannot get ahead of the other. The motors connect to the drum shafts by means of worm gearing, as an additional safeguard in regulating the movement of the bridge arms. The motive power may also be a steam engine in each tower, electrically controlled to operate synchronously. A hand winding arrangement is provided at each worm shaft, so that the bridge can be operated by hand power, in the very improbable case of this being necessary.
>
> The floor can be raised to the arch in less than 20 seconds and the full raising of the bridge can be done in 40 seconds. No locking of any kind is required, on closing, and therefore no time is taken up in this way.
>
> Forming the center joint of the arch, one arm has a convex end and the other a corresponding cavity with guide projections, which serve to bring the two arms to their proper bearings against each other. The surface of contact between the arms is, in vertical section, a little less than a vertical semi-circle, a slight revolution of one end about the other being provided for. This allows for expansion and contraction of the arch arms, without disarrangement of any part. To avoid shock on the coming together of the two arms, hydraulic buffers are interposed at the tops of the towers to check the main counterweights as they come to their upper limit of travel. Buffers are also placed at the points where the floor impinges against the arch, during the raising of the bridge.

Mr. Chas. E. Bedell, 156 Fifth Ave., New York city, submitted a design which is shown by Fig. 3. It is of the bascule type, and the outer ends of the two folding arms are supported by eye-bars from the towers. An important feature of the design is the support of the towers on cylindrical piers and the provision of a rear anchorage for the tower to a masonry abutment on the shore to take up the pull of the suspenders that carry the channel span. In order to vary the pull of the counterweight with the varying positions of the channel span, each counterweight will consist of a number of separate plates of cast-iron arranged to be supported on small brackets at intervals of about 2 ft. vertically in the height of the tower and to be picked up in succession as the counterweight ascends, or deposited as it descends. This is practically the same device that was used in the temporary drawbridge of the New York Central R. R. over the Harlem River.

---

*See Engineering News, July 9, 1896, pp. 24 and 26.

*By an error in our drafting department the dotted lines showing these suspenders were omitted from Mr. Brown's design.—Ed.

The bridge is to be operated preferably by a 50-HP. electric motor, in each tower, and 40 seconds is given as the time necessary to raise or lower the bridge. The dimensions proposed are a clear span of 150 ft.: lift-arms, 96 ft. each; fixed spans, 50 ft. each; height of towers, 112 ft. Travel of counterweight, 95 ft.; cross-section of counterweight well, 4 × 8 ft.

It will be seen that the eye-bar suspenders are attached to the channel spans at a point ⅓ of their length from the outer end and make an angle of 45° with the towers. They have a pin joint at the center permitting them to fold as the bridge is raised by the cable.

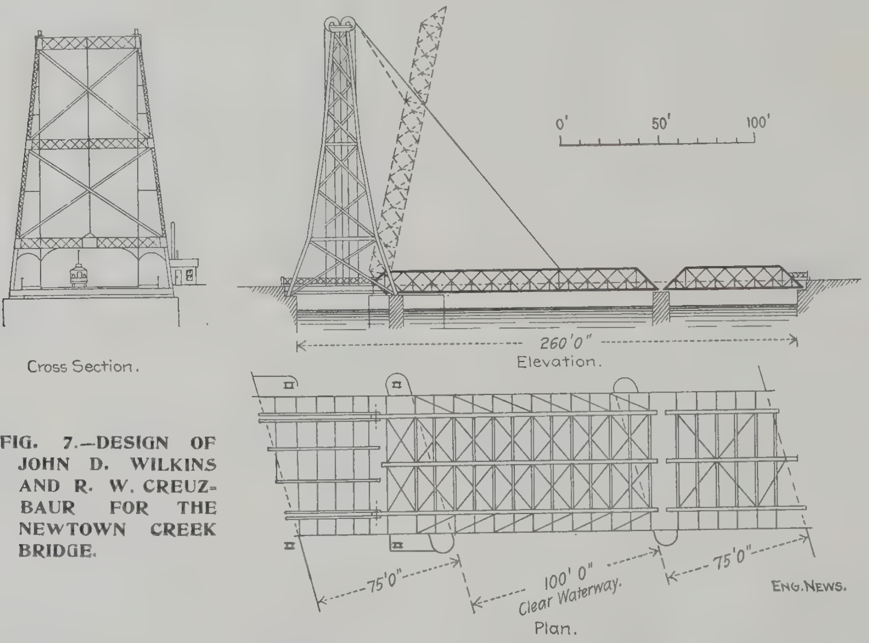


FIG. 7.—DESIGN OF JOHN D. WILKINS AND R. W. CREUZBAUR FOR THE NEWTOWN CREEK BRIDGE.

To operate the structure an attendant is required in the motor-house in each tower. Folding gates to close the sidewalks and roadway and operated from the motor-house are provided at each tower.

The design submitted by Mr. E. B. Jennings, 170 Florida St., Springfield, Mass., is shown in Fig. 4. It is also of the bascule type, but dispenses with towers, and a truss is used instead of a girder for the span. When the bridge is closed the top chords of the two halves simply butt against each other, but the bottom chord is made continuous by a pin joint. We quote as follows from the description furnished to us by Mr. Jennings:

> To open the bridge it is only necessary to withdraw this pin, when by means of suitable machinery at each end the bridge revolves vertically on the pivots and the channel is left entirely free for navigation.
>
> The ends are counterbalanced, and the gearing used may be similar to that of an ordinary horizontal swing bridge.
>
> At the center of the top chord there is a V-shaped projection at one end, and a corresponding depression at the other end serving to bring the bridge into proper position when closed. The eye-bars at the center of the bottom chord are placed an inch or two apart so that they may more easily come into place when the bridge is closed. The pin at the center of the bottom chord is made cone-shaped and the chord bars are bored to fit, thus allowing the pin to be more easily moved in and out.
>
> If the motive power is steam, the engine, boiler, etc., may be placed under the roadway, or electric motors may be used if preferred.
>
> Two subways are suggested to accommodate foot passengers while the bridge is open.

The design submitted by Messrs. F. S. Williamson, M. Am. Soc. C. E., and Alfred Liebmann, 50 Broadway, New York city, is for a lift bridge (Fig. 5), resembling in its general construction Mr. Waddell's Halsted St. lift bridge at Chicago. The chief difference is that these designers have curved the rear leg of the tower and have arranged to have the span raised and stopped at a level of about 30 ft. above low water to permit the passage of tugs, scows, etc., and still permit foot passengers (but not vehicles) to cross the bridge. Further, these designers propose to use gates to automatically close the roadway at each tower when the bridge is raised.

We have been favored by the designers with the following interesting discussion of the elements involved in the problem and the reasons for their selection of the design which they submitted:

> The Bridge Committee of Kings and Queens counties, having invited designs for this bridge at Vernon Ave., we commenced the study of the problem by at once visiting the site and seeing for ourselves the conditions we had to meet.
>
> We found in the first place that the majority of the people of Long Island City were in favor of a high level bridge, and that they had so publicly expressed themselves on more than one occasion. Also that this view of the case had been held and advocated by the "Brooklyn Eagle" for a long time past. The approach on the Long Island City site is crossed by no fewer than six tracks of the Long Island R. R., a most dangerous crossing, and it is not to be wondered at that the people using this bridge should advocate a raised approach thereto.
>
> We next found that the railway company was prepared to co-operate with the city in the building of a viaduct in connection with such a high level bridge, and moreover would surrender a portion of its yard for this purpose if required for a more gradual descent to the street level.
>
> The abolition of this dangerous grade crossing would be only in the line of the vast improvements going on in almost every large city of the country, at great cost to all concerned.
>
> The roadway of the bridge, if this plan were carried out, would cross the creek at such a height that all mastless vessels could pass under it, thus allowing the passage of seven-eighths of all the water traffic at this point. This is a matter not only affecting the owners of tugs and barges, and the shippers and manufacturers doing business along the banks of the creek, but the thousands of pedestrians and wagons crossing the bridge.
>
> The writers on one occasion stood at the entrance of the bridge for 15 minutes and in that time the bridge was opened no fewer than three times, and the gates at the railway crossing, not 300 ft. away, closed four times. The obstruction to street traffic was as serious as it was confusing, dozens of teams being hemmed in between the gates on the one hand and the open draw on the other. Now, if a bridge should be built which would allow seven-eighths of the water traffic uninterrupted passage, while permitting a free crossing for the thousands of pedestrians, a great part of the problem would be solved.
>
> It was feared. however, that the opposition of the property-owners would result in legal complications and long delays. The decision was therefore arrived at to abandon this part of the plan, owing to the urgent call for the new bridge at this point. Nevertheless the probability of this high level approach being called for at no very distant date, led us to believe that the bridge must be of such a character that it could be converted cheaply and expeditiously to meet this eventuality.
>
> Now that we were obliged by force of circumstances to give up the idea of a high level structure, the importance of having to close the bridge as seldom as possible to the very large number of foot passengers using the bridge, became evident. These passengers at certain times of the day are largely work people, going to or coming from their work, whose crossing should be obstructed as little as possible. This would be impossible if the bridge had to be lifted every few minutes for the passage of every tugboat or float.
>
> We think that our design offers a solution of the two important points herein enumerated; first, the inexpensive and ready manner in which the lift bridge can be changed to suit the future construction of a high level approach; and second, the importance of being able to raise the bridge to such a height as to admit of the passage of mastless vessels without interrupting the crossing of the large number of foot passengers.

The illustration on our inset sheet shows the construction which these engineers propose for the present. It will be evident that by merely placing column supports of proper height at the towers the bridge would become a high level structure whenever the necessary viaduct approaches may be built. The estimate of cost submitted by Messrs. Williamson & Liebmann was as follows:

Steel in superstructure, 1,290,000 lbs, at 4 cts...	$51,600
Lumber in floors, 60,000 ft. B. M., at $30.......	1,800
Operating machines, cables, weights, etc........	72,600
Substructure	74,000
Total	$200,000

A peculiar design, submitted by Mr. Chas. Steiner, 403 Bushwick Ave., Brooklyn, is shown in Fig. 6. It is a hinged lift span in two halves. Each half consists essentially of a principal compression member which is stiffened by trussing, as shown. When the bridge is closed these two compression members abut against each other and their thrust is transmitted to the abutments on each side. To raise and lower the leaves a segmental-shaped chamber is built on each abutment and a rectangular piston attached to and forming part of the bridge truss is moved to and from in this chamber by water, "at a head of 100 to 200 ft." Sketches were submitted, which we do not reproduce, showing a method of making this rectangular piston and the chamber in which it moves water tight, and "spray-guards of light plates protect waiting passengers from occasional escape of water."

Messrs. John D. Wilkins, 51 State St., Albany, N. Y., and R. W. Creuzbaur, Assoc. M. Am. Soc. C. E., submitted a design of which we received a drawing too late to include it on our inset sheet. It is, therefore, shown herewith (Fig. 7), while Fig. 8 shows a detail of the counterweighting system employed, which is the principal feature for which claims are made in this design. It will be seen by the drawing that the counterbalance, or a part of it, is in the form of a heavy chain, as in the design submitted by Mr. Breithaupt, but one end of this chain is attached to a cable passing over the pulley at the top of the tower instead of being attached to a fixed point as in Mr. Breithaupt's design. We quote as follows from the description submitted with the drawings:

> The movable part of the proposed bridge is a hinge bridge, firmly hinged at one end and lifted by means of steel cables to nearly a vertical position, to give a clear way for the passage of vessels.
>
> The bridge is designed with the Wilkins improved counter-balance, which has no loose parts, is noiseless in its operation and counterbalances the bridge with the greatest precision in any position it can take. Being so nicely balanced, it requires the least amount of power to operate the bridge, and on account of the steady motion of all the moving parts the bridge can be opened or closed with the greatest rapidity.
>
> A balanced-hinge bridge in motion requires a continually changing counterweight. In the original hinged bridge this change of counterweight was effected by releasing parts of the counterweight at intervals during the raising of the bridge, and in picking them up again during the lowering of the bridge. Only a rough approximation of the true counterbalance can be made in this way. The continuous releasing and picking up of heavy pieces of cast iron occasions severe blows, and requires powerful engines and a heavy tower. The motion of such a bridge must be slow to avoid destruction of machinery and structure. The Harlem River hinge bridge was built on this plan; it has to be operated slowly, but otherwise it works very satisfactorily.
>
> The Wilkins system provides for a continuous change of counterweight by connecting the separate parts of the weight in the form of an endless chain. A perfect counterbalance may be obtained in this way, the motion is steady,

without shocks and vibrations, therefore the maximum of speed is attainable. It is the simplest device of a changeable counterbalance known; it has no loose parts, is almost without friction, and it cannot get out of order. In addition to perfect balance and speed of operation, the Wilkins system of counterbalancing a hinged bridge requires less than half the power required for a vertical lift bridge, only one tower and no other substructure besides the bridge. It requires less machinery than any other kind of movable bridge. The operating engine occupies a space of about 6 × 8 ft.; besides this there are no other parts of machinery, no gear wheels, no shafting, no part of the structure or machinery is below high-water mark, and every part is easily accessible. The greatest care has been taken to select and combine only such devices as will insure immunity from repairs. All parts of the machinery and the wire ropes are arranged so that they can be replaced if worn out without interrupting for a minute the operation of the bridge.

The bulk of the counterweight is in stone ballast, contained in a box made of steel plates and angles. If at any time it is desired to put a heavier floor on the bridge, practically perfect counterbalance can be restored by adding more stone and adjusting the chains.

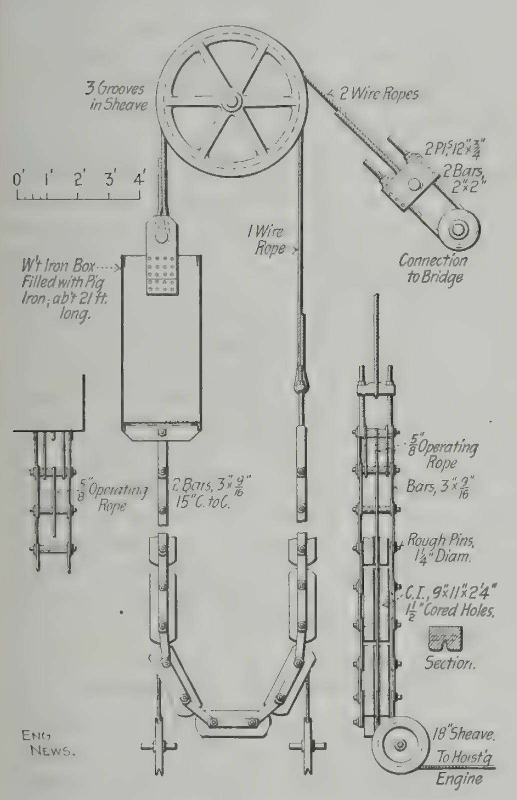

3 Grooves in Sheave
2 Wire Ropes
2 Pl.s 12"×$\frac{3}{4}$"
2 Bars, 2"×2"
0' 1' 2' 3' 4'
1 Wire Rope
Connection to Bridge
W't Iron Box Filled with Pig Iron; ab't 21 ft. long.
$\frac{5}{8}$" Operating Rope
Bars, 3"×$\frac{9}{16}$"
$\frac{5}{8}$" Operating Rope
2 Bars, 3"×$\frac{9}{16}$" 15" C. to C.
Rough Pins, 1¼" Diam.
C.I., 9"×11"×2'4" 1½" Cored Holes.
Section.
Eng News.
18" Sheave. To Hoist'g Engine

Fig. 8.—Details of Wilkens' Counterweight System for Bascule Bridges.

With this description an argument was also submitted respecting the advantage arising from quick opening in a swing bridge and from economy in operation. We reproduce it as follows:

> The difference in time of opening does not represent the total amount of time gained. A bridge-keeper finds it much more difficult to estimate the distance a vessel can cover in three minutes than in one. Therefore, in the latter case the vessel is far more likely to be ready to enter the channel as soon as opened; whereas, with a slow-opening bridge, the vessel is apt to be a distance off after the passage for it is clear.
>
> The gain of only two minutes semi-hourly during fifteen hours—a moderate estimate—amounts to a saving of one hour; an hour taken daily from a busy community complaining of the loss of every minute. Estimate the loss of time to all the waiting vehicles and pedestrians at only $20 per day, shows that a bridge which saves such time is worth to the city, at 5% interest, $120,000 more than any other bridge that does not save such time, every other qualification being the same. * * * *
>
> A saving of $10 a day in operating a bridge increases its value at 5% by $60,000.

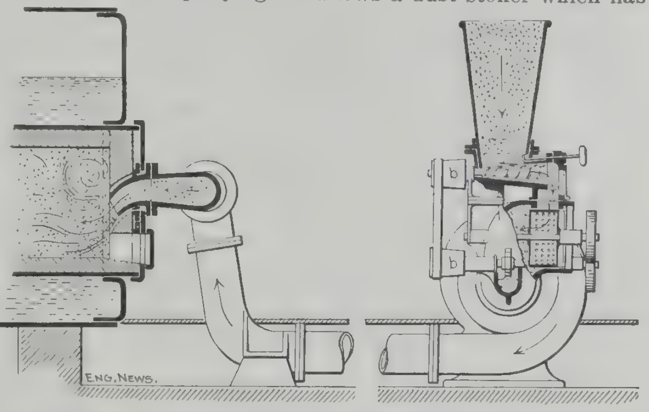
Messrs. Wm. W. Crehore, Assoc. M. Am. Soc. C. E., and Frank Miller, C. E., Havemeyer Building, New York city, submitted to the committee a design for a tunnel with an argument in its favor. We omit the design, but present the substance of the description submitted to the committee as follows:

> The chief objection always raised, whenever a tunnel has been proposed at this site, is the expense consequent upon having to reach back on either side of the Creek far enough to avoid impracticable grades. The accompanying plans have been prepared with the idea of reducing this item of expense to a minimum.
>
> Beginning at the intersection of 3d St. and Vernon Ave., in Long Island City, it is proposed to depress the middle of Vernon Ave. (for a width of 30 ft.) to a grade of 10%. for a distance of one block or to the north side of Ferry St., at which point the covered tunnel would begin. This opening in the street will, of course, be fenced in and the street curb will be moved back about 5 ft. on each side of the street to permit vehicles to pass along beside the opening. Thence passing under Ferry St. and the Long Island Ry. tracks with a grade of 5.3%, to a point 37½ ft. beyond the bulkhead line on the Long Island City side, the tunnel will have reached its lowest point. The War Department's requirement for a channel is 125 ft. wide and 18 ft. deep at low water. The proposed tunnel is level for a distance of 125 ft. in midstream and at such a depth that its highest point is 7 ft. below the War Department requirement above mentioned. Thence on the Williamsburgh side the ascending grade will be 6.7 ft. in 100 to Commercial St., whence a 10% grade continues to the surface of the ground one block away.
>
> It is proposed that the main section of the tunnel shall be composed of a steel frame and concrete arches 2½ ft. thick, so constructed as to be impervious to water. The clear height at the centre will be 14 ft. and the clear width 32 ft., which provides for a 20-ft. roadway and two 6-ft. sidewalks. An efficient system of drainage, including a small pumping plant, will be supplied. On the 10% grades at each end of the tunnel, the roadway will be widened to 32 ft., the sidewalk being discontinued before reaching this grade by providing stairways on either side for pedestrians. By increasing the width of roadway on these grades and by placing the car tracks at one side, a suitable track of inverted steel channel bars could be provided on the other side of heavily loaded vehicles going up. Vehicles entering the tunnel are to follow the entering car track, while those leaving may select either the up car track or the track especially prepared for them. This method will facilitate travel on the steepest part of the road and prevent delays. It is also proposed to provide an endless cable on this 10% grade, moving slowly at any desired velocity along the side of the wall about 3 or 4 ft. above the tunnel roadway, having rings at short intervals so that teams which need assistance in ascending the grade at the mouth of the tunnel may carry a hook and line to catch in one of these rings.
>
> Pedestrians will enter and leave the tunnel by easy flights of stairs located between Ferry St. and the Long Island Ry. tracks on the Long Island City side; and just north of Ash St. on the Williamsburgh side, These stairways will be 10 ft. wide to a platform about one-third the distance up and then shall divide in two stairways, each 5 ft. wide, leading in opposite directions. Two such flights of stairs will be placed at each entarnce to the tunnel, one on each side, as shown on plans. The capacity, roughly estimated, would be 15,000 to 20,000 pedestrians per hour in each direction.
>
> Method of Construction and General Cost.—There are several methods of constructing tunnels in soil which is of the nature of this soil and it would be a matter for contractors to figure on as to which method might be the cheapest and best. In proposing a steel frame and concrete arch lining for the tunnel, we considered that the coffer-dam method of construction would be the cheapest and that it would be possible to use it throughout the length of the tunnel. It would only be necessary to keep open a portion of the route at a time, and in view of the fact that the traffic would have to be turned aside over a temporary bridge, in any case, this should not be a serious objection. The cost of excavating, constructing the tunnel, and back-filling, including all contingencies, such as the removing of the old bridge pier on the river and setting up the old bridge as a temporary affair further up stream, we estimate would be in the neighborhood of $450,000.
>
> Advantages of a Tunnel.—The item of time saved to teams, pedestrians and street car traffic as well as to the traffic in the river itself, is something that cannot be accurately estimated, but can readily be imagined. With a tunnel instead of a bridge, the cost of maintenance would be reduced practically to nothing, and a continual stream of travel may be kept up in either direction, both on land and in the river. The one item of the cost of seven men (four by day and three by night) to attend the present drawbridge is worth, if capitalized at 4%, about $75,000. Practically the only running expense in connection with the tunnel would be a small pumping engine and one man to tend it.
>
> Any proposition to cross the river by a bridge at this point, which does not include a viaduct approach on the Long Island City side, leaves half the problem unsolved, inasmuch as the delay to traffic by crossing the Long Island Railroad tracks at grade is fully equal to any delay due to a drawbridge or lift bridge. The present proposition is to cross these railroad tracks below grade, and in addition to the saving of time thus made there is the advantage of absolute security from any accident from railroad traffic. This advantage accrues to the railroad company, as well as to the municipal government, inasmuch as they are practically secured against suit for damages due to accidents or loss of life. The railway people will also be relieved from the running expense of guarding this crossing. It seems to us in view of the advances being made in other states in the matter of abolishing grade crossings, that the time is not far distant when some legislation will be taken by the State of New York to compel the abolition of all grade crossings of whatsoever nature. In such an event, either a tunnel must be constructed similar to the proposed design, or a problem of much greater magnitude will present itself for solution. In either event any bridge across Newtown Creek at the level indicated by the present lay of the land would have to be abandoned.
>
> In addition to the advantages already enumerated, the adoption of the tunnel will provide much greater dock front on both sides of the river at the points now used for the bridge approaches.

◆

A GERMAN COAL DUST STOKER.

The burning of coal dust was taken up in this country a dozen years or more ago with a view to utilizing the culm or waste products of the anthracite mines in this way. Since it is now found possible to burn the culm as it comes from the breakers without further crushing or grinding, nothing has been done, we believe, toward the development of dust fuel burning. In Germany, however, the matter has been taken up and the accompanying cut shows a dust stoker which has been in successful use in Berlin for 18 months. The construction is evident from the drawing. The coal is ground in a mill and carried to the hopper of the stoker by a traveling conveyor. The rate of feed of the dust is regulated by a slide in the bottom of the hopper and also by the cone pulleys b b, which drive the feeding worm. The amount of air blown into the furnace with the dust is also regulated by a slide in the fan.



A STOKER FOR FIRING COAL DUST.
F. de Camp, Inventor, Berlin, Germany.

The apparatus is the invention of F. De Camp. The boiler which is working in Berlin is said to have shown the system to be durable and to require few repairs. The boiler flues are cleaned once or twice a day. The advantages claimed for the system are that it is an automatic stoker and forced draft combined; that combustion is complete and smokeless, even when the poorest grade of fuel is used; and that the system gives a high evaporative efficiency and is economical in operation. It will be noted that it has the advantage over automatic stokers of the ordinary type that no machinery is exposed to the fire.

◆

THE COMMERCIAL UNION OF SAXONY, says U. S. Consul Monaghan, of Chemnitz, has issued its tenth annual report showing the progress made in building up a foreign trade. In this ten years the Union has sent out, at a total expense of $75,000, seven traveling commissioners to investigate trade prospects in Canada, Mexico, the West Indies, South America, Eastern Asia and South and East Africa. It has also circulated German and English catalogues, circulars and reference books in five languages, calling attention to the industries of Saxony. Since 1885 8,000 merchants have visited the sample rooms and 9,000 answers have been sent out regarding the standing of foreign firms. Sample orders to the extent of 13,000, and covering $1,750,000, were sent out and these secured business valued at $7,500,000 more. The union has 46 agencies in Europe and 53 beyond the seas, with a home membership of 504 business houses. This union is only one of a number in Germany, and Mr. Monaghan says that the 3,500,000 people of Saxony are "busy as bees" turning out all manner of products for the English, French and American markets. This ten years of Saxon experience should be studied and followed by American producers. Export organizations already in existence in New York and in Philadelphia will tell them how to profit by it.

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

In the Supreme Court of Kings County, Mr. John Ireland is held personally responsible for the construction of his building which collapsed in this city, a year ago, and the jury returns a verdict of $10,000 against him for the loss of the life of one Burke in the suit brought by his mother. While this suit was also instituted against the two contractors, these latter were exonerated by the jury, which held that the construction was under the personal supervision of the architect, the direct agent of Mr. Ireland. While this finding will probably be contested, the tendency of similar awards would be to impose greater responsibility upon the owners of real estate, and to lead them to be more careful, both in the selection of their architects and their contractors. The lowest professional fee combined with the lowest bid for work to be performed would no longer be a safe standard for acceptance on the part of the owner and actual builder.

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The censure of Chief Engineer W. S. Moore, U. S. N., for the late grounding of the battle-ship "Texas" in Newport Harbor, carries with it a lesson not made sufficiently plain in the official finding of the board of inquiry. And that is that the whole accident was due to the lack of a sufficient number of trained steam engineers on board this important vessel, and that as a consequence both port and starboard engines at the time of the accident were in the temporary charge of unskilled and irresponsible men, one a naval cadet and the other the chief machinist. It is true that a remarkable chain of circumstances preceded the accident that could not have been foreseen. The dynamo broke down and put out the lights in the engine-room just as the ship was entering the harbor; this accident made it necessary for the Passed Assistant Engineer in charge of the starboard engine to leave his engine in the temporary care of a naval cadet. When the signal came to reverse the engines, the starboard engine stuck and the Assistant Engineer in charge of the port engine left his post to assist the naval cadet in handling the reversing gear; the chief machinist put in temporary charge of the port engine, meanwhile, failed to observe the working of the mechanical telegraph which was used in place of the disabled electric telegraph, and he kept his engine going ahead while reporting that he understood the signal given from the bridge. The Chief Engineer was at his post, but he could not see the indicator dials and know that the signals were being misinterpreted. The court ascribes the grounding to a combination of these causes and censures the engineers, while very properly exonerating from all blame the captain of the ship. The accident is a telling commentary upon the attempt of certain naval officers, not engineers themselves, to still further reduce the engineering staff, and to put the actual working of the costly machinery of our war vessels into the hands of machinists and other subordinates of no authority and limited training. With the proper officers at their proper posts the signals given from the bridge of the "Texas" would most probably have been obeyed and the grounding would not have occurred. But, by reason of two engineers having to attempt to do four men's work, both engines were temporarily left in the hands of men who blundered; for no particular cause other than that they were not equipped for the work entrusted to them. The accident is a further illustration of the fact that in handling modern warships plenty of well trained engineers are an absolute essential; and that the number on board each ship should be such that no emergency can call from his post the engineer in direct charge of any engine. It never pays, even in the United States Navy, to set a boy to do a man's work, though some officers think that this can be done with safety.

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A correspondent believes that we have been somewhat too sweeping in our note of timber and pile graving docks, as expressed in our issue of Oct. 22, and he questions the existence of timber dry-docks in England at all. Our chief arguments in favor of timber for this purpose were the cheapness of such docks as compared with either stone or concrete, their roomy proportions, which better facilitated work within them, their quick construction, and the fact that they could be protected against the marine worm, and against decay in the upper works, by a judicious use of concrete. There is one qualification, however, which we omitted, and that was in the location of the docks. In our country it is altogether probable that in the warm waters and damp weather of the South, a timber dock will decay faster than in the North (and the point may possibly be reached where the stone or concrete will be preferable). In the North, the stone dock is subjected to the attacks of frost, and this mischievous agency does necessitate, more or less, frequent and costly repairs, and the timber dock is, as a consequence preferable.

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Our statement above referred to contained a misprint as to the time occupied in the construction of the Puget Sound dry-dock. The original contract of Oct. 29, 1892, called for completion in 36 months; but a supplemental contract was made. on Dec. 10, 1892, for lengthening the dock 50 ft., with an extension of time amounting to 3½ months, or 39½ months in all. But notwithstanding the added work the dock was finished in about 33 months; not 43 as printed. The timber dry-dock at St. Johns, Newfoundland, was completed in 13 working months; the timber dock at Norfolk was built in 21 months and the Newport News and the League Island docks each in 24 months. As to the actual experience with timber dry-docks in the United States, it may be stated that the oldest Simpson dry-dock was built at East Boston, and finished in November, 1854; another was constructed there in 1855, and a third in 1864. These docks are practically in good condition at the present day. The two timber docks at Portland, Me., were built in 1868-70. Concerning the use of timber for dry-dock construction in England, our correspondent is referred to a valuable chart on the "Dry Docks of the Thames," issued in 1882, by Mr. Charles James Jordon, M. I. N. A. This chart, in book form, covers all the dry-docks on the Thames, at that date, 41 in all. Of this total, in 1882, 6 were all wood, only 7 were all masonry, and 28 were partly of wood. Unfortunately the date of construction is not given for these several docks; but the fact that some of the all-wood docks are of small dimensions, and are closed by the old-fashioned wooden gates would point to a very early construction. These wooden docks, however, are unlike the type now built in this country, in being unprovided with altars, or steps, and in having vertical side walls of timber. Some of them have wooden bottoms and wooden gates with brick side walls. The important fact, however, is that timber has long been used for this purpose in England, and that many of these timber docks were still in use upon the Thames a comparatively short time ago.

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The results of the tests of the Roebling system of fireproof construction, in which a concrete arch, strengthened with steel rods, constitutes the floor support, will, we think, be a surprise to those who have not known hitherto the value of concrete as a fire-resisting material. That an arch of this construction of 4 ft. span, only 3 ins. thick in the center, could support a floor loaded with 150 lbs. per sq. ft., while a fire was kept under it for five hours, reaching a temperature of above 2,300° F., or beyond the melting point of copper and even of cast-iron, and then after this heating and sudden cooling by a stream of water could withstand a load of 600 lbs. without fracture, would, we think, be considered highly improbable had it not been proved by these tests. The competitive test between an arch of concrete and one of hollow tile, in which the latter failed, is one of the most important contributions to our knowledge of the ultimate resistance of fireproof floors which has been made for many years. The manufacturers of tile floors will no doubt have something to say in their own behalf in regard to this test, for it was not an official one, but as the matter stands it looks as if the concrete men had shown that in fire-resisting qualities their construction is at least as good as that which has heretofore been accepted as the best standard construction.

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THE DESIGN OF MOVABLE BRIDGES.

The designs for a movable bridge over Newtown Creek, at Brooklyn, N. Y., which are presented on our inset sheet in this issue, are interesting not only as respects the solution of the problem presented in this especial case, but as evidence of departures in the construction of movable bridges from the long-time standard swing span, which deserve the careful attention of engineers.

It is true in engineering work as in every other industry, that the force of precedent and custom is exceedingly powerful, and often leads to the adoption of a certain pattern or type of structure or machine, not because it is the best that could be devised or that is offered, but because custom has sanctioned it, and anything else is an innovation. In the especial case before us it has come to pass that the swing bridge is accepted without question as the proper means of carrying a road over a navigable waterway. Only within the past dozen years have any notable instances been furnished of exceptions to this general rule.

It is of interest to trace the process by which the swing bridge came to be the standard type of construction. The original drawbridge was not a swing bridge at all, but a lift bridge. In the centuries preceding the modern era, practically the only place where movable bridges were used was in crossing the moat that surrounded a castle or fortress. For this purpose a simple floor, hinged to a tower on the inner side of the moat and drawn up to a vertical position when the bridge was opened, was the type of structure in general use. The floor of the bridge when opened was an admirable barrier against enemies who might succeed in crossing the moat. The under-side of the bridge was sometimes covered with iron to prevent an attacking party from cutting it away.

Of course the openings which all such spans covered were of trivial width. Not until the art of building timber trusses was developed was it possible to bridge any stream of considerable breadth with a fixed span even, much less a movable one. With the advent of timber trusses, however, it for the first time became possible to throw structures across navigable streams of some size, and then the problem for the first time was presented of providing a passage both for vessels and for the bridge traffic. While various structures of the bascule type were devised for narrow openings, the spans to be moved soon reached such dimensions that with the hand power which was alone available at that day, the only course open was to build the span on a center turntable, or pivot, and revolve it in a horizontal plane. When iron and steel construction took the place of timber, it was entirely natural that the wooden swing span should be copied in metal.

It is only within very recent years, since the necessity of bridging waters which carry a busy traffic has arisen, that the defects of the swing bridge have become apparent. For all crossings of any considerable width, and where the water traffic is inconsiderable, it is doubtless true that the swing bridge is the best possible type. The structure itself is as stable, if properly designed, and erected, as a fixed span; and, aside from the machinery for turning it, it costs but little more. But when we come to narrow channels, and especially those where a large traffic is moving, the swing bridge is no longer so satisfactory. In a narrow channel, a center pier with the necessary draw-rest forms a serious obstruction to navigation. The time required to open or close it constitutes a delay to the traffic both over and under it. The swing of the arms necessitates keeping a considerable of the channel unobstructed and may in some cases make unavailable for docks, etc., valuable water-front adjacent to the shores. The liability to accident through collisions with passing vessels is considerable, and such accidents sometimes not only disable the bridge, but leave it in such a position as to stop passage through the channel. The danger to the traffic using the bridge, when the bridge is open, has been made familiar by a long series of distressing accidents. It is doubtless true that no structure could prevent a runaway team from dashing into an open draw; but it is quite possible that the elevated floor of a bascule bridge would prevent an electric car from taking such a fatal plunge as occurred at Cleveland less than a year ago, and it can be made to form a barrier which is a certain protection to ordinary foot and vehicle traffic.

We may add to this that the swing span thus far is the despair of those with a regard for the aesthetic in bridge construction. Its development thus far has been strictly on the lines of maximum strength with minimum material, and the resultant form, while undeniably correct from an engineering point of view, is a most awkward and ugly monstrosity to an artistic eye. There may be some method by which a swing span may be made a graceful and pleasing structure, but so far as we are aware, it has not yet been discovered. While this consideration in many situations will be considered of no importance, the tendency is all the time growing toward the requirement of some features of architectural merit in the bridges of city streets; and in locations adjacent to public parks or the choice residential sections of large cities this matter may often have more weight than anything else in selecting the design for a structure.

Turning now to the types of movable bridges other than the swing span, they may be classified broadly as straight lift bridges, pontoon bridges, rolling bridges and folding or bascule bridges; each of these classes, the latter especially, including a great variety of designs. The straight lift bridge is simply an ordinary bridge span with cables attached at each end passing over towers and with a counterweight attached. To open the bridge the span is lifted straight upward. The pontoon bridge explains itself by its name. The rolling bridge is mounted on wheels running on a track and rolls straight back in the direction of its axis to open the channel. The bascule bridge is a bridge in which the floor lifts or revolves backward toward the end of the span to open the channel.

Some interesting examples of these various types of construction were furnished by the competitive designs for a draw bridge over the ship canal at Duluth, Minn. (Eng. News, Oct. 27, 1892.) Of the 12 designs presented in this competition, one was a straight lift, two were pontoons, six were rolling draws, and only one was a bascule bridge. The other two were swing bridges with unequal arms, and pivot piers on the shore, the ends of the long arms meeting in mid-channel.

The straight lift bridge has the merit of simplicity; but its reputation has been somewhat injured by several unfortunate accidents which have befallen the only prominent example of this construction, the Halsted St. bridge at Chicago. From the experience there it would appear that to make this type of bridge a success the greatest care must be given to the operating machinery in every detail, and it should be so designed as to make the failure of the mechanism so as to stop the working of the bridge an exceedingly remote possibility. This type of bridge is rather expensive to operate from the fact that the entire weight of the span must be lifted. It leaves the streets unprotected when it is raised unless an additional provision of automatic gates is made. On the other hand it may be made a very handsome structure, and an especial advantage in the case of the Vernon Ave. crossing is the ease and economy with which changes in its height may be made to suit changes in the street level.

The pontoon bridge has never been actually used where frequent and rapid opening and closing were essential. Some interesting designs which contemplated this were submitted in the Duluth competition, but it is doubtful whether rapid opening and closing could ever be attained by this type of structure. The fact that it has to swing against the traffic, moving in one direction, increases the amount of delay necessary and it will be evident that it is worse than a swing bridge with respect to its obstruction of the water front, and the sweep of clear water that it requires. It may also be pointed out that it is essentially a low-level structure, whereas a movable bridge over a busy stream ought to have its normal level far enough above the water to permit the passage of most mastless vessels without opening the bridge.

Rolling bridges are chiefly objectionable because of the space required by the structure when it is drawn back on shore to open the channel and for the complication in approaches which is necessary. In the case of a double rolling bridge, the ends meeting in mid-channel must be locked together to make a continuous truss, as it is hardly feasible to provide counterbalance on the shore arms for live load. Existing examples of rolling bridges are of very small span, so far as we recall.

The folding, or bascule, bridge has been built in a variety of types during the past few years, and is at present, with the exception of the swing bridge, the most popular type of movable bridge Some of its popularity may be due perhaps to the success of the noted Tower bridge in London. It is certainly remarkable that in the Duluth draw bridge competition of 1892, only one design out of 12 was of this type, whereas in the Newtown Creek competition, six out of the eight designs are for a structure of the bascule type.*

The advantages of the bascule type of movable bridge may be enumerated as follows: It leaves an entirely clear channel.; it interferes with no dock space adjacent to the towers; it requires less power to operate it than any other type of structure, the average lift being only half (or a quarter) that of a straight lift bridge, and one end being supported at the tower. The span itself may be made to furnish an automatic barrier across the roadway when the bridge is opened. It can be opened and closed very quickly, and in its motions takes no space in the channel as do all classes of swing bridges. Its towers enable the bridge to be made a very graceful and ornamental structure, wherever this is a consideration.

Of the various types of bascule bridges that have been devised, the least expensive, when the cost of operation is considered, is probably the type with a single moving leaf spanning the entire channel, of which the design of Messrs. Wilkens & Creuzbaur is an example. A single operating-house moves this bridge, and with bascule spans, meeting at the center of the channel, it is not yet demonstrated that operating machinery on each side of the channel will not be necessary. It may be objected that this type of bascule leaves the roadway open at one end when raised, but it ought not to be difficult to provide automatic gates at this end worked by the raising of the bridge. Of course, for very long spans, the truss would become very heavy to handle; but for spans of moderate length, it appears to be a very promising type of bascule.

Of the bascules with arms meeting in mid-channel, a variety of types are shown on our inset sheet. Two classes are represented, those in which the span is made continuous by connecting the lower chords of the two halves when the bridge is closed, and those in which the floors and their loads are carried entirely on suspenders from the towers or from an everloaded construction. With the first class the tower may be made very light, or may even be dispensed with altogether; but the truss itself must of course be made considerably heavier, and the connection of the lower chord might prove rather complicated.

A problem of some interest in connection with the bascules supported by inclined suspenders from the towers is the method by which the two parts of the span will be kept at the same level at the center when a heavy load crosses. It will be seen that the weight of the span itself is balanced by a cable running to the counterweight. The office of the eye-bar suspenders is to support the live load, and they will evidently hang in a considerably flatter curve when the bridge is loaded than when it is empty. It will probably be necessary to provide locking gear to keep the abutting ends at the same level.

The problem which has been solved in the greatest variety of ways is the method of counterbalancing the span uniformly in all its positions. Several different plans of affecting this are shown in the designs on the inset sheet. The system in which the counterweights hang in a chain, which transfers its weight to a fixed point, or to the other side of the head sheave as the span moves, seems to promise especially well for smooth and rapid working.

The question of the best power for operating a movable bridge should have but one answer at the present day, the electric motor, in any city where a reasonably certain supply of electric current is obtainable. The only objection to it is the possibility of failure, and this is very small at the present day. Of course all movable bridges should be fitted with hand gear for moving in case of failure of the power machinery in any event, and in a very important structure an emergency steam plant with a fire-engine boiler might also be installed. The actual amount of time that is occupied in moving a bridge even over the busiest streams, is so small that the amount of power actually used is very small. With an electric motor there is no expense for power save when the bridge is actually moving, and what is of more importance, the bridge operator has nothing to do but move a switch and can give his undivided attention to the movements of vessels and traffic.

As most movable bridges require attendance both day and night, the ability to operate them with a small force is a very important matter; the saving of the wages of one or two men per shift will pay the interest on a large sum of money. It is worth noting that lift bridges, in which the operating machinery is on the shore, are better adapted to operation by electric power than swing bridges where the machinery is on a pier in the stream and the current must be carried to the pier by cables under water, which are liable to be fouled by passing vessels.

Space forbids the discussion of other interesting questions in connection with the subject, such as to the comparative first cost of swing span and bascule structures; but it is hoped that what has been said may lead to a better appreciation of the merits of movable bridges other than the swing span. The design of every bridge should be a matter of study in connection with the local conditions and a swing span should not be adopted where a movable span is necessary unless it fulfils the requirements better than any other type.

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*For drawings and descriptions of recent bascule bridges, see Engineering News, May 23, 1891; Dec. 14, 1893; Jan. 18, 1894; Feb. 21, 1895, and March 7, 1895.

LETTERS TO THE EDITOR.

Early French Movable Dams.

Sir: Can you refer me to any descriptions of the primitive movable dams used in France, say prior to 50 years ago, and of the Thenard shutter?

Very truly, "Barrage."

State College, Pa., Oct. 28, 1896.

(In the "Proceedings of the Institution of Civil Engineers," Vol. LX., p. 24, will be found a paper on "Fixed and Movable Weirs," written by Mr. L. F. Vernon-Harcourt, M. Inst. C. E. This paper describes the Poiree needle-weir, of 1834, the movable shutter of M. Chanoine, and the drum-weir, bear-trap weir, segmental gate weir, rolling shutter and the various hydraulic shutter weirs, all used in the improvement of the River Seine. The needle-weir, which seems to have been one of the earliest forms, was made up of a series of needles, or bars, 11½ ft. long, and 3 ins. square, furnished with hooks by which they revolved on the top-bar of a supporting trestle of iron work. They were used side by side with shutter weirs and were regarded as simpler in construction, more easily moved and less liable to get out of order than the early types of shutter weirs. The Chanoine shutter or wicket was introduced upon the Seine about 1860. Our correspondent is also referred to the published work of Mr. Vernon-Harcourt on "Rivers and Canals." We regret to say that we can give no detail of the Thenard shutter.—Ed.)

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A Puzzle in Mechanics.

Sir: A problem in mechanics recently given to the students here has attracted considerable attention and aroused no little enthusiasm. I take the liberty of stating the problem and asking that you give your solution:

"A man stands on a perfectly level, solid and frictionless table, large enough so that he will not fall off. Nothing but air surrounds him and he has nothing to throw. How can he get off the table?"

Of a number of answers given, the most sensible were, that he could swim off or blow himself off. But when action and reaction are considered, even these seem impossible solutions. Of course a quick exhale would produce some motion, but the inhale would also tend to move him back to his original position, and so with his hands if used as in swimming. When he threw them out he would move nearer his destination, but when he drew his hands back again would he not tend to move toward his original position? Again, is it possible for him to turn his head, even slowly, without a movement of his feet?

You will note that the problem brings up a number of complicated questions, and I hope you will give me your idea.

Very respectfully yours,
Chas. W. Gennet, Jr.

Chi Psi Lodge, Ithaca, N. Y., Oct. 29, 1896.

(The man could blow himself off for he could inhale vertically, through the nostrils, which would produce no horizontal reaction, while he could exhale horizontally through the mouth. He could also inhale slowly and exhale rapidly. He could also get off by a swimming motion, for he could move his hands in one direction while they were placed so as to cut the air, and turn them to act as paddles against the air before moving them in the opposite direction. We think he would not be able to turn his head without moving the rest of his body, for the motion is produced by contraction of some muscles in the neck, which would act at both ends, pulling the head in one direction and the body in the other.—Ed.)

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Wright's "Element of Mechanics,"

Sir: In the review of my "Mechanics," contained in Engineering News of Oct. 22, the reviewer advances views which to say the least are misleading.

1. The reviewer takes to task writers who do not follow the methods of twenty years ago, but introduce innovations.

The answer is not far to seek. The Mechanics of to-day, unlike that of twenty years ago, is not for the civil engineer only. The electrical engineer and physicist have come to the front in the meantime. They must have a notation and units as well as the civil engineer. His are not sufficient for the reasons stated in the book (p. 62), Hence to the gravitation system of units is added the absolute system, and hence the new terms micron, megadyne, kilo-watt, barad, etc. Hence, too, the theory of dimensions at which the reviewer sneers. Without an account of the theory of dimensions any book on Mechanics is antiquated.

The introduction of new terms is, therefore, to be looked for mainly* in a region in which the civil engineer has hardly any concern. And by omitting to read the last chapter he may never meet them. At least the reviewer has found nearly all that excites his ire in the domain of the physicist and electrician.

The terminology given is that of the best authorities, the British Association Committee and the International Electrical Congress held at Chicago in 1893. I have been careful not to add anything as I am as much opposed to terms not authorized as is my critic.

2. Twice my attention is called to the absence of the relation

$$M = \frac{W}{g}$$

or mass is equal to the quotient of the weight by the factor g.

This is found in all the old books and has, I venture to say, been a source of endless confusion. Its elimination marks a great advance.

The factor g is introduced to change from an absolute to a gravitation system, or vice versa (p. 60). When this is understood the question "whether shall I multiply or divide by g" is answered.

3. In order not to make this letter too long I will not enter upon a discussion of the questions raised regarding force and energy. The definition of force laid down is that given by Newton in his first law of motion and is not a verbal hair-splitting by any means.

It would seem that, after all, progress in Mechanics is possible—in fact modern physics is rapidly assuming the form of a dynamical problem.

T. W. Wright.

Schenectady, Oct. 27.

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The Economy of Steam Shovel Work.

Sir: In your issue of Sept. 24, you give in detail the bids on the "Nashua Aqueduct," for the new Metropolitan water supply. These bids make an interesting showing of the advantage which any contractor has who uses steam shovels for work of any magnitude. The successful bidder on this work has been using a Vulcan "Little Giant" steam shovel and based his bid on what he knew could be done at a profit. The work comprises 290,000 cu. yds. of earthwork and stonework of different kinds. There were 21 bids opened, and the totals ranged all the way from $86,960 to $401,275, quite a difference. The lowest bid was rejected. The next lowest and successful bid was $89.470. In this bid the 290,000 cu. yds. of earthwork were priced at 18 cts. per cu. yd.

I give below a statement in detail, showing how much lower than the successful bid each one would have been if each had figured the earthwork at the same price (18 cts. per cu. yd.) Strange as it may seem, the highest bid, $401,275, if figured at 18 cts. (the lowest price), would have been $12,995 lower than the successful bidder. It was actually $324,800 higher on the excavation.

Yours truly,
The Vulcan Iron Works Co.,
Alex. Backus, President.

Toledo, O., Oct. 26, 1896.

Table Showing the Effect of High Estimates for Earthwork in Bids for Nashua Aqueduct.

Bid No.	Price per yd. over successful bid, cts.	Excess on the earthwork.	Actual total bid.	Had each bid been 18 cts. per cu. yd. on earthwork, the bids would have been:	
				For whole work.	Or less than successful bid by.
1	3	$8,700	$86,960	$78,260	$11,210
2	...	.....	89,470	89,470	......
3	4⅞	14,137	90,117	75,980	13,490
4	4	11,600	94,372	82,772	6,698
5	6	17,400	97,159	79,759	9,711
6	7.6	22,040	97,509	75,469	14,001
7	5.5	15,950	103,495	87,545	1,925
8	11	31,900	114,920	83,020	6,450
9	14.9	43,210	119,115	75,905	13,565
10	14	40,600	120,230	79,630	9.840
11	12	34,800	120,362	85,562	3,908
12	12	34,800	121,882	87,082	2,388
13	17	49,300	125,932	76,632	12,838
14	15	43,500	130,076	86,576	2,894
15	17	49,300	134,745	85,445	4,025
16	21	60,900	146,660	85,760	3,710
17	21.5	62,350	149,850	87,500	1,970
18	28	81,200	172,646	91,446	1,976
19	31	89,900	175,172	85,272	4,198
20	48	139,200	228,837	89.637	167
21	$1.12	324,300	401,275	76,475	12,995

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Salinas Bay as a Pacific Terminus for the Nicaragua Canal.

Sir: I notice in your paper of the 8th inst., a letter from Mr. Sylvanus Miller, M. Am. Soc. C. E., in which, among other things, he advocates a survey of the Salinas Bay route for the Nicaragua Canal, on the west side of the isthmus. It is undeniably the fact that the surveys made by the Nicaragua Canal Construction Co. were too much confined to one route, but I must take exception to Mr. Miller's assertion that the surveys on the Salinas Bay route were not thorough and complete enough. It must be remembered that we went out there for the purpose of locating one of two predetermined routes, and not, like a government expedition, for the purpose of exploring the isthmus. That had been done previously by the U. S. Government, by the Government of Nicaragua and by various private companies and persons; and as a matter of information I will inform Mr. Miller that a survey of the Salinas Bay route had been made by Col. Childs, in 1851, and by the parties under command of Commander Lull, in 1874.

However, the first thing that I did after being placed in charge of the Nicaragua Canal, was, in obedience to orders from the chief engineer in New York, to send one of my assistants, with a full field party, to Salinas Bay, to make a careful survey of this route and settle the question; which, by the way, had been twice settled before. I always supposed that this survey was ordered to appease the Costa Rica Government, in whose territory it lay, and who naturally wanted the canal terminus in their republic, if possible.

Be that as it may, my assistant, Col. Perez, went to Salinas Bay and started the survey toward the lake, and a copy of his report is before me. Before they had proceeded three miles they attained an elevation of over 800 ft., and were confronted with perpendicular rock cliffs, which they could not scale without making a great effort. They examined the country thoroughly, all about the bay, and this was the best line they could find. It was intended to take the line down the valley of the Sapoa River, an insignificant stream, emptying into the Lake Nicaragua, or any other that could be found that would better answer the purpose; but upon receiving his preliminary report, it was seen to be utterly impracticable, as much as we would have liked to utilize the fine harbor of Salinas, and I therefore recalled the party.

While the Salinas Bay line is unfortunately impracticable, I will say that I know that a better line, more economical and more practicable by far than the line selected by the Nicaragua Canal Co. does exist. It is thoroughly known to me, and I have personally examined it; a line that will do away with the immense divide cut and most of the other objectionable features of the line we were sent out to locate, and which had previously been selected by the company. If I had been sent out there by the company to find and locate a line across the isthmus that would be the best and most practicable and least expensive, I should certainly have selected the line referred to; we were not, however, sent out for any such purpose, but to make the best and most thorough location on the route previously determined upon, which comprised the high and low level lines that we surveyed, and I found by experience that any suggestions in regard to other routes were not received with favor.

In regard to the line that we did locate, I venture to say from an experience of over 25 years on public works that no public work ever projected, and I make no exceptions, ever had more complete, thorough and careful surveys, examinations and studies than the upper route of the Nicaragua Canal; and if the U. S. Commission had seen and examined all of the surveys, preliminary and trial locations, reconnaissance and fly-lines, cross-sections, check and counter-check levels, measurements and gaging of streams, determinations of river slopes and oscillations, soundings and borings, rainfall records, barometric levels, lake oscillations, etc., etc., they would have been forced to the same conclusion. But from reading their report, it would appear that the half of the data collected and forwarded to the home office by myself and my predecessor, Lieut. Peary, had never been collated and placed before them.

J. Francis Le Baron.
Late Principal Assistant and Division Engineer in charge,
Nicaragua Canal.

Jacksonville, Fla., Oct. 9, 1896.

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TESTS OF THE ROEBLING FIREPROOF FLOOR.

In our issue of Sept. 17, we described a test which was made in New York city, on Sept. 3, of a fireproof floor constructed by John A. Roebling's Sons Co. A description and illustration of the system of construction, and of earlier tests upon it, was given in our issue of July 18, 1895. In that test the floor was subjected to a hot fire for two hours, and was then cooled by water, and found to be uninjured. As a protest sent to the Building Department of New York city claimed that two hours was not a sufficient time for a thorough test, it was decided to have a second test for a period of five hours. This test took place on Oct. 28, and its conclusion was witnessed by a member of the staff of this journal. Invitations had been freely sent out by the builders, and a large crowd was present, including many engineers and others interested in fireproof building construction. The test was made in the same building that was used in the former test, its location being an open lot at 81st St. and Western Boulevard. It is a steel skeleton brick structure, built after designs of Mr. G. C. Henning, the expert of the Department of Buildings, who also was in charge of the test. The size of the test structure is 12×16 ft. in area, by 12 ft. high. The floor was made of 10-in. I-beams, 25 lbs. per ft., 15 ft. 6 ins. between supports, spaced 4 ft. apart between centers, with concrete arches 3 ins. thick at the crown sprung across the beams. The concrete was made of 1 part Aalborg Portland cement, 2 parts sand and 5 parts ashes, from steam boiler furnaces. A filling 2 ins. thick was placed between the nailing sleepers, consisting of a concrete made of 1 part Aalborg cement, 2 parts sand and 10 parts ashes. A ceiling was placed under two-thirds of the floor, made of wire netting and lime plaster furnished by the United States Mortar Supply Co. The remainder of the floor was left unprotected. The floor arches were concreted on Sept. 26, and the ceiling plastered on Sept. 30 and Oct. 1. A grating extending over the entire floor area was fixed at about 3 ft. above the ground, and on it was placed a 2½-ft. layer of dry hard cord wood, sprinkled with oil, so as to cause it to ignite readily. A second grate about 2 ft. below the first was also supplied with fuel with the object of heating the air entering the building and thereby creating a higher final temperature. Before the test the central panel of the floor was loaded with brick to 150 lbs. per sq. ft. The test was begun by lighting the cordwood, at 10.06 a. m. The temperature was measured and graphically recorded by a Uehling & Steinbart pyrometer, which worked perfectly throughout the test. Some of the temperatures recorded are the following:

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*Mainly, but not wholly, as for example, torque and horse-power-hour.

Time.	Temperature.	Time.	Temperature.
10.40 a. m.	1,100°	1.03 p. m.	2,050°
11.00 "	1,450°	1.33 "	2,050°
11.20 "	1,725°	1.55 "	2,125°
12.00 "	2,000°	2.11 "	2,050°
12.23 p. m.	2,100°	2.28 "	2,100°
12.43 "	2,300°	2.51 "	2,000°

From 11.55 a. m. to 2.51 p. m. the temperature was never less than 2,000°. This is a more uniform range of temperature than has been obtained in any of the previous tests by the Department, or in any other fireproofing tests ever made, so far as we are aware: At 3.06 p. m., a strong stream of water from a fire engine was thrown directly against the underside of the floor. When the structure had been sufficiently cooled, and the steam cleared, so that the floor could be inspected, it was found that the ceiling of wire netting and plaster had disappeared, but the arches were to all appearances uninjured, and the floor sustained its load. The maximum deflection of the roof before the water was put on was about 4 ins. On the next day the load on the roof was increased to 600 lbs. per sq. ft., which load was sustained without any signs of failure.

A comparative test of the Roebling system and ordinary hollow tile flooring was made on the day preceding the official test above described, in an adjoining structure. We abstract the following from a printed statement issued by the John A. Roebling's Sons Co.:

On Sept. 3 a comparative fire and water test was made in the smaller of the two brick structures at 82d St. and Western Boulevard, New York city. Two fireproof floor arches had been built in the structure, about 8 ft. above the ground, one according to the Roebling system; the other, an ordinary sectional hollow brick flat arch. A concentrated load of common brick, weighing 9,000 lbs., was distributed over about 15 sq. ft. near the middle of the arch. A hot fire was started and maintained underneath these arches for about an hour and a quarter, after which the water was turned on by a detachment of the Fire Department. After the fire was extinguished, it was found that both arches had sustained the test without apparently any damage other than the displacement of some of the plaster and a slight deflection of the hollow brick arch.

It was claimed by some of the persons present that the test was without significance, and that to have any value, the arches should be fired until one or the other failed. Acting on these suggestions, the ceilings of both arches were replastered on Oct. 1. A second fire and water test of these same arches was made on Oct. 27. Pig iron weighing 10,000 lbs. was piled over an area of about 7 sq. ft. in the center of each of the two arches, making a superimposed load of over 1,400 lbs. per sq. ft.

At 10.00 a. m. the fire was started.
- 10.30, the white coat of plaster off in many places, and at others, clinging to ceiling.
- 10.50, plaster still intact under both arches.
- 11.45, rough plaster of ceiling still intact under both arches. Copper plug for indicating temperature not fused.
- 1.00, rough plaster still in place; copper plug not fused.
- 1.35, copper plug fusing.
- 1.50, cracks beginning to form around load in hollow tile arch.
- 1.55, cracks opening parallel to wall and adjacent to it along both arches. That portion of the hollow-brick arch directly under load slightly depressed below level of the remainder of arch. Joints opening and smoke issuing around load on flat arch.
- 2.05, load over flat arch dropped through suddenly to the ground inside the brick structure.

Iron work erected Aug. 10; Roebling arch concreted Aug. 11; flat arch erected Aug. 10 to 11; first fire and water test Sept. 3; ceilings replastered Oct. 1; thickness of crown, Roebling arch, 3 ins.; depth of hollow brick arch, 10 ins.; size of beams, 10 ins.; 25 lbs.; spacing of beams, 5 ft., center to center; proportions of cement mortar used in setting flat arch, 1 part Aalborg Portland cement, 1 part sand; proportions of concrete used in Roebling arch, 1 part Aalborg Portland cement, 2 parts sand, 5 parts steam ashes.

This test was an unofficial test, but was witnessed by several members of the Department of Buildings as well as a number of others interested in the subject of fireproofing.

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THE VILLA BRICK MANTLE, FOR PROTECTING RIVER BANKS FROM EROSION.

Signor Giovanni Villa, of Milan, Italy, has invented and now tested for some years a system of protection for the banks of rivers and canals that is simple and cheap and certainly possesses meritorious features. This protective device is a mantle made of perforated bricks of terra-cotta or cement strung upon galvanized iron wire and connected laterally, between each row of bricks, by a strip of wood. The bricks vary in dimensions so as to break joints, as shown in Fig. 1. Mr. Villa has designed a special apparatus for making the mantle and for putting it in place on the river bed.

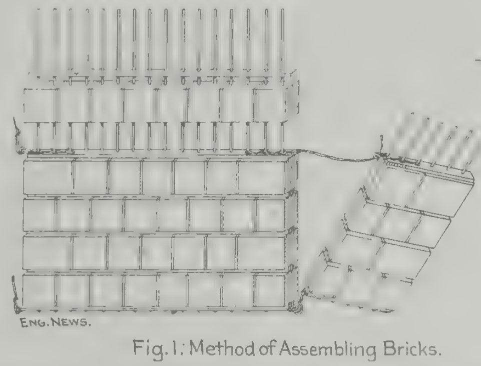

Fig. 1.—Details of Construction of the Villa Brick Mantle for Protecting River Banks From Erosion.

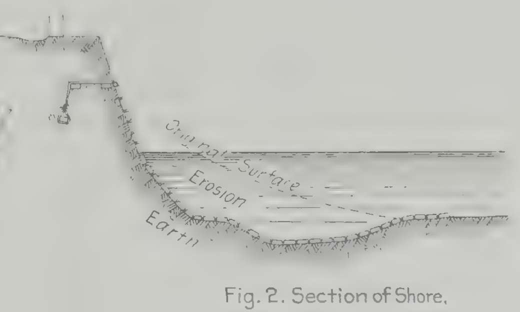

Fig. 2.—Cross Section Showing the Mantle in Place.

The mantle is applied to an eroding river bank in sections varying in width from 5 to 10 ft. with the character of the work; but these strips are also united together by wire at intervals, as shown in Fig. 1, and are anchored to the shore above the water-line. The resulting mantle, or covering, is strong and flexible, adapting itself to the conformations of the river bottom and extending from any desired point in the river to the bank. It is quite smooth and permits the water to flow easily over it. The inventor makes the following claims for this mantle: Cheapness, as compared with other methods of accomplishing the same end; great efficiency and duration; and rapidity and ease in making and laying. There is no obstruction to the normal flow of water in the river, and the deposit of fine mud carried into and behind the mantle only tends to give it greater permanence.

As to the important claim of durability, it seems that the first mantle was tried about five years ago on the River Olona, near Milan. Here a dike protecting some agricultural lands from inundation was faced for a distance of about 3,000 ft. on the Villa system. In 1895 this work was in good condition and grass was growing between the bricks. On the River Po, near Crespino, the mantle has been used to protect a communal hospital which was in danger from the cutting away of the bank in a curve in the river. This mantle is about 800 ft. long, and it is said to extend under the water for about 130 ft. It has stood two years' wear without any injury and has stopped all erosion, though the bank is very steep. Its cost was about $1,500, including the preparation of the bank for the mantle.

Mr. Villa says that a single threading machine will keep 15 men busy and make 180 sq. yds. of mantle "per day," without specially trained men. As to cost, the inventor supplies the following estimate for one square meter, stating that one of the chief advantages of this system of bank protection is that the cost can be definitely fixed beforehand, at so much per square yard, regardless of the stage of water, etc.:

Cost per Square Metre in Francs.

17 cement bricks	3.40	francs.
2 bundles of wooden slats	.20	"
2.2 lbs. of galvanized iron wire	.35	"
Foreman	.50	"
Tools and labor	.15	"
Cost per square metre equals	4.60	"

This is equivalent to about 77 cts. per sq. yd., though the materials and labor are doubtless figured on a European basis in the above. Mr. Villa says that the use of terra-cotta bricks would reduce the above total to 3.75 francs per meter, or say to 63 cts. per sq. yd. The plant required for a considerable piece of work is estimated as costing $20,000 in Europe, and included in this plant are:

6 barges, at 5,000 francs each	30,000	francs.
6 hand machines for threading	18,000	"
Tools	5,000	"
Chains and rope	5,000	"
12 small boats	6,000	"
Office expenses, etc.	20,000	"
Contingencies	16,000	"
Total	100,000	"

The English patents seem to be controlled by the "Villa's Patent Mantle Syndicate, Ltd.," of Liverpool; the inventor is Signor Giovanni Villa, of Milan, Italy, and the present owner of his patents is Signor Riccardo Biragchi, of Milan.

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THE USE OF OLD RAILS AS UNDERGROUND CONDUCTORS.*

By F. O. Rusling.

While the writer was the Superintendent of the Buffalo (N. Y.) Railway Co., serious indications of electrolysis of the pipes within a half-mile of the power-house made it necessary to call in expert advice to put a stop to the trouble. A careful and thorough electrical survey was made of the entire district. This was a long and difficult matter, since there were three systems of natural gas pipes, two of illuminating gas, one of water and two conduit systems. Although the pipes were already connected to the negative bus-bar by large copper cables, it was found that these were entirely inadequate, and that there were two points where the pipes at heavy load were 3 to 5 volts positive to the adjacent rails. One of these points was 1,500 ft. north and the other 1,800 ft. east of the power-house.

The expert calculated that, until extensive changes could be made in rail returns, the former point would deliver about 1,000 amperes and the latter about 3,000. To bring this current to the dynamos with but 5 volts loss would need over $8,000 worth of copper. While hesitating over this large expenditure it occurred to us that there were about 300 tons of old tram rails on hand that might be used for the purpose. These were flat, center-bearing rails, originally weighing 56 lbs. to the yard, but worn down to 50 lbs. or less; they were high in carbon, hard and brittle.

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*Reprinted from the "American Gas Light Journal."

The best scrap price obtainable was $8 per ton, delivered. Our expert carefully tested their conductivity with 1,000 to 1.500 amperes, using an instrument reading to .001 of a volt in order to secure accuracy. As the showing was satisfactory, it was determined to try the rails on the 1.500-ft. length, which would require four rails in parallel to give the desired results. A trench was dug between the curb and sidewalk and a continuous trough of rough lumber put into it.

The rails were bolted together in pairs back to back, and arranged so that the end of one rail was at the center of its mate. The bonding was effected by scraping contact spots with a file near the end of each rail and amalgamating them with the Edison solid alloy. A steel washer ¼-in. thick, 1⅛-in. inside diameter, and 4 ins. outside was dipped into hot insulating compound and placed against one rail so as to inclose the contact spot. The hole in the washer was filled with the Edison-Brown plastic alloy, inclosing an amalgamated steel spiral spring. The upper rail was then bolted on and the completed conductor lowered to the bottom of the trough, resting on one edge so that gravity would maintain the contacts. It will be evident that with this arrangement two of the bonds on any one rail would have to give way before the circuit could be broken; each bond was made large enough to transmit 1,500 amperes. When the second set of rails was lowered into place, the trough was filled with a hot insulating compound and a cover nailed on. This compound was cheaper and better than asphaltum; it remains viscous even in cold weather and has high insulating qualities. It is a product of petroleum distillation much lighter than asphaltum and costs about $25 a ton.

This four-rail conduit was connected up and carried at heavy load, 1,100 amperes, 1,500 ft. with a loss of but four volts. This result was so surprising that our expert suspected that his instruments were wrong and sent them back to Weston for recalibration; they were returned, but proved that the measurements were correct. To appreciate the performance of these old rails and their bonds I need only say that, to give the same result, it would require a copper section of 3.55 sq. ins.; 1,500 ft. of this would weigh 20,532 lbs., and cost at 12 cts. per lb., $2,462.83. Our four-rail lengths weighed 50 tons and cost as scrap but $400. The resistance of steel as compared with copper is usually considered to be between 7 to 1 and 9 to 1. but this including 50 bonds in each length, was about 5.63 to 1. The tests proved that the plastic bonds actually did make an "electrically continuous rail," and after a year's service they are still maintaining their conductivity. This is more than can be said of any copper bond ever used. It will be noted that steel like this, even at $30 per ton, would be cheaper than copper as a conductor.

As the steel was so hard and brittle, a great deal of time was required to file the contact spots and to bore holes for the bolts to hold them together, so another method was adopted in the second case. In the power-house is an air compressor for cleaning out armatures and removing dust from the boiler-house walls. An iron pipe was connected from the air reservoir to the yard and a single layer of rails, bottom up, was put on each wagon. Each load was carried into the yard and the contact spots were rapidly cleaned with a reciprocating pneumatic tool, borrowed from a boiler shop. To avoid drilling the rails, pieces of ¾-in. iron, about 24 ins. × 8 ins., were placed in the trough every 15 ft. These were bored at the ends for a pair of countersunk ¾-in. bolts and had four contact spots cleaned with an emery wheel. On these were laid the plastic bonds and four rails side by side, with base down. The spaces between the treads were just right for a second layer of three rails bottom side up. Then another set of bonds and an iron plate ¼-in. thick, 20 × 8 ins. On these more bonds, other layers of four and three rails, and finally a ¾ × 24 × 8-in. top, bolting all layers together. The sides of the trough were but ½-in. from the rails between clamps, so as to save wasting insulating compound, with wider spaces to accommodate the clamps. Rail joints were broken as before.

This construction allowed very rapid and satisfactory work compared with the first. The performance was also satisfactory, as the 14 rails transmitted 3,250 amperes 1,800 ft. with but four volts drop; an insulated pilot wire was put down with this conduit and permanently connected with a voltmeter in the power house. The rails used in this conduit weigh about 210 tons, which at $8 would amount to $1,680.

It would require a section of 12.48 sq. ins. of copper to equal in conductivity the section of 70 sq. ins. of steel. This copper would weigh 86,580 lbs., and at 12 cts. per lb. would cost $10,389. The total cost of the rails and bonds, for both conduits was about $3,322, as against $12,852 for equivalent copper. The labor to install the copper would of couse be less, but on the other hand we had the rails in stock and the only actual outlay was for labor, bonds, lumber, bolts and insulating material. I have not the details of these now at hand; my recollection is that the total expenditure did not exceed $2,500, and that we thus secured results which would otherwise have cost nearly $15,000.

From my experience with copper bonds I should not advise the use of buried rails for conduits if ordinary copper bonds are used for connections. Even when new it is impossible to get the full conductivity of the rail, and the contacts get worse and worse as time passes. The copper when covered with the damp earth will oxidize at a rate determined by the composition of the soil and the amount of current transmitted.

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A 54-IN. WOODEN BARREL SEWER.

By J. C. Meem, Assoc. M. Am. Soc. C. E.

The accompanying sketches show sections and details of a typical 54-in. wooden barrel sewer, adopted from plans of similar ones, recently designed and built in Brooklyn. Mr. Chas. H. Myers, M. Am. Soc. C. E., Engineer in Charge of Sewers, however, makes no claim to originality, as the Brooklyn plans are practically the same as those used by the Dock Department of New York.

The sketches show two designs, Fig. 1, with boxed supports for pier extension, discharging through a mouthpiece in the bottom; and Fig. 2, with supports better adapted for cribwork, and with an open end discharge. The general construction is similar in both cases, except when shown to be different in the plans.

The "streaks" or staves are creosoted with 10 lbs. of dead oil of tar, weighing 8½ lbs. per ft. at 120° F.

The intermediate bands and the cover bands for the joints are of galvanized iron, as is also the mouthpiece which is fitted to the opening in the sewer. This last is bolted to the staves at the four corners and to a galvanized iron strap which goes over the sewer at the center of the opening.

In constructing the sewer it is made in 20-ft. sections and floated to place at high water, or else it is set up in position, according to circumstances. A little calking may be given to the joints between sections when it is impracticable to get a good fit. The simplicity of their construction and the durability of these sewers make them especially desirable for this character of work.

The sewers are built in elliptical or other shapes as well as circular, according to necessity.

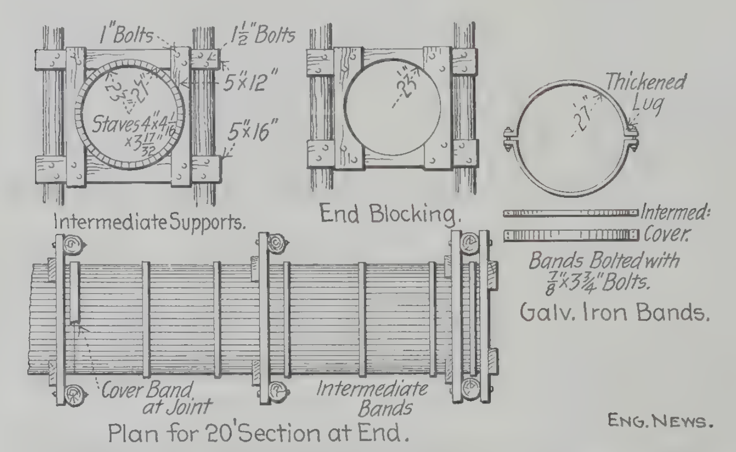

FIG. 1.—DETAILS OF BOXED SECTION WITH MOUTHPIECE AT DISCHARGE END.

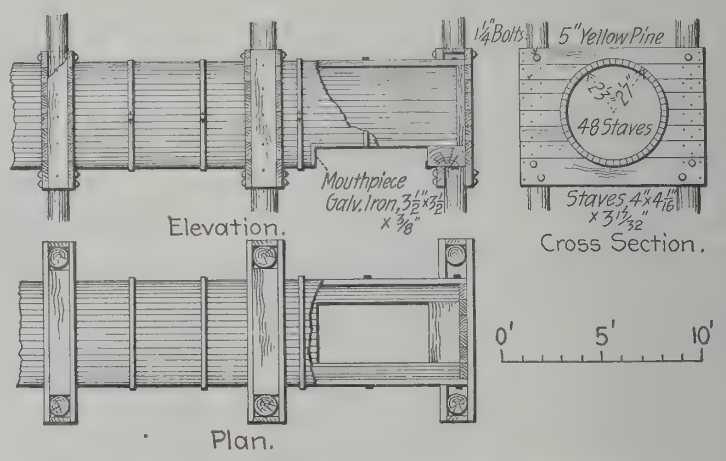
1¼" Bolts
5" Yellow Pine
23"
27"
48 Staves
Mouthpiece Galv. Iron, 3½"×3½" ×⅜"
Elevation.
Staves, 4"×4$\frac{1}{16}$" ×3$\frac{17}{32}$"
Cross Section.
0'
5'
10'
Plan.

FIG. 2.—DETAILS OF PIER EXTENSION OR CRIBWORK

A 54-IN. WOODEN OUTLET SEWER AT BROOKLYN, N. Y.

THE FAIRMOUNT PARK ELECTRIC RAILWAY, at Philadelphia, Pa., is now completed and nearly ready for traffic. It opens up communication with all parts of the great park, and all roadways and drives are crossed below grade. The power-house has an engine room 156 × 55 ft., and a boiler room 156 × 36 ft., with a large coal storage vault. There are three tandem compound Corliss engines, each directly connected to a General Electric dynamo of 500-K-W. capacity. Steam is supplied by six Berry vertical boilers of 250 HP. The boilers and engines were built by Robert Wetherill & Co., of Chester, Pa. The car shed is 425 × 114 ft., of ornamental design. The equipment includes 30 motor cars and 30 trail cars, each seating 72 passengers. Each car is mounted on two four-wheel trucks, with 33-in. wheels, and each motor car has four motors. All the cars have electric brakes. They were built by the J. G. Brill Co., of Philadelphia, Pa.

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NEW STEEL MAKING PROCESSES claimed to supersede the Bessemer process, are invented every year or two, and achieve a brief notoriety through the medium of the daily papers. The latest is the Hawkins' process, which is described in three columns of fine print in the St. Louis "Globe-Democrat" of Oct. 25. As nearly as we can understand, the operation of the process is as follows: Pig iron melted in a cupola flows in a stream into a reverberatory furnace beneath; the stream is met by two jets, one of air and one of steam. The steam or hydrogen blast is supposed to turn sulphur into a gas that is burned up, and to turn the phosphorus into a slag which floats on top of the melted metal. The latter is then tapped out of the reverberatory furnace or "converter." Experiments are said to have been made with the process by Chicago capitalists at the old Jefferson Steel Works in Birmingham, Ala., in a plant which was erected at a cost of $10,000. A dispatch received from them says "Parties interested jubilant over results and declare it a revolution in steel making." The most absurd claims are made for the process, such as that steel may be made by it as cheap as cast iron, and that steel castings made from the Hawkins' process are equal to steel forgings.

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ALUMINUM CAN BE SOLDERED OR BROWNED, says Dr. Gottig, in the "Metallarbeiter," as follows: The aluminum is treated with a solution of ammonia alone, or with ammonia in the presence of salts of ammonia. In the first case, the aluminum, which always contains a little iron and silica, is dissolved on the surface; but the silica and the iron remain and form an adhering coating of a brownish yellow or a blue-grey color; the color varying with the amount of impurities in the metal. In the case of the treatment with ammonia in the presence of salts of ammonia the iron is also dissolved and the silica alone remains. But the combination formed reacts upon the ammoniacal salts and the deposit of hydrate of alumina and oxide of iron again forms a protecting coating. The physical and chemical properties of the surface of the aluminum are so modified that this surface will resist the action of humid air and waters slightly acid. Another advantage is that the aluminum thus treated can be easily soldered and electrolytic deposits will adhere strongly.

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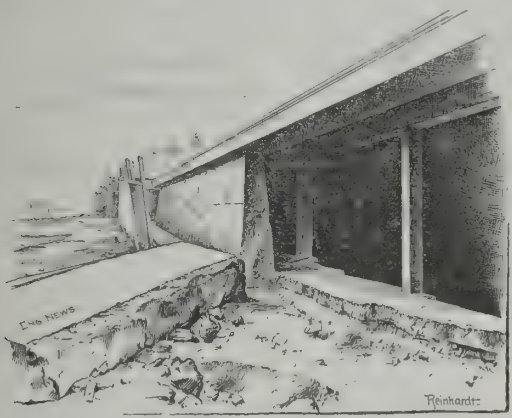
THE WESTERN UNION TELEGRAPH CO., according to its annual report for the year ending June 30, 1896, owns 826,929 miles of wire, has 21,725 offices, forwarded 58,760,444 messages, for which it received an average toll of 30.9 cts. at an average cost per message of 24 cts. In 1893 it transmitted nearly 66,600,000 messages and received 31.2 cts. for each at a cost of 22.7 cts. The gross earnings for the year 1896 were $22,612,736, with operating expenses of $16,714,756 and net earnings of $5,897,980. The company is reconstructing its trunk lines with copper wire, with excellent results.

A RESERVOIR FAILURE AT OAKLAND, CAL.

A reservoir on Vernon Heights, Oakland, Cal., belonging to the Oakland Water Co., failed about 6:30 a. m., Oct. 20. No damage was done beyond flooding basements of houses for a few blocks. The accompanying view was drawn from a photograph taken the next day.

The original reservoir was about 100 ft. square, partly in excavation, lined with brick, and plastered on the inner face with a coat of asphalt. It extended to the height of the ledge shown in the photograph.

To increase its capacity, a wall of asphalt concrete was built around the old reservoir, 8 ft. higher, and connected with the brick and asphalt lining by an 8-in. layer of the same material. This wall was 2 ft. wide at the base and 1 ft. at the top, with its inner face vertical. It had no depth in the ground and no footing, and was built partly on made earth. This upper wall failed. The break showed no bond between the wall and the horizontal layer, but it did show a break in the bond between the upper and lower parts of the wall (also shown by a crack in the wall left standing).



A Reservoir Failure at Oakland, Cal.

It is stated that previous to the break, water had been carried to within 1 ft. of the top of this wall and at the time of failure it was 22 ins. above the ledge.

The reason assigned by the water company for failure was the explosion of dynamite by some malicious person.

We are indebted to Mr. Geo. S. Dillman, of Dillman & Wallace, San Francisco, for the above information, and for the photograph from which the view was drawn.

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NOTES FROM THE ENGINEERING SCHOOLS.

Lehigh University, South Bethlehem, Pa., opened Sept. 23, with a Freshman class of 115, as against 75 last year. The president announced the return of Professor Thornburg, the head of the Mathematical Department, who had been on leave of absence for the past year, and the addition of two new instructors in the departments of Mechanical and Electrical Engineering.

A characteristic feature of the technical instruction at Lehigh University, is the regular and systematic instruction given to the students in the shops of the Bethlehem Iron Company, and the shops of the Lehigh Valley R. R., at South Easton.

On Founder's Day, Sept. 8, Mr. John H. Converse, of Philadelphia, a member of the firm of the Baldwin Locomotive Works, made the annual address. Mr. Converse is a graduate of the University of Vermont, and much interested in educational matters. His address on "Citizenship and Technical Education," which will be published by the University, will attract much attention on the part of engineers and educators. He advocated a college course which should for the first three years be devoted to culture studies and the humanities, and for the last two or three years to professional subjects.

The "Combined Courses," at Lehigh University, which cover five or six years, and lead both to the degree of A. B. and an engineering degree, are largely in the line of Mr. Converse's proposition. The chief objection to the present system of education of engineers in our technical schools is its one-sidedness. If we are to make this education broader we must take more time for it.

Separate pamphlets are issued by the different engineering departments, describing in detail the methods of instruction. We have received three of these pamphlets, describing, respectively, the courses in civil, mining and mechanical engineering.

At the University of Michigan, Mr. John R. Allen, Univ. of Mich., '92, and J. T. Faig, Mich. & Agl. Coll., of Kentucky, '94, have been appointed Instructors in Mechanical Engineering, to fill the place vacated by the resignation of Asst. Prof. F. C. Wagner, who has gone to the Rose Polytechnic Institute, at Terre Haute, Ind.

At the Massachusetts Institute of Technology, the equipment of the engineering laboratories has been increased by the acquisition of new apparatus as follows:

In the laboratory of Applied Mechanics has been added a 100,000-lb. Olsen testing machine, capable of testing specimens 5 ft. long and under. In the same laboratory has been added a frame of two large iron girders, and other suitable apparatus, provided with a set of steel rods, which, with a pair of large cast-iron skewbacks already in the laboratory, make a machine of 400,000-lb. capacity for testing masonry arches of such sizes as are used in practice. To the Mechanical Engineering laboratory has been added a 36-HP. Otto gas engine, which is to be used mainly for purposes of investigation. An apparatus for testing steam injectors has been built and was in use during the latter part of last year. A compound Marsh pump of a capacity of 800 gallons per minute has been loaned to the laboratory for experimental purposes. In the Hydraulic laboratory has been added a calibrated measuring tank of 20,000 lbs. capacity, in addition to the old tank of the same capacity. Each is equipped with ten quick-opening valves, enabling large quantities of water to be measured accurately.

In the double number of the "Technology Quarterly," just issued, dated June-Sept., 1896, will be found Nos. IV. and V. of the "Results of tests made in the Engineering laboratories," No. IV. giving the detailed results of the test of the triple engine of the Chestnut Hill Pumping Station, made in May, 1895, by the students under the direction of Prof. E. F. Miller. No. V. contains the detailed results of tests made in the course of the regular work of the laboratory of Applied Mechanics, on the following subjects:

1. Tests on two series of bolted joints.
2. Tests on wrought-iron pipe of different sizes, used as columns.
3. Tests of spruce and of Norway pine beams.
4. An extensive series of tests of the compressive strength of timber at right angles to the grain.
5. Torsional tests of shafting, mostly 2 ins. in diameter.
6. Tensile tests of specimens or steel and of iron, of wire, of manila, of cotton, of hemp, and of sisal rope, and of the strength of alloys.

During the last school year, in the course of the regular laboratory work, complete tests of two large plants; one a 50-hour test of the West End R. R. Power Station, at Sullivan Square, Charlestown, and one a 24-hour duty test on the triple engine of the Chestnut Hill Pumping Station.

Extensive additions have recently been made to the plant of dynamo-electric machinery. The principal of these are a 30 arc-light Brush machine, a 30-HP. Westinghouse 4-pole direct current machine, and a 10-HP. Westinghouse direct-current machine, arranged so as also to give quarter-phase alternating currents when desired. This machine can also be used as either a direct or alternating current motor, or as a rotary transformer. Two 20-HP. transformers have been added to be used in connection with the large alternator already possessed by the Department. All of this apparatus is for regular use in the laboratory by the students.

There is also under way a new plant especially arranged for illustrating the testing of the combined efficiency of steam engine and dynamos. It consists of two similar multipolar direct-current dynamos, of 35-HP. each, made by the General Electric Co. These will be driven by a separate compound high-speed engine.

A 20-HP. electro-magnetic transformer for heavy currents has also been added to the equipment. This is intended to be used particularly for the study of the heating effects of very strong currents. There has likewise been constructed a transformer giving a pressure of 40,000 volts, whose special use is to determine the electrical strength of materials used for insulating purposes, A large addition has also been made to the storage-battery equipment already possessed by the department.

Many additions have been made to the apparatus for precise measurements in electricity and heat, including special forms of apparatus for studying the errors of standard thermometers, and for determining thermal conductivities. A new standard air condenser should also be mentioned.

The New Mexico College of Agriculture and Mechanic Arts, Mesilla Park, N. Mex., sends us a photograph of its new engineering building. It is a flat-roofed one-story building of a very substantial appearance, and differs in one particular from probably every other engineering college laboratory in the country in being built of adobe, plastered inside and out. The adobe bricks (unburned clay and straw) are laid up in thick walls, making a building cool in summer and warm in winter; and in a land of sunshine and little rain, they make a very durable structure.

The equipment just added has been selected from the Davis & Egan Co., Egan Co., Fulton Steam Boiler Works, Laidlaw, Dunn, Gordon Co., Springfield Emerywheel Co., Weston Engine Co., Standard Scale Co., and other makers. The college offers four regular courses, viz., Agricultural, irrigation engineering, mechanical engineering and scientific. Spanish is thoroughly taught in the college. It is the prevailing language in much of New Mexico, and in all of the country southward.

The dry atmosphere and mild climate of New Mexico are very beneficial to those subject to pulmonary troubles, and the college has been of great service to many students who were unable to pursue such work at the eastern and northern colleges where the climate is more severe.

The engineering work is in charge of Frank W. Brady, M. E. (from Purdue University, Lafayette, Ind.), with Mr. Chas. Mills, assistant.

In the engineering department of the University of Minnesota, prizes for original theses have recently been awarded to students as follows: First prize, $50 and gold medal, to Mr. C. P. Jones, Jr., for thesis entitled, "An Original Design for the Steel Frame of a Ten-Story Building;" second price, $30 and a gold medal, to Mr. C. E. Magnusson, for thesis entitled, "Specifications for an Electric Lighting Plant for the Gillette-Herzog Mfg. Co." This system of prize-giving was instituted five years ago by the Gillette-Herzog Mfg. Co., of Minneapolis, Minn., with a view to stimulating original research in various lines of engineering. Their plan is to offer prizes as described above, placing the papers prepared by students in the hands of a committee composed of prominent engineers.

The Worcester Polytechnic Institute, Worcester, Mass., has made many important changes during the past two years. We are indebted to Prof. Sidney A. Reeve for the following account of them:

> News from this Institute can hardly be fully understood without a word as to the general changes which Dr. T. C. Mendenhall inaugurated upon his accession to the presidency and which are only now, some two years later, beginning to be manifest in works. Up to that time the Institute had remained one of the best schools for the training of mechanics which the country afforded. The growth away from this original character has, of course, always been responsive to the changing demands of the changing times; but within a few years this has been accentuated, and the school, still retaining its full original equipment of commercially operated shops, can boast a similarly complete equipment for scientific and technical education.
>
> The Washburn Shops continue to be the centre of the Institute. About them have sprung up in a very few years an array of laboratories, each specially equipped for its work. In chemistry, the special branches of gas-analysis, metallurgy, sanitary and industrial chemistry each have special laboratories, and, with the exception of the first, special professors devoted to them. The department of sanitary chemistry derives special advantages from Worcester's possession of the fine Blackstone River sewage-disposal works, which annually attract a number of experts in that line from all parts of the world.
>
> Applied electricity and electrical engineering now have

new laboratories of their own, with a new chair, occupied by Prof. Harold B. Smith. The lighter electrical work is carried on in the original laboratory, now remodelled; the heavier electrical power work occupies its portion of the new Power Laboratory, of which more will be said later.

The departments of pure mathematics and language have each been enlarged to meet the requirements of incrasing classes, and the superintendency of the Washburn Shops has passed into new hands. The most marked advance has been made in the departments of Mechanics and Steam Engineering. As the laboratories devoted to this work are of recent construction and of somewhat novel arrangement, a somewhat detailed description may be of interest.

The Mechanical Department.

The apparatus and work in this line was transferred about a year since to two new buildings erected especially for it from funds coming from the State of Massachusetts. One of these, locally known as the "Power Laboratory," is devoted to the study of questions in steam, electrical, and gas power, all on a commercial scale. The other, known as the "Mechanical Laboratory," is occupied by laboratories for lighter mechanical investigation into problems in general applied mechanics, strength of materials, hydraulics, kinematics and thermodynamics; it also contains an instrument-room, recitation and lecture rooms, and the mechanical and freehand drawing rooms.

The Power Laboratory contains two vertical 80 HP. boilers built for a steam pressure of 200 lbs., three horizontal steam engines, a condenser, absorption dynamometer, and the heavier electrical machinery. In the future it will also be equipped with a 100-HP. gas engine and power gas generator.

The possibilities in the line of combination of this apparatus, by means of clutches, quills, and a countershaft, are almost innumerable. The three engines, whose cylinder-volumes bear the ratio of 1 : 3.06 : 7.84, may be combined into a compound engine by the connection of any two of them, or all three may be run as a triple compound. The speed of any one or all, although all possess automatic cut-offs, may be varied so as to vary these cylinder-ratios to any value between 2 and 10. Any one or any set may exhaust into the atmosphere or into the condenser. Any one or set may be operated with or without steam-jackets, on barrel or on either head, and the jacket-water weighed separately. Between each pair of engines is a live-steam re-heater which may be used or not, and its condensation measured. While any engine or pair is being used experimentally, the other may be used to drive the commercially operated Washburn Shops, which normally consume about 25 HP., and which are driven from the Power Laboratory the year around. Finally, the power from any engine or any set may be carried over to the absorption-dynamometer and there weighed, or may be further transmitted up to any one of the three electrical generators for consumption or measurement.* The near future will add to this array of prime movers an 80 HP. motor receiving current from the Institute's Hydraulic Power Laboratory at Chaffinsville, five miles north of the city, and which may be similarly coupled in with the other apparatus in almost any combination. This hydraulic power laboratory, containing an 80 HP. turbine using the drainage from a 2,500-acre watershed under a 30-foot fall, with Venturi meter, absorption dynamometer, 10-ft. weir, and all accessory apparatus, constitutes practically a department of itself.

The circulating-water from the power-laboratory condenser is carried back to the Mechanical Laboratory building, where the laboratory hydraulic apparatus admits of its being measured by orifice, by weir, or by weight, or by all three in series. The same hydraulic apparatus of course is prepared for all experimental work in hydraulics itself, for which purpose water is supplied from a pressure-tank in the laboratory, for all heads up to 200 lbs. per sq. in. The tank is now being equipped with a mercury-column 33 ft. in height for standard orifice work, but which will also be used for testing gages or any other incidental work of the sort.

On the same floor are the testing machines: a 100,000-lb. Emery, a 50,000-lb. Fairbanks vertical, a Riehle torsion, and a Riehle light tension for wire and cement; to these is being added a 20,000-lb. Wicksteed lever-machine. The first of these machines is operated by water-power from the pressure-tank, under a system which permits the most delicate gradation of load and the retention of the load at any point almost independently of leakage. The others are operated by hand-power or belt-power.

Amongst the interesting work recently done by this section of the laboratory was the destruction by crushing of sixteen specimens of concrete of different compositions for a prominent firm of contractors and builders. The specimens were bedded in a mortar of plaster-of-paris, which was allowed to set while the specimen was under a strain of a few hundred pounds. The method of giving way to the strain which all of the specimens except three exhibited—that is, the leaving on the heads of the machine a pair of cones of material almost uninjured—gave rise to doubts as to whether the results were not more favorable to the concrete than would be the case in actual practice. It is perhaps, however, the only method of reducing the test-results of different mixtures and machines to a just basis for comparison. The following table gives the results of the compression tests of concrete cylinders, Sept. 28 to Oct. 1, 1896, axial compression:

	—Dimensions.—				—Strain—Lbs.—		
Mark.	Length, inches.	Cross-section, sq. ins.	Weight, lbs.	oz.	First crack.	Ultimate.	Per sq. in.
AT 1	8.15	28.22	18	12	25,000	26,900	954
AL 1	8.10	28.32	18	14	18,200	22,700	802
D 1	8.05	28.22	..	..	22,500	22,500	800
G 1	8.08	28.20	18	12	28,000	28,900	1,025
S 1	8.11	28.32	18	11½	20,400	27,200	961
R 1	8.08	28.22	17	7½	3,000	6,200	220
AT 2	8.11	28.04	..	..	89,900	89,900	3,210
S 2	7.97	28.13	17	11½	89,600	89,600	3,190
AT 3	8.12	27.94	..	..	19,000	35,800	1,280
S 3	8.06	28.32	18	9½	51,200	51,200	1,810
AT 4	7.98	28.13	18	9	25,500	28,500	1,013
S 4	8.06	28.41	18	7½	33,800	34,800	1,225
AT 5	12.12	50.68	52	11	Strained to 100,000 lbs. without apparent injury.		
S 5	12.13	50.36	50	15	64,400	69,100	1,371
D 5	12.17	51.06	50	11	81,400	82,200	1,609
G 5	12.11	50.30	52	2	99,100	100,000	1,988

NOTES.—The mixtures had set about 30 days, the exact time being unknown in the laboratory.

AT 3 was not well filled out on one side with sand and cement—irregular, elongated cavity about ½ in. wide and deep.

S 3 was full of small cavities on outside.

G 5 was not well filled out on a complete circle about 1½ in. from one end; but specimen did not give way there.

The mixtures were in proportions indicated by the numbers as below, the stone of No. 2 being fine stone of 1½ in. mesh.

No.	Stone.	Sand.	Cement.
1	5	2	1
2	2	1	3
3	4	2	1
4	6	3	1
5	4	2	1

The letters indicate different brands of cement.

Some recent tests of interest were made upon steel strips cut from a rifle-barrel which had been in actual use.

A recent acquisition in this connection has been an optical extensometer which reads, and with accuracy, verified within the limits of probability, to $\frac{1}{20{,}000}$ in. in 8 ins.

This same laboratory contains, besides the hydraulic apparatus already mentioned, a special small surface-condenser and three experimental steam-engines for thermo-dynamical problems. It is expected that a refrigerating and ice-making machine, erected solely for experimental and illustrative purposes in thermodynamics, will be shortly installed.

The department of drawing, which occupies the top floor of this same building, has recently received a new head, Prof. Ames, who is remodelling the course so as to unify all the branches—free-hand, mechanical drawing, and machine design—and all the four years' work, so as to lead towards a complete and homogeneous education in that direction.

In the electrical engineering department a post-graduate course has been established, which includes 14 hours per week of laboratory work, and 12 hours of electrical engineering design, besides lectures, reviews of current electrical literature, etc. The following new electrical machines are being placed in the Power Laboratory: A 30 K-W. 110-volt compound direct current dynamo, and one of 60 K-W. 500 volts; a 30 K-W. 1,000-volt single phase constant potential alternator, and a 60 K. W. 3,000-volt 3-phase motor to take current from a generator located at the hydraulic power plant of the Institute at Chaffinsville.

The Colorado State School of Mines is about to apply to the coming session of the legislature for an extension of space, the applications for admission having overrun the capacity of the present buildings. The summary of attendance shows that 33 per cent of the students are from outside of Colorado.

DERAIL FOR THE GIBBS ELECTRIC STREET RAILWAY INTERLOCKING DEVICE.

The greatly enlarged liability to serious grade-crossing accidents, which has followed the rapid increase of high-speed electric railways, has become so evident by frequent collisions and still more frequent narrow escapes that the need for a suitable protection for such crossings is now seldom questioned. It is also quite generally recognized, in the most advanced practice, that the old highway crossing gate is inadequate to the conditions of heavy, high-speed electric cars not infrequently rendered uncontrollable by the blowing of a fuse or jumping of the trolley, and that the logical solution of the problem is along the lines of the mechanical interlocking signals used at steam railway grade crossings. In our issue of Feb. 22, 1894, a special interlocking plant of this character, invented by Mr. Geo. Gibbs, M. Am. Soc. M. E., Mechanical Engineer of the Chicago, Milwaukee & St. Paul Ry., was described in some detail, and since that time the device has come into quite extended use along the lines of that company and on other railways.

The particular characteristics of Mr. Gibbs' device, as will be remembered, are: (1) the motive power of the electric cars is cut off when it is necessary to block the line; (2) a derailing device is provided to prevent the cars from drifting over the crossing. This derail resembled the scotch block sometimes used with steam railway interlocking apparatus rather than the derailing switch proper, and has recently been supplanted by Mr. Gibbs with a device more nearly approaching the ordinary derail. Through the courtesy of the inventor we are enabled to present herewith details of this improvement.

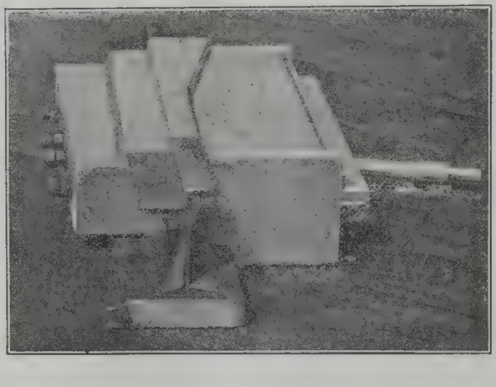
Fig 1.—Derail Closed.

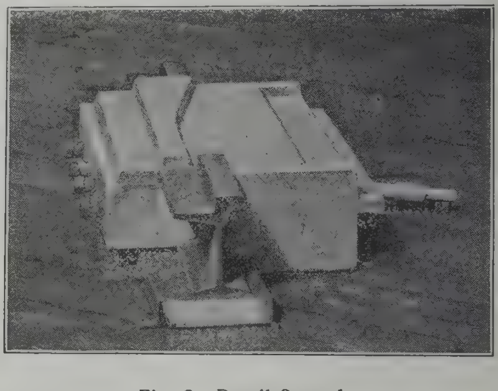
Fig. 2.—Derail Opened.

VIEW OF DERAIL FOR GIBBS' ELECTRIC STREET RAILWAY INTERLOCKING SYSTEM.

A brief consideration of the structure of the ordinary derailing switch will show its inapplicability to street railway tracks. It breaks the continuity of the rail, weakens the track, and affords an opportunity for destructive battering which can only be prevented by assiduous attention in keeping the joints tight and the ties well surfaced and tamped. In street railways the position of the ties and rails below the pavement renders impracticable this attention, and further the construction is an obstruction to wagon traffic, and is especially liable to clogging by mud and ice. The attempt was made to overcome all these difficulties in the derail illustrated. As will be seen by the illustrations it consists of two cast-iron boxes, bolted to each side of the rail through the web, and a cast-steel plate sliding on these blocks through a passage provided by cutting out the rail head for a distance of 26 ins. Cast on the top of the sliding plate is a suitable projection or ridge to replace the rail head cut away, when the derail is closed, as shown by Fig. 1. Fig. 2 shows the derail in the open position, that is thrown to one side, so as to break the track and derail the car. It should be noted here that the apparently narrow flangeway is due to the fact that when the photograph was taken the sliding plate had not been fully thrown open. In Fig. 3 the details of the various parts of the derail are clearly shown and need not be described further.

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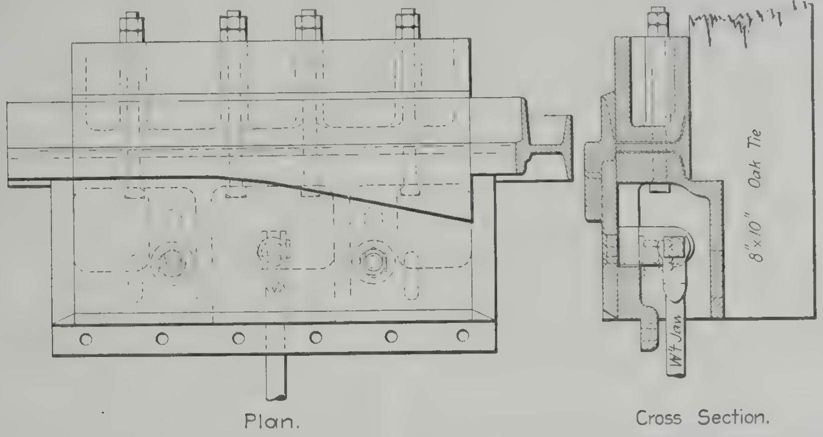
*Some preliminary tests of these engines will illustrate this opportunity of varied combination. While the middle engine of the three was driving the Washburn Shops upon 60 lbs. non-condensing, the first and third were running condensing under 110 lbs. of steam under a brake and indicated efficiency test. The water consumed was 15¾ lbs. per I. HP. per hour. After the test the shops were transferred from one engine to another without any interruption whatever.

The features to be noticed particularly in this device are: (1) The web and flange of the rail are left intact, only the head being cut away; (2) the device is applied to the rail by bolting through the web, and consists of two cast-iron boxes which have footings on the same crossties which carry the rail. Owing to this fact it is not necessary to make a special foundation for the derail or in any way to disturb the ties and their bedding; (3) a smooth surface is presented at a level with the street paving for the passage of wagon traffic; (4) the sliding plate has beveled edges to make it self-cleaning from mud or snow and ice; (5) all operating parts are protected from injury; (6) the operating rod or pipe is attached about 4 ins. only under the surface of the street, by which difficulty from drainage in deep boxes is avoided.

A number of derails of this construction have been put into use, the latest having been recently installed at Indiana St., Chicago, Ill., in a plant built by the National Switch & Signal Co. All of these have worked satisfactorily, being easily operated by the levers and infallibly derailing the cars as has been demonstrated on several occasions. It is stated that in passing over this derail no perceptible jar is felt, indicating that there is no deflection of the track by reason of the cutting away of the head of the rail.



Plan. Cross Section.

FIG. 3.—DETAILS OF DERAIL FOR GIBBS' ELECTRIC STREET RAILWAY INTERLOCKING SYSTEM.

RAILWAY TERMINAL STATIONS.*

The passenger movement at terminal stations is composed of three classes: 1, Through or long distance; 2, suburban or short distance; and, 3, excursion or irregular travel. In addition to these three classes of travel, it is generally necessary to provide for express and mail matter, and in many cases for the handling of milk.

The long distance passengers have a large amount of baggage, some of which can be taken directly to or from the train, but a large proportion requires provision for storage, and all requires provision for handling while at the station. Passengers of this class usually upon arrival go to their destination by some conveyance, either carriage or street car, so that the location of the station is of less importance to them than to those of the second class. Its arrangement as to comfort of waiting rooms and convenience of baggage rooms is of greater importance. Many passengers of this class wish to take the cars of some railway other than those of the road upon which they arrive. If the trains of both railways are in the same station, with convenient provision for the prompt transfer of the passengers and their baggage from one to the other, their comfort and convenience are served in the best manner. This result is reached in many of the union stations which have become common within the last few years.

The second class of traffic, including the greatest proportion of passengers using the terminal station, including all passengers whose work calls them to the city daily, have very different requirements. They do not need such provision for baggage nor waiting rooms. They reach the station just before the time of departure of their trains and hurry from their trains immediately on arrival. Inside the station, convenient ways for quick ingress and egress are the primary requirements, with a good system of running and despatching trains, and conspicuous and plain indicators showing destination and starting time of trains. To this class, the location of the station is of great importance, and for it, on general principles, the station should be as near the business centre as possible. If this class of business is to be attracted to the railway, the facilities offered and cost of transportation must be as favorable as those of competing lines. The majority of this class are people with small incomes, to whom the addition of a street car fare daily to the steam car fare is a serious expense, hence the necessity of bringing them as near to their places of business in the city as possible.

For the third class noted above, the location of the terminal station does not play so important a part, neither does the arrangement of waiting rooms and baggage rooms. The main features needed are large space and free egress from the trains for the excursion crowds. Care is needed also to have the train indicators plain and conspicuous, and proper provision for preventing crowds from going to the wrong train.

At first the steam railways took the larger share of suburban traffic. As the territory along their lines within reasonable distance of the city became built over, it became necessary to develop the territory between them. This was at first done by omnibuses and horse cars. It has become necessary to build farther from the business centers and farther from the suburban stations of the steam railways. The heavy passenger traffic brought about by the latter movement and the absence of branch feeders to the steam railways, has enabled the electric railways to develop and extend the street systems formerly operated with horses, and, by the superior facilities offered, to bring such competition as to seriously affect the earnings of the suburban steam lines. To meet this competition successfully, the steam railways must have better facilities than were called for by the small traffic of former times.

It may be interesting to show the number of passengers carried by the railways entering Boston during 1894:

	Total.	To and from Boston.
Boston & Albany..	12,152,000	7,546,000
N. Y., N. H. & H....	44,448,000	13,831,000
New England....	8,146,000	3,426,000
Boston & Maine....	33,385,000	21,654,000
Fitchburg....	7,117,000	4,055,000

Arranging these figures in groups according to the railways which use the north station and those which will use the new south station, the distribution is as follows:

	Total.	To and from Boston.	Trains per day.
North station.. ..	40,448,000	25,709,000	574
South station	64,502,000	24,803,000	678

After the location of a terminal station has been determined, the point next in importance is the arrangement of the buildings and tracks. The headhouse usually contains the waiting rooms for passengers, with ticket offices, toilet rooms and lavatories for men and women, news stands, restaurants, telegraph and telephone offices and information offices. It is also necessary to provide for baggage and express rooms, and often a place for the milk traffic. Besides the above noted rooms pertaining directly to the passenger traffic, provision must be made for many things incident to such traffic, such as rooms for trainmen, sleeping car companies and station officials, store rooms and other rooms for uses connected with the passenger business, but not used directly by the passengers.

In general, the station should be so designed that baggage, express goods and milk, with such other articles as may be received or delivered at the station, shall be handled either below or above the level of the tracks, and in most cases it must be below such level. There are several reasons why such an arrangement is desirable. The movement of passengers and of trucks conveying baggage on different levels makes it safer and easier for people to make such movements as are necessary or desirable about the station. The risk of injury to passengers is much reduced, and less platform room is required for the same amount of business. The movement of both passengers and goods can be made promptly.

On the score of economy of space and cost of land, it is better to have all work pertaining to baggage and freight under the headhouse and trainshed below the level of the tracks, thus making two uses of the ground area, which is quite an important saving where land has such value as is generally the case near the business centers of cities. Such an arrangement renders it possible also to give more and better space to carriages and teams receiving and delivering baggage and goods, also to separate the receiving and delivering points for the various classes of traffic in the station.

With the tracks above the level of the surrounding streets, passages can be made from the tracks to the streets by the most direct course, enabling passengers arriving on trains to disperse much more easily and quickly than if they are obliged to all pass along the platform and out through the headhouse. At times of extraordinary movement of passengers, this is quite an important element in their safe and prompt movement. Objection is sometimes made to such an arrangement, that it renders it necessary for passengers to go up or down stairs and that elevators are needed for the use of passengers. With careful planning, however, inclined ways can generally be provided which can be used by such passengers as object to climbing stairs.

Placing the tracks at a higher level admits of crossing above the streets near the station, avoiding the necessity of crossings at grade or of expensive changes of streets, which in important cities carry with them not only the great direct expense of making the changes, but also a greater indirect expense in the detrimental effect on the value of property. It is also generally possible to obtain better architectural effects with the tracks above the street level, as is well shown in many of the stations recently built in London and various German cities and notably in the terminal stations in Philadelphia.

Generally at terminal stations, space is allowed for carriages and cabs to stand while waiting for inward trains. In many English stations, a wide space between platforms at which long-distance trains arrive is devoted to this use, so that passengers leaving the cars can go directly across the platform into the cab. A practical objection to providing room for carriages under cover is that it is impossible to keep such places clean and free from odor.

In designing a trainshed, if the cost can be ignored, a roof of large clear span is desirable, but with most railways it is necessary to consider the first cost, and as short spans with rows of posts between the tracks give the greatest economy in construction, this plan has been followed in many of the trainsheds recently built. With the improvements in the manufacture of glass, it has become possible to make a large portion of the roof covering transparent, thus giving good light to the interior of the trainshed. The greatest objection to the use of short spans with posts is the trouble experienced in taking care of snow and the difficulty of keeping the roof tight.

Platforms between tracks should be of some hard material which can be easily kept clean. The surface of platforms should be on the same level as the top of rails, so that baggage trucks and other wheeled vehicles can pass from one platform to another upon the same level, thus doing away with the need of moving such vehicles on the same platform with passengers taking or leaving trains. This construction is also safer for passengers, especially for those who get on or off moving trains.

Unless there is some very serious practical objection, inward long-distance trains should always enter on one side of the trainshed, and outward long-distance trains depart from the other side, although such an arrangement may cause more crossing of trains on tracks outside the trainshed. The middle tracks, those between the inward and outward tracks devoted to long-distance trains, should be used for short-distance suburban trains. These suburban trains can enter the station, discharge the inward passengers and take on outward passengers without switching, another engine backing onto the train and hauling it out, relieving the engine which brought the train in. This engine can follow the train out, going to some place where provision has been made for turning and taking water ready for the next trip.

The tracks in trainsheds are usually arranged in pairs, with a platform between each pair of tracks. For suburban trains it might be well in some places to lay three tracks together, in order to allow the locomotives to pass around the trains and avoiding the necessity of drawing the train out of the station before loading it for its outward trip. For tracks on which inward trains having a large amount of baggage and express goods arrive, it might be well to change the above arrangement by placing a narrow platform between the tracks of a pair, and using this platform for baggage and express trucks, thus keeping the regular platform free for the movement of passengers, avoiding what in many stations is a serious inconvenience.

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*Abstract of a paper read by Mr. E. K. Turner, M. Am. Soc. C. E., at a meeting of the New England Association of Railroad Superintendents, at the United States Hotel, Boston, Mass., Oct. 12.

The modern application of interlocking switches and signals, with the improved methods of handling both switches and signals, together with the good track appliances and material now obtainable, makes it possible to do many things safely and promptly with moving trains that would a few years ago have been impossible, so that the crossing of trains from one track to another is now admissible, removing the principal objection to the arrangement of trains alone recommended. It is possible to have a terminal station too large, for anything beyond the room required for active use is not only wasted, but is positively objectionable. It increases the distance of those parts of the station between which passengers and employees must pass; it furnishes room for standing cars which should be stored elsewhere, and it leads to carelessness and lack of neatness in the care and policing of the station. Therefore, while a proper provision for growth of business should be made, care should be used not to carry this to an extreme.

BOOK REVIEWS.

A MANUAL OF STEAM BOILERS.—Their Design, Construction and Operation. For Technical Schools and Engineers. By. R. H. Thurston, M. A., LL. D., Dr. Eng., Director of Sibley College, Cornell University. Fifth edition, revised and enlarged. New York: John Wiley & Sons. 1896. 8vo.; pp. 881; $5.

This well-known work has now reached its fifth edition. It has been brought up to date by the addition of a good deal of new matter, among which we notice condensed reports of the tests on steam boilers recently made in England by Messrs. Donkin & Kennedy.

LOCOMOTIVE MECHANISM AND ENGINEERING.—With an Appendix on the Modern Electric Locomotive. By H. C. Reagan, Jr., Locomotive Engineer. Second Edition. New York: John Wiley & Sons. Cloth; 8vo.; pp. 419; illustrated. $2.

The first edition of this book was reviewed in our issue of April 19, 1894, and the principal addition to the second edition is the appendix on electric locomotives, which occupies nearly 100 pages. The book deals largely with the handling and emergency repairing of locomotives, while nearly 100 pages are devoted to modern types of American compound locomotives, and 80 pages to matters connected with the brakes. In the appendix the general operation of electric motors is described at some length, and particulars are given of the construction of the Baltimore & Ohio R. R., Sprague and Heilmann (French) electric locomotives. The book is written in a style easily comprehended, is well printed in large clear type, and is fully illustrated.

EXPERIMENTS UPON THE CONTRACTION OF THE LIQUID VEIN Issuing from an Orifice and upon the Distribution of the Velocities within it. By H. Bazin, Inspecteur Generale des Ponts et Chaussees. Translated by John C. Trautwine, Jr., Civil Engineer. New York: John Wiley & Sons. 8vo.; pp. 64; with diagrams. $2.00.

The author is already well known to engineers by his studies of the flow of water in open channels, made in connection with M. Darcy, and by his careful determination of the coefficients of discharge under widely varying conditions. In the present work, admirably translated by Mr. Trautwine, M. Bazin deals with the contraction of the liquid vein and the velocities within it, as observed in passing through rectangular and circular orifices in both vertical and horizontal walls. He treats of the method of determining the coefficient of discharge, the geometrical figure and transverse section of the vein, and, by a modified form of the Pitot tube, he ascertains the velocities in the vein and the distribution of these velocities. In his resume he says that his experiments do not show the generally-admitted existence of a contracted vein, if that expression is taken in the sense of a minimum section. In reality the vein, after being rapidly contracted upon passing the orifice, always continues to contract, much more slowly but constantly, as its distance from the orifice increases. While there is no doubt as to the absence of the minimum of section for veins issuing from circular and rectangular orifices there may be some doubt as to the square orifice, experimented with. In the distribution of the velocities in the plane of the orifice there is a minimum; in circular orifices in a horizontal plane this minimum is, of course, in the center and in vertical orifices it is a little above the center of gravity of the section. In the case of circular horizontal orifices the velocities are rapidly equalized as the distance from the plane of the orifice increases, and they soon become uniform through the entire transverse section. But this is not the case with orifices in a vertical plane; the minimum existing in the central region soon disappears, but the velocities in the lower part of the vein remain greater than those in the upper part. M. Bazin presents full data for all his conclusions, and gives in tabular form a long series of experiments in the determination of the velocities and of the pressures in the interior of the liquid veins.

DIE SCHWINGUNGEN EINES TRAEGERS MIT BEWEGTER LAST. (The vibrations of a girder under a moving load.)—By Dr. H. Zimmermann, Geheimer Ober-Baurath. Pp. 46; illustrations in text; 4 lithographed plates; paper; 8vo. W. Ernst & Sohn, Berlin. 1896. Price, M. 6.00 ($1.50).

In the calculation of the strains in a girder, due to static load, it is generally assumed that the live load in its various positions rests upon the girder; the fact is, however, that the live load often traverses the girder or truss with considerable speed.

The girder changes its outline under the passing live load; the latter, therefore, does not move in a straight line, but describes a curve. The movement of a body in a curved line is influenced by a centrifugal force, which depends upon the mass and the speed of the moving load. The pressure which the load exerts upon the girder is therefore dependent upon the bending moment of the latter and the speed of the passing live load; this pressure then causes the bending of the girder and incidental curvature of the line traversed. Intricate, as the law of the mutual dependence of these two factors may appear, it will still admit of mathematical investigation. Attempts in this direction have so far, however, utterly failed, as the error generally committed was to confound the curved line traversed by the moving load with the elastic curve of the girder. The author has attempted to treat this difficult subject from a mathematical standpoint. The method of integration employed here will yet admit of a solution, when the force acting upon the moving load is not unchangeable, but is a function of the position of the load. It need hardly be said that this is a piece of hair-splitting which will scarcely be applied in practical bridge design. It is an excellent example of the "mathematical engineering" which has caused so many practical men to look with distrust upon the work of technical schools. It is, however, a perfectly proper field for the student of pure mathematics, and there is no reason why it should be confounded with practical engineering studies.

A PRIMER OF THE CALCULUS.—By E. Sherman Gould, M. Am. Soc. C. E. Van Nostrand's Science Series No. 112. New York: D. Van Nostrand Co. 16mo., boards; pp. 91; with 17 folded plates. 50 cts.

The object of this little book is well expressed in the following words from the preface:

> This work is a development of the infinitesimal calculus as far as the first differentials of algebraic functions of one independent variable and their corresponding integrals. That is to say, it is restricted to the absolute rudiments of the science. Within these narrow limits, however, the treatment is tolerably full, and suffices to show how far-reaching a mathematical instrument the calculus is, even in its elementary steps. This seems to the author to be the best way of communicating a working knowledge of the science; namely, to teach a few elementary rules and then put them into immediate use, as far as they will go. The student then recognizes the necessity of the more advanced steps.

The ideas of the author, as expressed in the above extract, appear to be most excellent, and his methods of carrying them out in the book are admirable. He seems to have written the book with the intention of furnishing an easy introduction into calculus to the beginner of the study, and of making it interesting from the start by giving numerous practical examples of its application. We think, however, that the book may also be found useful to another large class of students, namely, those college graduates who toiled through calculus during their course with the object of passing an examination in it, and then proceeded as rapidly as possible to forget all about it. To many such students there comes a time in after years when they wish they could remember something of the subject, and to them this book may be useful as a refresher of their memories; in fact, it may offer to them a new view of a science which may thereafter prove to them a useful tool. The time at the disposal of the present reviewer will not allow of any critical examination of a mathematical work like this, but a rather hasty reading of the text shows it to be generally quite clear and accurate. Exception, however, must be taken to a couple of sentences on p. 29. The first is:

> The province of the calculus is to deal with ratios, which while constant as between the variables, are constantly changing as to their numerical values.

The meaning of the words "constant as between the variables," is not very clear, and the author in attempting to explain the sentence gives the differentiation of the equation of the parabola and then says the differential coefficient $dy \div dx$ "is the constant ratio of the infinitesimal increase of the ordinate to the infinitesimal increase of the abscissa, but it is changing its numerical value by infinite gradations." As the ratio $dy \div dx$ in the parabola has a different numerical value for every value of x, we cannot see how in any sense it can be considered a "constant." For the word "constant" the word "finite" should apparently be substituted, and the word "infinite" is, apparently, a misprint for "infinitesimal."

THE MANUFACTURE AND PROPERTIES OF STRUCTURAL STEEL.—By Harry Huse Campbell, S. B. New York and London: The Scientific Publishing Co.; 8vo.; pp. 397. $4.

Mr. Campbell is the superintendent of the Pennsylvania Steel Co., at Steelton, Pa., having been connected with that company since 1879, shortly after his graduation from the Massachusetts Institute of Technology. During the last few years he has contributed several papers on the subject of steel to the Transactions of the American societies of mining and civil engineers, which have shown an unusual amount of scientific study and experiment for one practically engaged in manufacture. The volume he has now produced is filled with matter of great value to every student of the subject of steel, and especially to the engineer who uses steel in construction. Mr. Campbell is not a professional writer of books, and the reviewer from a literary standpoint might find much in it to criticise. For instance he writes as if all his readers were well-versed in steel technology, whereas many of them will be young students who would like to have his definitions more clearly explained. Thus under the head of the Acid-Bessemer Process, he states that the operation is conducted in an "acid-lined vessel." This may be perfectly clear to those familiar with the difference between the "acid" and the "basic" processes, but it might be well to explain that the "acid lining" is made of fire-brick or ganister high in silica, while the "basic" lining is one high in lime and magnesia. Such literary defects, however, are of trifling importance as compared with the value of the work as a whole. Mr. Campbell is an original investigator, he has a great deal of valuable information to give as the results of his researches, and he gives it in his own way. We should be grateful to him for having thus given us the results of his labors, and not be hypercritical as to its literary form.

We are glad to observe that Mr. Campbell takes strong ground in regard to the retention of existing trade nomenclature. Thus he closes a discussion in which he unsparingly castigates those writers who have endeavored to thrust into our language the terms "weld-iron, ingot-steel," etc., by the following:

> By the term wrought iron is meant the product of the puddle furnace or the sinking fire. By the term steel is meant the product of the cementation process, or the malleable compounds of iron made in the crucible, the converter or the open-hearth furnace. This nomenclature is not founded on the resolutions of committees or of societies. It is the natural outgrowth of business and of fact, and has been made mandatory by the highest of all statutes—the law of common sense. It is the universal system among engineers not only in America but in England and in France. In other lands the authority of famous names, backed by conservatism and governmental prerogative, has fixed for the present, in metallurgical literature, a list of terms which I have tried to show is not only deficient, but fundamentally false.

In regard to the recent controversy concerning the elastic limit and the "yield point," Mr. Campbell takes equally strong ground, quoting from the editorial review of the subject in Engineering News of July 25, 1895, and approving the position there taken in the following words:

> These conclusions represent common sense in their summary dealing with the petty theories of enthusiasts, who are so wrapped up in the accurate determination of a micrometrical measurement that they ignore the more important variations inherent in the method itself, not to mention the still more overwhelming differences caused by changes in the history and shape of the material.

The first chapter of the book is entitled "The Errancy of Scientific Records," and is devoted especially to a discussion of the differences in results of chemical analysis of steel as obtained by different chemists. Then follow chapters on pig iron, on wrought iron, and on the several metallurgical processes by which steel is made. This portion of the book, which occupies about a quarter of the whole, will be of interest chiefly to metallurgical students. The remainder of the work appeals more directly to the structural engineer. It contains chapters on homogeneity and segregation, influence of hot working, annealing, the history and shape of the test piece, the influence of certain elements on the physical properties of steel, classification of structural steel, welding, steel castings and inspection. A great deal of space is given to a mathematical investigation by the method of brace squares, of the problem what is the influence of carbon, phosphorus, manganese, copper, sulphur and silicon upon ultimate tensile strength. To solve this problem, the records of 1,880 test pieces were taken, combined into 137 groups, and the average chemical analysis of each group was obtained. An enormous amount of mathematical work was performed upon this mass of data, resulting in the conclusion that the method of least squares is inapplicable to the problem if all the data are included. Thus the mathematical solution gave the absurd conclusion that .06% of sulphur would increase the strength of steel 22,000 lbs. per sq. in., when in fact it would cause only a very slight increase, if any. By neglecting the factors silicon, copper and sulphur from the mathematical equation and applying the method of least squares to the remaining factors, equations were reached which gives results which are probably as close to actual test records as any formula for relation of strength to chemical analysis can possibly give, although individual tests will frequently show wide differences from the result given by the formula.

The chapter on inspection should be carefully read by every one who has occasion to draw specifications for steel contracts. Dishonesty of manufacturers is a "sad fact" to which Mr. Campbell calls attention, and his exposure of some of the tricks of the trade should have a salutary influence.

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AND
AMERICAN RAILWAY JOURNAL.

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THE THREE ELECTRIC LOCOMOTIVES of the Baltimore & Ohio R. R. tunnel line, at Baltimore, O., will soon be used to handle the passenger trains as well as the freight trains. The overhead conductors are being extended ¾ mile northward (to the new Mount Royal station) and 1,500 ft. southward, to obviate the necessity of using steam pusher engines on the tunnel approaches. The electric engines are giving good satisfaction, and the maximum trainload hauled so far has been a train of 41 loaded freight cars with two locomotives not working. The electric power plant is now being used not only to furnish the power for the tunnel locomotives but to run 180 street cars of the Baltimore Traction Co., and also to light the Camden station and yards, the tunnel, the Locust Point freightsheds, warehouses and yards, the Mount Clare shops and the new Mount Royal passenger station.

◆

THE CASCADES LOCK, built by the U. S. government for passing the Cascades on the Columbia River, Oregon, was formally opened to traffic on Nov. 6. The completion of the 3,000 ft. of canal through the rocky gorge of the Columbia River and the construction of this lock was contracted for on Jan. 24, 1893, with J. G. & I. N. Day. It was to be finished in one year from the date of contract, but the unprecedented flood of June, 1894, and other causes delayed the work. The lock is 521 ft. long between hollow quoins, 90 ft. wide and has a low-water lift of 24 ft. The lock and guard gates are built of steel and were furnished by the Maryland Steel Company, of Sparrow's Point, Md. They are of the single-skin type, swinging freely on the pivots without the aid of rollers or flotation chambers. The height of the lower guard gate is 36 ft. above the miter-sill, and the lower lock gate is 46 ft. and the upper lock gate 40 ft. high, with an upper guard gate 54 ft. high. These are claimed to be the highest metal gates ever built; the five gates in the Sault Ste. Marie Canal, built by the U. S. government, ranging from 25½ to 43 ft. in height.

◆

THE DRY-DOCK AT ABERDEEN, Scotland, has become famous among engineers for the deterioration of the Portland cement concrete used in its construction through the chemical action of the sea water. In 1887, repairs were carried out on the dock under the direction of Mr. P. J. Messent, M. Inst. C. E., but the deterioration has continued, so that the engineer to the Aberdeen Harbor Board has just made a report advising the entire reconstruction of the dock at an estimated cost of about $500,000. The action of the sea water on the cement at the Aberdeen dock was fully described in Proc. Inst. C. E., Vol. CVII, pp. 73-198.

◆

ADDITIONAL WOOD PAVEMENTS IN MILWAUKEE are prohibited by an ordinance now pending before the common council of that city. The ordinance also provides that all pavements must be laid on concrete foundations. The ordinance may be amended to permit the use of wood pavements in outlying districts, to be laid on concrete. The requiring of concrete foundations would in itself practically exclude wood, according to Mr. Geo. H. Benzenberg, M. Am. Soc. C. E., City Engineer, who states that in Milwaukee brick pavement is cheaper than wood, if each is laid on concrete.

THE PROTECTION OF MACADAMIZED ROADS is aimed at in an ordinance prepared by the Street and Water Board of Jersey City, N. J. The trucking traffic on some of the avenues has become very heavy since the new pavement was put down, and much damage has already been done. The ordinance provides that vehicles which weigh, with their loads, 2,000 lbs. or over, shall be provided with tires not less than 3 ins. wide, and vehicles weighing 5,000 lbs. or over shall have tiers not less than 4 ins. wide.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was caused by a rock slide on the Northern Pacific R. R., near Paradise, Mont., Nov. 10. A passenger train ran into the slide and the engineman was killed, while the fireman was badly injured.

◆

A LOCOMOTIVE BOILER EXPLOSION occurred Nov. 5, in the yards of the Southern Ry., at Atlanta, Ga. The engine had just come in from Chattanooga, and was in the cleaners' hands. Two men were killed.

◆

A RAILWAY BRIDGE COLLAPSED under a wrecking train, Nov. 1, near North Adams Junction, Mass., on the Boston & Albany R. R. The derrick had not been fully secured and had slewed so as to strike one of the trusses. The engine and cars went down, but the crew jumped and nobody was hurt.

◆

A BROKEN CRANKSHAFT on the twin-screw steamer, "Fuerst Bismarck," of the Hamburg-American Line, on its latest trip to New York, obliged the vessel to finish its trip with only the port engine working. The crack developed just beyond the after crank cheek of the crank of the low pressure cylinder of the starboard engine. A spare shaft was carried, and this was fitted in place in time to allow the ship to sail on Nov. 14, as scheduled.

◆

A FLY-WHEEL BURST in the power house of the Rochester, N. Y., Gas & Electric Co., on Nov. 6. The wheel was 18 ft. diameter and 42-in. face, and weighed about 20 tons. One of the flying pieces struck the steam pipe above the engine, breaking the pipe and allowing steam to escape, by which the engineer was seriously burned. Other fragments passed through the ceiling of the engine room into the dynamo room above, wrecking it, and putting a portion of the city in darkness. The probable cause of the accident is not given in the press reports, other than the statement that the wheel was defective.

◆

FOUR BOILERS EXPLODED at the Centralia colliery, Shamokin, Pa., on Nov. 7, killing four men and causing a loss of $10,000. The four boilers were in a group of 16. It is stated that one of the men, who was fatally injured, saw steam issue from a crack in one of the boilers, and shouted a warning, but the explosion took place before any one could get out of the boiler house.

◆

A SAW-MILL BOILER exploded at Summersville, W. Va., on Oct. 22, killing three men and injuring three others. Pieces of the boiler were thrown several hundred yards.

◆

THE U. S. BATTLESHIP "TEXAS" sank in the East River on Nov. 9. Fortunately the mud in the bottom of the river in front of the Brooklyn Navy Yard, where the vessel was stationed, was only a few feet below the keel, so that the sinking was not a serious matter as it would have been if it had happened in the middle of the river or at sea. The ship was raised the next day, and the total damage, it is said, will not reach $10,000. The true cause of the accident will not be known until after an investigation by a court of inquiry, which has been appointed by the Secretary of the Navy, but from the imperfect reports now available it appears that it was due to the breakage of a 13-in. sea-cock, through which water enters to supply the condensers, and the filling of the engine-room compartment by water. It is also stated that the bulkhead doors between the engine-room failed to hold water. The accident should lead to a thorough investigation of the water-tightness of compartment doors and of the strength of sea-cocks.

◆

THE LEAKY RESERVOIR AT MONTREAL has been reported on by Prof. C. H. McLeod, of McGill University, and Mr. J. O. A. La Forest, Acting Superintendent. The reservoir has a capacity of 42,000,000 U. S. gallons and is formed by a masonry wall, backed first with puddle and then with an earth and stone embankment. Hook gage measurements, with allowances for evaporation, showed that with 23 ft. of water the level fell at the rate of 2.302 ins. in 24 hours, the test lasting 13 hours, or at the rate of about 350,000 U. S. gallons per 24 hours. With 18 ft. of water the leakage was at the rate of 120,000 U. S. gallons per 24 hours. Mr. La Forest believes the leakage is caused by the ice action near the high water line. Both he and Prof. McLeod recommend that the upper portion of the walls be repointed before cold weather sets in, as a temporary measure. Prof. McLeod suggests that "it might be well to consider the advisability of coating the walls with a waterproof wash." The water committee has been instructed to have the repointing done, as recommended. Mr. La Forest states that the high level reservoir, with a capacity of about 1,900,000 U. S. gallons, leaks 54,000 U. S. gallons a day, making the leakage of the two reservoirs more than 400,000 gallons a day. It costs $8 per day to pump the water wasted, in addition to which the leakage from the larger reservoir passes to the grounds of McGill University where, according to Prof. McLeod, it "constitutes a very serious source of injury to the buildings and grounds of the university."

◆

A MUNICIPAL ELECTRIC LIGHTING PLANT for Des Moines, Ia., is recommended by Mr. John MacVicar, Mayor, after a somewhat extended investigation of the subject. Public lighting now costs the city $53,500, divided as follows: Electric street lamps, $31,696; electric lights for city hall, $2,202; gas street lamps, $5,724; gasoline street lamps, $13,888.

◆

MUNICIPAL BONDS are now in active demand, where a month ago they could hardly be sold on any terms. The city of New York, which in September could not obtain bids for its bonds at all, opened bids on Nov. 10 for 3½% bonds to the amount of $16,000,000. There were no less than 185 bids received and the total of all the bids reached the enormous sum of $181,000,000.

◆

A NEW STEAM GARBAGE SCOW for the city of New York was launched Nov. 9 from the Crescent ship yards of Mr. Lewis Nixon, at Elizabethport, N. J. The boat, which has been christened the "Cinderella," is a twin-screw vessel, formed of two pontoons with a garbage compartment between, having an estimated capacity of 600 cu. yds.

◆

A FAST RAILWAY RUN was made on the Chicago, Rock Island & Pacific Ry., Nov. 8, by a train carrying a party of the Western Society of Engineers from Davenport back to Chicago. The run of 181 miles was made in 3 h. 41 mins., or 3 h. 30 mins. actual running time. The distance of 163 miles from Moline to Blue Island was made in 176 minutes running time, excluding three stops.

◆

MUNICIPAL HOSTILITY TO RAILWAY CORPORATIONS is the main reason given by Judge Biddle at Carlisle, Pa., for refusing the petition of the people of Riverton to have the tracks and property of the Cumberland Valley R. R. and Northern Central R. R. included in the new borough. The former road has large and busy terminal yards, while the latter has a traffic of 40 trains daily. The following is an extract from the decision:

> From recent litigation we know that inharmonious relations exist between the inhabitants of Riverton and the two companies above referred to, and this makes manifest the fact that if the tracks of the latter should be brought into the borough, the business thereon would be liable to be much hampered by ordinances relating to the speed of trains, crossings at grade, employment of watchmen, and other matters in regard to which the authorities of a town are at times prone to legislate. On account of the unusual amount of train work which is done at the locality in dispute, severe damage, both to the stockholders and to the public could be inflicted by an unreasonable or hostile council. We have no hesitation in laying down the broad abstract proposition that it is directly contrary to public policy to unnecessarily subject the corporations of a railway to local municipal control, and, therefore, as no necessity or even reasonable cause for doing so appears in this case, the court would not be justified in granting the prayer of the petitioners.

◆

THE PLANS FOR THE BASCULE BRIDGE over Newtown Creek, Brooklyn, N. Y., have been modified to the extent of increasing the span 24 ft., to give a clear span of 150 ft. clear of the fenders. The designs for the bridge were published in our issue of Nov. 5.

◆

THE WORK OF THE BUILDING DEPARTMENT of New York city during the first nine months of 1895 and 1896 is shown by the following table, which is taken from the quarterly report of Mr. Stevenson Constable, Superintendent of the Department of Buildings:

	1895.	1896.	Increase in 1896.
Applications filed, new bldgs. and alterations	4,228	5,416	1,188
New buildings commenced	2,164	2,175	11
New buildings completed	1,703	2,480	777
Alterations commenced	1,094	1,465	371
Alterations completed	1,105	1,546	441
Iron and steel beams, girders, etc.	58,106	161,162	103,056
Violations of the law reported by inspectors	3,843	4,754	911
Buildings reported by inspectors as unsafe	1,705	2,666	961
Notices issued	10,704	39,457	28,753
No. inspections made of passenger elevators	2,632	4,257	1,625
Unsafe buildings made safe or taken down	1,204	2,510	1,306
Violations removed	2,722	4,628	1,906
Cases forwarded attorney for prosecution	2,714	2,772	58
Pass. elevator cases to attorney for prosecution	16	182	166
Defective pass. elevators reported by inspectors	62	856	794
Made safe on notice from Dept.	44	912	868
Notices of suits issued	5,075	5,284	209
Cases disposed of by attorney	2,841	4,522	1,681
Totals	101,962	247,044	145,082
Money collected by the attorney..	$5,778	$14,337	$8,558

THE STEEL ARCH ROOF FOR THE CHICAGO COLISEUM.

(With inset.)

One of the largest single span steel arch roofs erected in this country since the construction of the great buildings for the Columbian Exposition at Chicago is that recently completed to cover the main auditorium of the Chicago Coliseum, a building designed for convention and exhibition purposes and located about on the site of the "Wild West" show, so familiar a side feature at the great World's Fair of 1893. It is of passing interest to note that this same "Wild West" show was the attraction which inaugurated the recent opening of the building to the public, and perhaps of more interest to some of our readers—of certain political affiliations at least—to note that it was the scene of the struggle which signalized the choice of a Presidential nominee at the Democratic convention held July 7. It is for great exhibitions and assemblies of this kind that the Coliseum is designed. It is the magnitude of its steel roof, however, and not its uses, that makes the structure worthy of description in Engineering News.

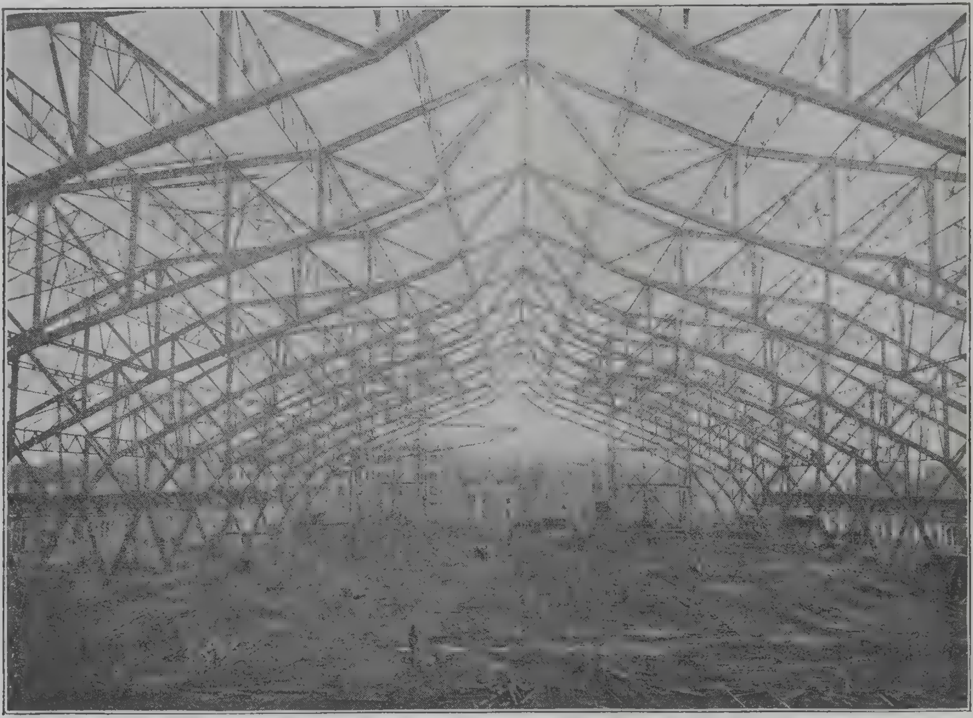


FIG. 11.—INTERIOR VIEW SHOWING ROOF ARCHES CHICAGO COLISEUM

The dimensions of the roof arches of the Coliseum as compared with those of a number of other large arch roofs, are as follows:

	Span c. to c. end pins.		Clear height at center.		Width out to out.		Length out to out.		No. pairs of arches.
	ft.	ins.	ft.	ins.	ft.	ins.	ft.	ins.	
Manufactures' Bldg.*..	368	0	206	4	787	0	1,687	0	18
Mach. Hall, Paris Ex.*.	364	0	147	7	480	0	1,380	0	20
Pa. R. R., Philadelphia.	300	8	100	4	304	4	589	0	10
Pa. R. R., Jersey City.	252	8	86	0	256	0	652	6	12
P. & R. R. R., Phila..	259	0	88	0	266	0	506	8	11
Mid. Ry., London.....	240	0	100	0	....		600	0	..
Chicago Coliseum*	215	0	73	10	300	0	675	2	6

---

*These figures of length and width include the area covered by shed roofs and side galleries, except in case of the Coliseum where the end vestibule and ticket office is not included.

Most of the above structures have been described in previous volumes of Engineering News; the two Pennsylvania R. R. train-sheds, Sept. 26 and Oct. 3, 1891, and June 1, 1893; the Philadelphia & Reading R. R. trainshed, Jan. 19 and Feb. 2, 1893, and the Manufactures Building and Paris Machinery Hall, Sept. 1, 1892. No roof arches yet built have exceeded in span those for the Manufactures Building at the Columbian Exposition; and including shed roofs, no building yet constructed has ever had so great an area of ground plan.

As a matter of some interest, the capacity of the Chicago Coliseum as compared with the capacities of some other buildings designed for public gatherings, is given below from figures made public by its architect, Mr. S. S. Beman, of Chicago:

Name of Building.	No. people.	Name of Building.	No. people.
Chicago Coliseum....	50,000	St. Sophia, Constantinople	23,000
St. Peter's, Rome....	54,000	Notre Dame, Paris..	21,500
Cathedral, Milan....	37,000	Cathedral, Pisa......	13,000
St. Paul's, Rome....	32,000	St. Stephens, Vienna.	12,400
St. Paul's, London..	31,000	S. Dominic's, Bologna.	11,400
St. Petronia, Bologna.	26,000	Cathedral, Vienna...	11,000
Cathedral, Florence..	24,600	Madison Sq. Garden..	8,433
Cathedral, Antwerp..	24,300		
St. John Lateran, Rome	23,000		

The manner of seating the large assemblies which the Chicago Coliseum will accommodate will vary somewhat according to the extent of main floor required for exhibition purposes. Two stationary galleries extend around the building on all four sides and these are provided with permanent seats, but the seats on the main floor are movable and will be arranged to suit conditions. Only the weight of the audience in the galleries comes on the framework of the building.

The Chicago Coliseum is 675 ft. 2 ins. long without the vestibule, and 300 ft. wide in its outside dimensions. In Figs. 1 to 4 inclusive, are shown a number of plans and sections which give in diagram the principal features of the steel framework. Corresponding members in the sections and plans are lettered alike, so that reference from one to the other is easy. It is obviously impossible to show within reasonable space the details of all members and the detailed drawings here will be confined to a few of the most interesting features only. From these and the diagrams, Figs. 1 to 4, the nature of the construction will, we think, be reasonably clear.

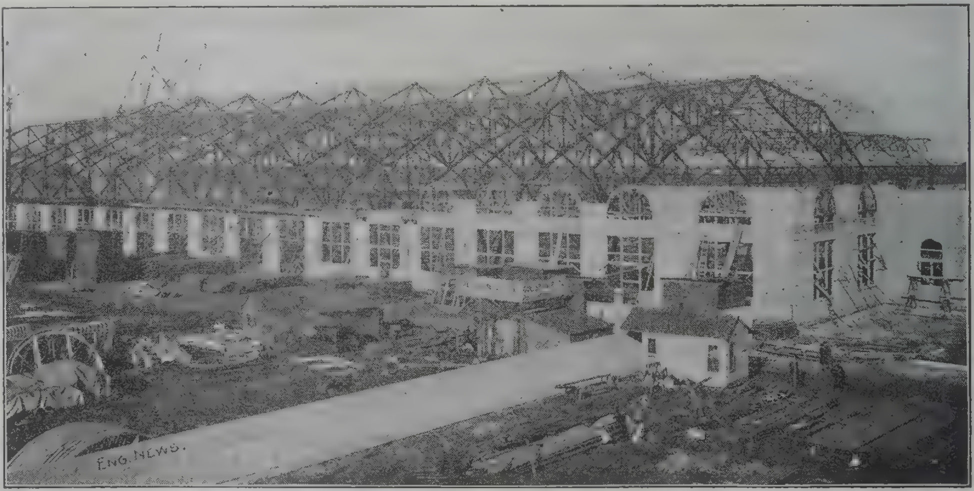


FIG. 12.—EXTERIOR VIEW SHOWING STEEL ROOF FRAMEWORK AND PARTLY COMPLETED SIDE WALLS.

Fig. 1 is a plan of the roof framing, showing the main roof arches, lateral bracing, purlins, shed roof trusses and their supports. Fig. 3 is a part plan of the gallery framing, and Figs. 3a, 3b, 2 and 4 show the above framing in section. There are twelve main roof arches connected in pairs. The two arches forming each end pair have the outline shown by Fig. 5, and the eight forming the four interior pairs have the outline shown by Fig. 6. The main difference between these two styles of arches is at the apices; the apex of each interior arch being raised at the demand of the architect so as to give the building an appearance of height to correspond with its great lateral dimensions, and yet to obtain as far as practicable the advantages of easy heating which a low roof presents. This form of apex was also influenced by the style of skylight framing and roof construction adopted by the architect, as it saved a vertical ridge frame for the ridge skylight and considerable supplementary ironwork; in brief, it was considered a cheaper and practically as satisfactory a construction by the engineer under the conditions imposed upon him. A study of the strain sheet, Fig. 6, showing the apex members will enable the reader to determine for himself the sufficiency of the design. Fig. 2 shows the two styles of arches side by side and also shows the span, height, foundations, etc. It will be noticed, particularly, that the horizontal thrust is taken by the foundations, there being no tie rod between end piers. The strain sheets show this thrust and also the strains in all other members of the arches under various conditions of loading.

The arch roof covers the main auditorium and the shed roof provides for a gallery and extends the main floor beyond the feet of the main arches, as shown by Fig. 2 and Fig. 4. At the side of the building the trusses forming the shed roof and carrying the gallery are carried by the girders and arches Fig. 3b and the wall columns Fig. 2, the construction being quite simple. At the ends the trussing necessary to carry the shed roof is somewhat more complicated, as shown by Figs. 2 and 4, but will be easily understood from the drawings, Sections Y. Z. and N. S. The part longitudinal elevation, Fig. 4, shows the timber roof carried by the steel framework, and it is also indicated in outline on Section Q. R., Fig. 2. This timber roof was used partly for architectural appearance and partly to provide for skylights, the architect fearing that such lights in the plane of the roof would not be satisfactory under snow load and on account of leakage, and also that the cost would be greater.

The framework of the arch roof comprises besides the arches proper 17 lines of purlins and wind bracing. The purlins between the pairs of arches differed from those between the arches of each pair as indicated by Fig. 3a. The purpose of the bracing below the purlins in the latter case is of course for the purpose of holding from lateral motion the lower chords of the arches. With the other type of purlins the lower chord is stiffened simply by a knee brace, Fig. 3a. The wind bracing is in the plane of the top chord of the arches and its character is shown by Fig. 1.

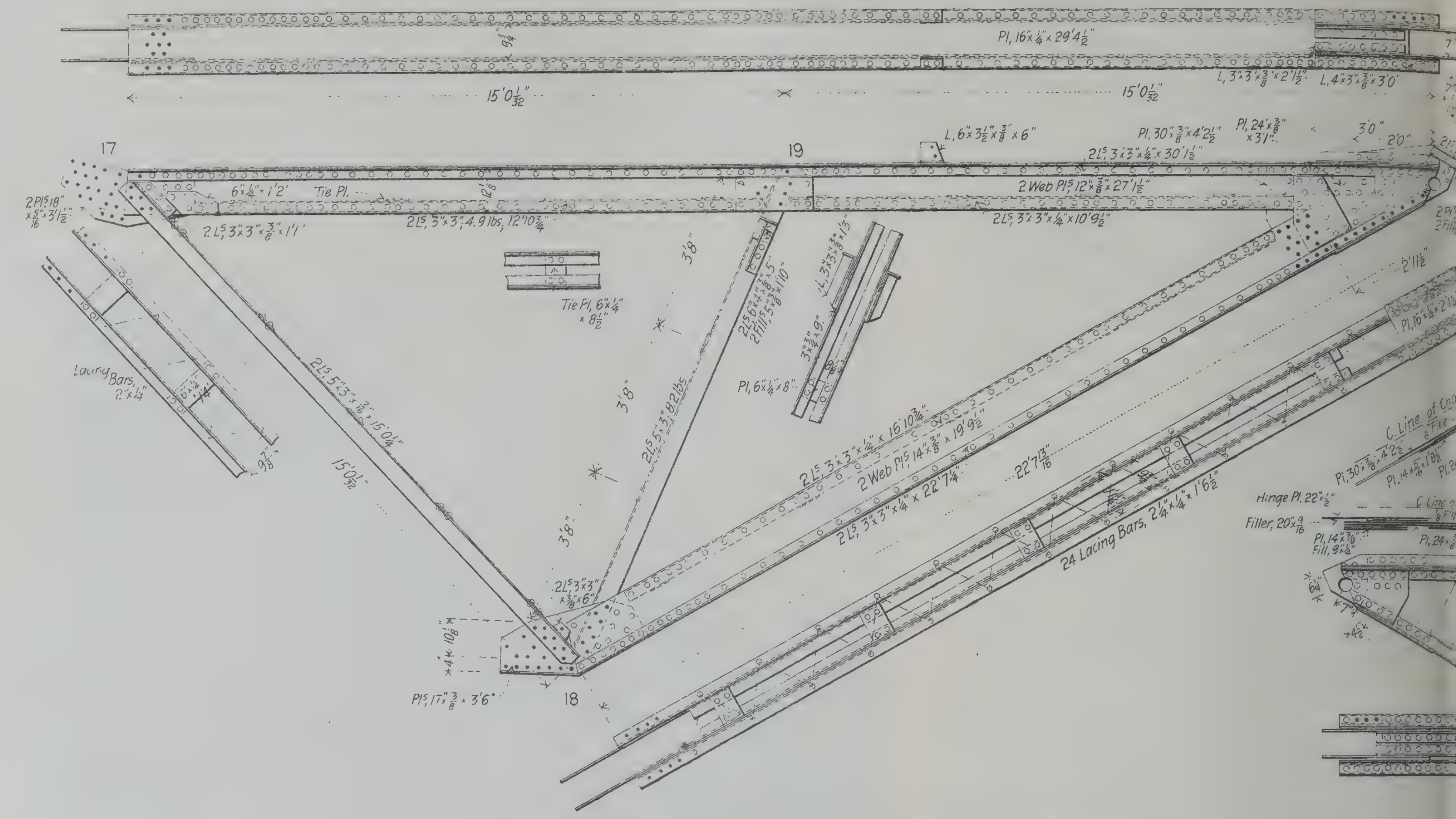
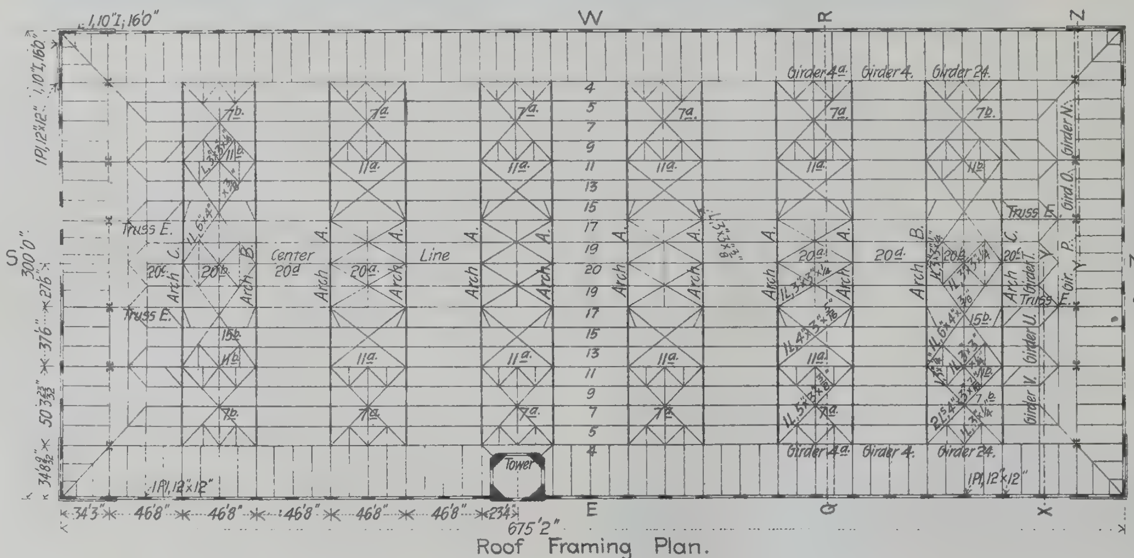


FIG. 9. DETAILS OF APEX FOR INTERIOR ARCHES A.



Roof Framing Plan.

FIG. 1.

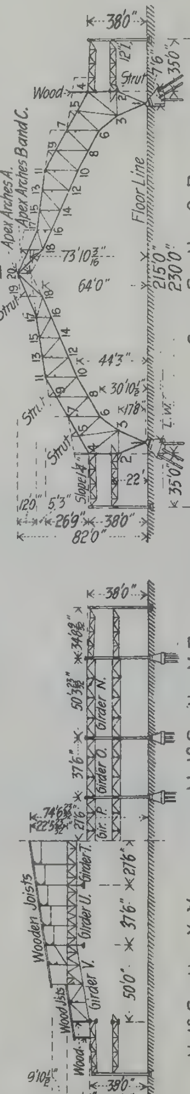


FIG. 2.

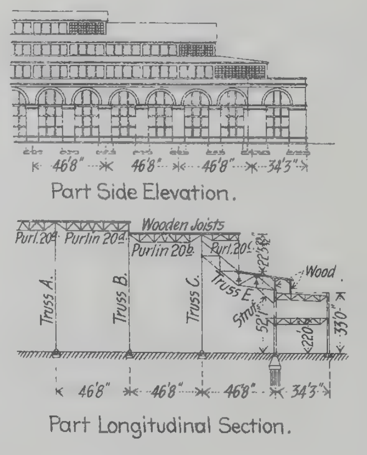


FIG. 4.

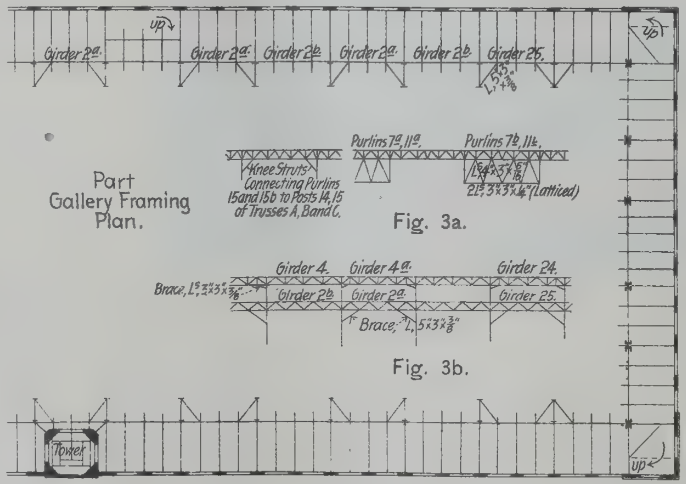

up
Girder 2a.
Girder 2b.
Girder 25.
Tower
Part Gallery Framing Plan.
Knee Struts Connecting Purlins 15 and 15b to Posts 14, 15 of Trusses A, B and C.
Purlins 7a, 11a.
Purlins 7b, 11b.
2L^s 3"x3"x¼" (Latticed)
Girder 4.
Girder 4a.
Girder 24.
Brace, L^s 5"x3"x⅜"

Fig. 3a.

Fig. 3b.

FIG. 3.

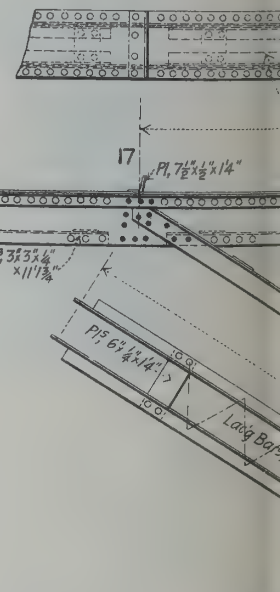


FIG. 1

STEEL ARCH ROOF OF TH

Carl Binder, Chicago, Ill., Designer and Contractor

Probst Constru

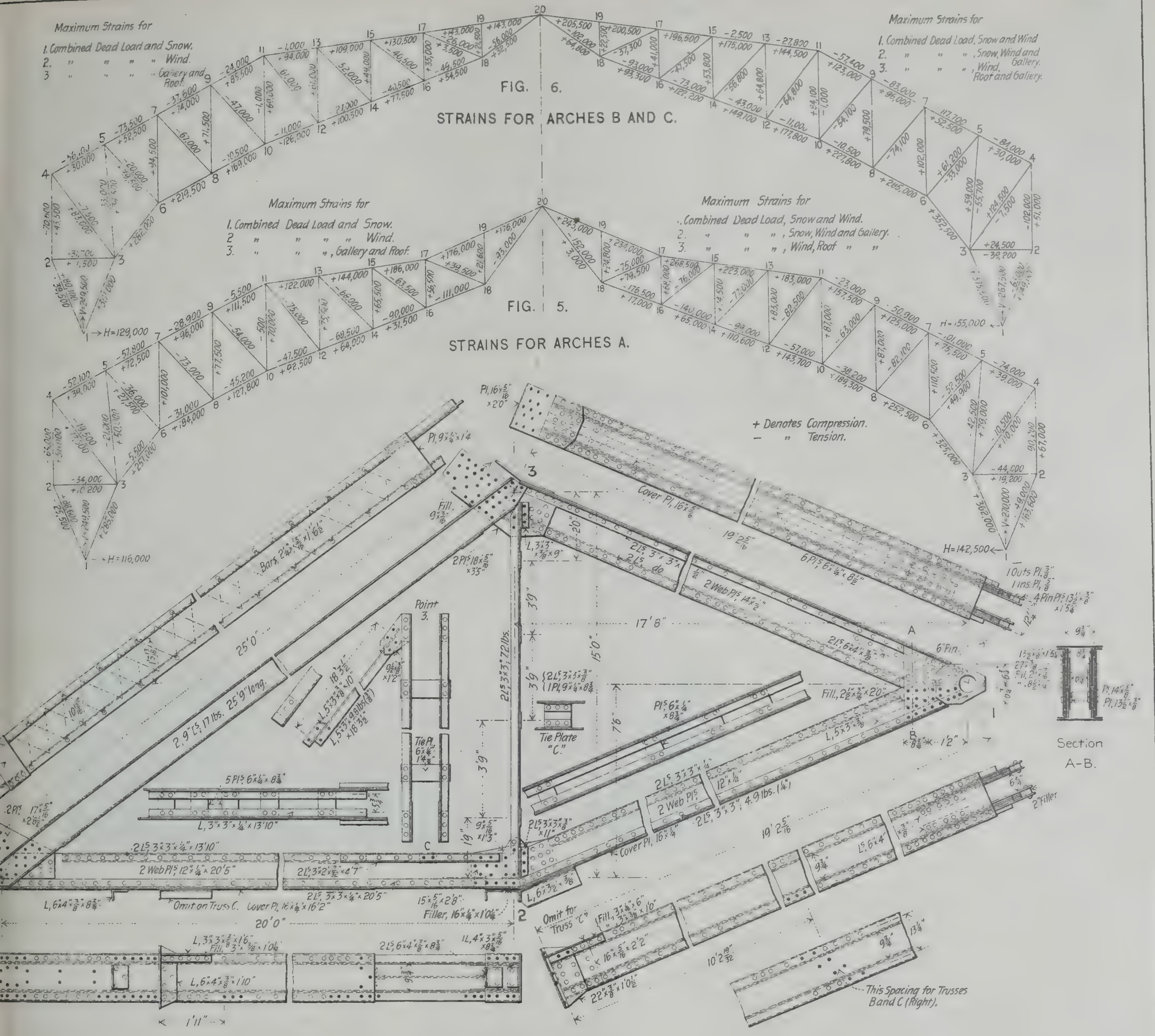
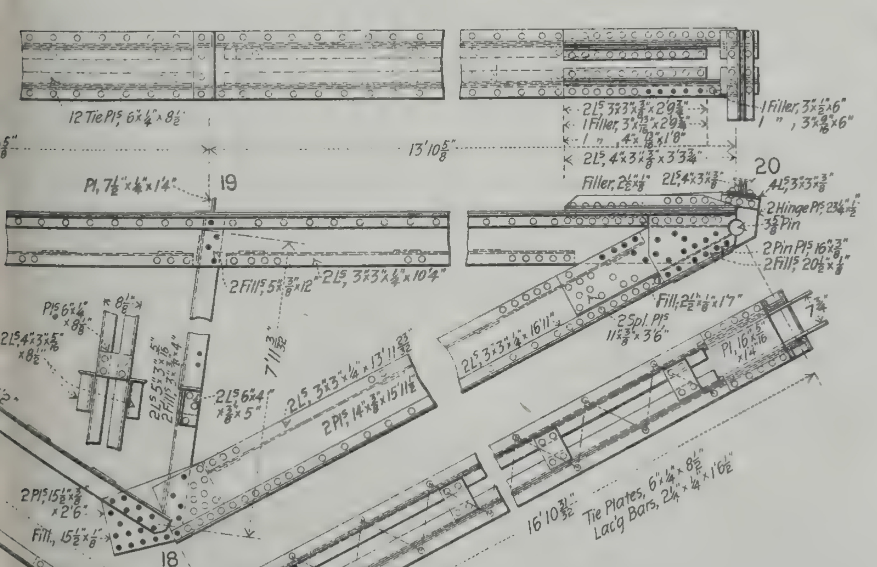

Maximum Strains for
1. Combined Dead Load and Snow.
2. " " " " Wind.
3. " " " " Gallery and Roof.
Maximum Strains for
1. Combined Dead Load, Snow and Wind
2. " " " , Snow, Wind and Gallery.
3. " " " , Wind, Roof and Gallery.
Maximum Strains for
1. Combined Dead Load and Snow.
2. " " " " Wind.
3. " " " , Gallery and Roof.
Maximum Strains for
1. Combined Dead Load, Snow and Wind.
2. " " " , Snow, Wind and Gallery.
3. " " " , Wind, Roof " "
H=129,000
H=116,000
H=155,000
H=142,500
+ Denotes Compression.
− " Tension.
Point 3.
Tie Plate "C."
Section A-B.
This Spacing for Trusses B and C (Right).
Omit for Truss "C"

FIG. 6. STRAINS FOR ARCHES B AND C.

FIG. 5. STRAINS FOR ARCHES A.

FIG. 7. DETAILS OF ARCH FOOT.



APEX FOR END ARCHES B AND C.

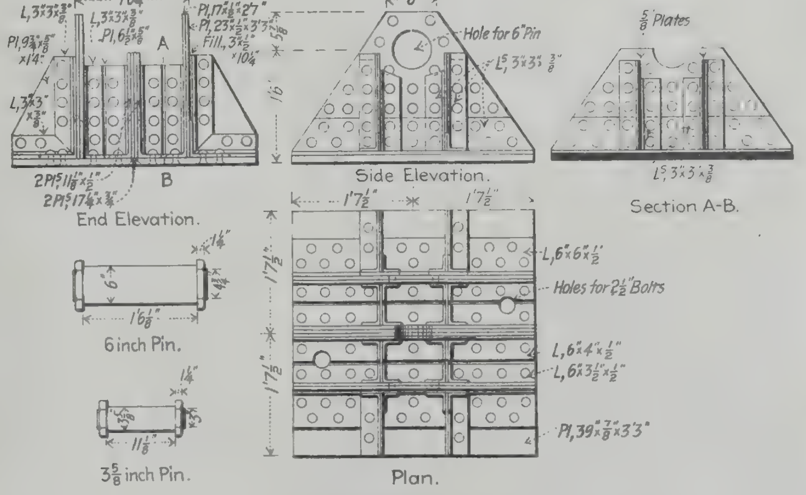


FIG. 8. DETAILS OF BEARING SHOES FOR ARCHES.

O COLISEUM, CHICAGO, ILL.

York. S. S. Beman, Chicago, Ill., Architect.

General Contractors.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

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In the foregoing the general arrangement and nature of the steel work is pretty clearly indicated and attention may now be turned to the composition and some of the details of the various arches, girders, purlins, trusses, etc. The main roof arches will be considered first. They are three-hinged arches and the details of chief interest are the feet and bearing shoes and the apices. Fig. 7 is a detail of the arch foot and Fig. 8 details of the shoes. These drawings give all dimensions and need not be described further. Fig. 9 is a detail of the apex of the arches of the form shown by Fig. 6, that is the eight interior arches. This detail is of especial interest in connection with the peculiar shape of the arch at the apex—the reasons for which were stated above.

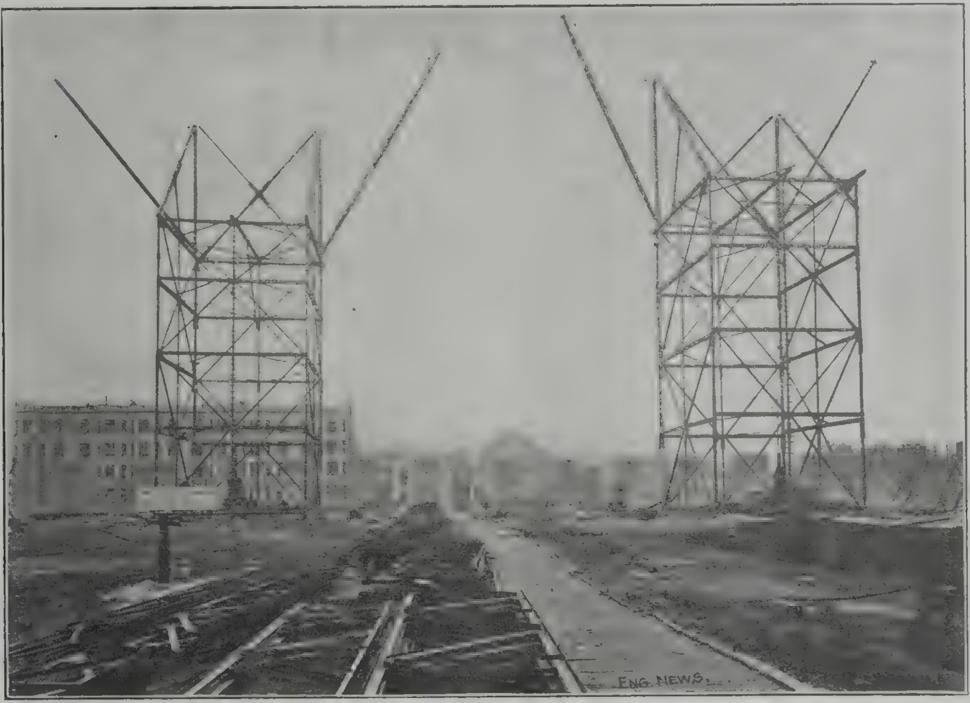


FIG. 13.—VIEW SHOWING TRAVELERS USED IN ERECTING ROOF ARCHES.

The composition of the purlins, girders and other trusses is of one type, viz., riveted triangular truss work. The members consist of one or more angles with riveted plate connections; generally the chords consist of two angles and the web of single angles. The shapes of the various trusses are indicated clearly in the general plans, Figs. 1 to 4. All material was steel and was required to show a tensile strength of 58,000 lbs. to 68,000 lbs., an elastic limit not less than 32,000 lbs., an elongation of 22%, and a reduction of area of 45%. The assumed loads for which the metal work was calculated were as follows:

	Per sq. ft.
Dead load	25 lbs.
Live load, vertical snow and wind	20 "
Live load, horizontal wind	30 "
Purlins:	
Dead load	12 "
Live load, vertical	30 "
Gallery and roof girders:	
Dead and live loads	80 "

In tension the maximum allowable strains were for main trusses 16,500 lbs.; for purlins, 14,500 lbs., and for gallery and roof girders, 15,000 lbs. per square inch. In comparison the maximum strains were, for the main trusses, those obtained by the formula,

$$\frac{15,000}{1+\frac{L^2}{36,000\, r^2}}.$$

and for the purlins and gallery and roof girders, respectively, the same with the numerators 14,000 and 14,500, in the formula. The possible conditions of loading assumed are shown on the strain sheets Figs. 5 and 6.

The extent and general character of the steel work have been pretty clearly shown in the foregoing, but additional clearness will be given to the construction by the photographic views Figs. 11 and 12. The first of these is an interior view along the longitudinal axis of the building and shows the truss work and purlins principally. The second is an exterior view and shows the side walls partly completed and also gives a rather impressive view of the network of roof framing. In Fig. 11 it will be noticed that at the far end one of the roof trusses is being erected, the right half being nearly at full elevation and the left half part way up. The traveling towers used for erection are also shown in this view and more clearly by Fig. 13. Each half arch was assembled complete on the ground and raised into position by tilting up the apex. After the erection of the roof arches the other framing was put in place by means of hoists and derricks placed on the roof.

As the readers of Engineering News already know (Eng. News, Aug. 29, 1895), a serious accident occurred to this building during its construction, and although the data are not available for a full discussion of the causes of this accident, a few words may be said in regard to its occurrence. The accident took place Aug. 21, 1895, after twelve main roof arches and most of the other roof framing were in place, although probably not fully connected, and resulted in the collapse of all but one of the roof arches. The collapse occurred at night when no one was at work, so that no person was hurt, and as far as known it occurred unwitnessed. The accident is stated by the engineer and designer to have been due probably to the fact that roofers had concentrated large loads of boarding and other timber at various points on the roof, thus increasing the strain to a dangerous point at places and at a time when the framework was not in the best condition to withstand it. After the collapse the steelwork was entirely rebuilt and it is of course this second structure that is shown by the illustrations accompanying this article.

The architect for the Chicago Coliseum was Mr. S. S. Beman; the general contractors were the Probst Construction Co., and the designer of and contractor for the steel work was Mr. Carl Binder, all of Chicago. The material was furnished by the American Bridge Works and inspected by G. W. G. Ferris & Co., also of Chicago. The building was erected by the Chicago Exhibition Co. For the drawings from which our illustrations are prepared we are indebted to Mr. Carl Binder.

THE EXHIBITION OF VALVES AND HYDRANTS at New York city, which was to have been held on Nov. 10, has been postponed to Nov. 17. The exhibition will be at the Corporation Yard of the Department of Public Works, 437 East 24th St. All exhibits must be at the yards by Nov. 14. Col. Chas. H. T. Collis, 150 Nassau St., is Commissioner of Public Works, and Mr. A. G. Gear is General Foreman Corporation Yards.

THE TOPOGRAPHICAL SURVEY OF BALTIMORE, MD.

In connection with and as a necessary preliminary to projected municipal improvements in the city of Baltimore, Md., a thorough topographical survey of that city was authorized by an ordinance passed on April 26, 1893. A commission was appointed made up of the Mayor, City Register and City Comptroller, and Col. H. T. Douglas, M. Am. Soc. C. E., was selected as the Chief Engineer of the survey. The first section of the ordinance called for "a thorough, accurate and comprehensive geodetic and topographical survey" of the city of Baltimore, beginning with the recently annexed district. From these surveys official maps were to be made:

> On a scale sufficiently large to show clearly the following details: All streets and alleys as now laid out, with their width between the building lines; the elevation of streets above mean tide, at street corners or at other points, as may be necessary; the dimensions of blocks in feet and inches; all streets not yet opened to be located by dotted lines and their grades established, with a view of conforming to a uniform system of surface drainage or underground sewerage, and the survey made of the unimproved and undeveloped portions of the city shall be such that there may be defined on said map, all streams, water-courses, highways, boundary lines of farms or estates, with the names of the owners thereof; the undulations of the ground to be shown by contour lines representing the different elevations in a manner to enable the establishment of grades, locations of sewers, etc.

The second section of the ordinance provides:

> That plats be also made from said surveys and bound in atlas-form for the use of the Tax Department, City Surveyor and Commissioners for Opening of Streets, etc.; said plats to be made on a scale sufficiently large to show, in addition to the matters contained in the general official map. the following details: The dimensions of each lot or tract of land embraced in the city, with the character of the improvements thereon; the location of all sewers, with their dimensions; the system of water supply, with the location of all fire plugs; all corporation buildings, such as school houses, station houses, etc., all railway lines, and such other details as may be considered requisite.

This work was commenced at once under the direction of Chief Engineer Douglas, and a primary triangulation was made covering 54.7 sq. miles of territory. This was followed by precise traverse and leveling parties, and 1,964 bench marks were established over 26 7-10 sq. miles of area by Dec. 31, 1894. In the same time the topographical party had covered 11,200 acres of territory. The report which gives the above figures also states that the final probable error in the length of the whole base-line was 1 in 354,432 in one line, 1 in 985,334 in another and 1 in 15,000,000 in a third comparison. In precise leveling the computed probable error was 0.614 mm. per kilometer, or less than 1-50th in. per mile. In comparison with similar work by the Coast Survey and Mississippi River Commission this was claimed to be the best on record. The total area embraced by the maps of this topographical survey was approximately 32 sq. miles, though the primary triangulation covered 54.7 sq. miles. The scale of 200 ft. to one inch, or 1:2400, was adopted for plotting the topographic maps, and 40 ft. to one inch for the property maps. The field work was done by transit and stadia, or plane-table and stadia, on the same scale of 1:2400, requiring extreme minuteness and accuracy in drawing. The details of the maps, completed in the field, were to be filled in by direct measurements of directions, or azimuths and distances from each topographic station, with occasional measurements for plotting of details with tape. Free use of the telemeter was made in locating elevations or in tracing contours.

Early in the present year some complaint was made as to the methods and results of this survey, and by joint resolution of both branches of the City Council a committee was appointed to examine into and to report upon the character and condition of the topographical survey of Baltimore. This committee reported in August, 1896, and from their report the following is taken: The committee held six public meetings and heard the testimony of a number of city surveyors, engineers and others interested, and it appointed two experts, Messrs. John W. Donn and John E. Sadler, to examine the work and make tests of the accuracy of the work as they deemed proper.

These experts recently reported that they were satisfied that the work of the triangulation division of the survey had been thoroughly and accurately done, and that the measurements and adjustment of angles and the computations of sides of the triangles had been as accurate as those of any survey ever made. The work of the precise levelling party was also thorough and accurate and the bench-marks established will furnish valuable and reliable data for the use of engineers in any part of the city. But, say the experts, no matter how thorough, accurate and comprehensive may be the methods serving as a basis for such a survey, the results are only valuable when accurately shown on maps of detail.

They then find fault with the methods of securing details for map-making, and say that from the methods adopted it was impossible to show these details upon a map in the manner prescribed by the ordinance. The ordinance calls for all measurements in "feet and inches," whereas all office records and field note-books show that the corners of streets, width of streets, dimensions of blocks, etc., were determined in meters, not in feet and inches. These details were obtained by transit and stadia, and the stadia measurements were generally read only to the nearest meter, and in going over 30 or 40 field-books not more than 1 in 100 measurements is made to a nearer degree of accuracy than one-half meter. One-half a meter is nearly 20 ins., or more than 1½ ft., and when distances are required in "feet and inches" on a map, it is difficult to see how they can be determined when the measurements in the field are made only to meters, of nearly 40 ins.

The work of the draftsmen was found to be excellent, and as they practically merely inked in the completed maps made in the field, they can not be held responsible for errors. The experts then tested the accuracy of field-sheets reported as finished and for the purpose used a Johnson plane-table, a special Fauth alidade, a steel tape and an alinement rod furnished by the Chief Engineer of the survey. They reported that they considered the plane-table and alidade furnished as extremely inefficient instruments for the purpose intended, and not adapted to work of a critical character. The table was very unstable and had neither tangent screws for exact orientation and alinement, nor levelling screws for horizontal adjustment. The alidade, specially designed for this survey, was also an inferior instrument, according to the experts, badly balanced, too light and too small to allow easy handling. They report that without exception every station occupied developed errors in details, on some sheets varying from 1 to 14 ft., and these not in one invariable direction only. The reading of the telemeter to the nearest meter was responsible, for many of the smaller errors; imperfect plotting in the field caused others; and the absence of direct control over the work by a single observer in each party engaged was everywhere apparent. Many important details were omitted and small details on the ground plan of houses were left out, or in error.

Careful examination of the sheets show that the chief object of the engineers was to secure the accuracy of traverse stations, with seemingly scant consideration given to the exact location of topographical details. The record of distances given by stadia to the nearest meter is an evidence of this. On a scale of 1 : 2400, or 200 ft. to 1 in., a measure of one foot is distinctly appreciable, and in standard plane-table work an error of 3 ft. on this scale is annoyingly felt. The report goes on to say that

> This sensitiveness of the instrument makes it unapproachable by any other device or method used, for its excellence in critical work or the work of inspection. Angles measured are correct, although their value trigonometrically may not be exactly known because of the impossibility of protracting them to very small measures of arc. In graphical descriptions, however, such knowledge is rarely required, and if any exigency should call for a statement of trigonometrical value, the finely graduated arc of a transit or theodolite would be necessary for their measures. Topographical studies are best made from graphical delineations and the methods by which those delineations can be most quickly and accurately given, afford the most useful, economical and decisive results. An accurate topographical survey can have but one definition—that the results graphically shown are strictly graded to the power of the scale used. Two-tenths of a foot are definable by a scale of 1 : 600, four-tenths by a scale of 1 : 1,200 (100 ft. to 1 in.), and on a scale of 1 : 2,400, a foot is very easily discernible. In plane-table practice, the whole field encompassed by the scale of the work on a sheet of paper of convenient size is directly controlled by the topographer, and at any time he is able to have under inspection, his work already accomplished.

The experts object to the manner of marking the traverse points, by driving a gas-pipe into the ground under the pavement, for example, and say that these can not be regarded as permanent, and they also find fault with the contour system.

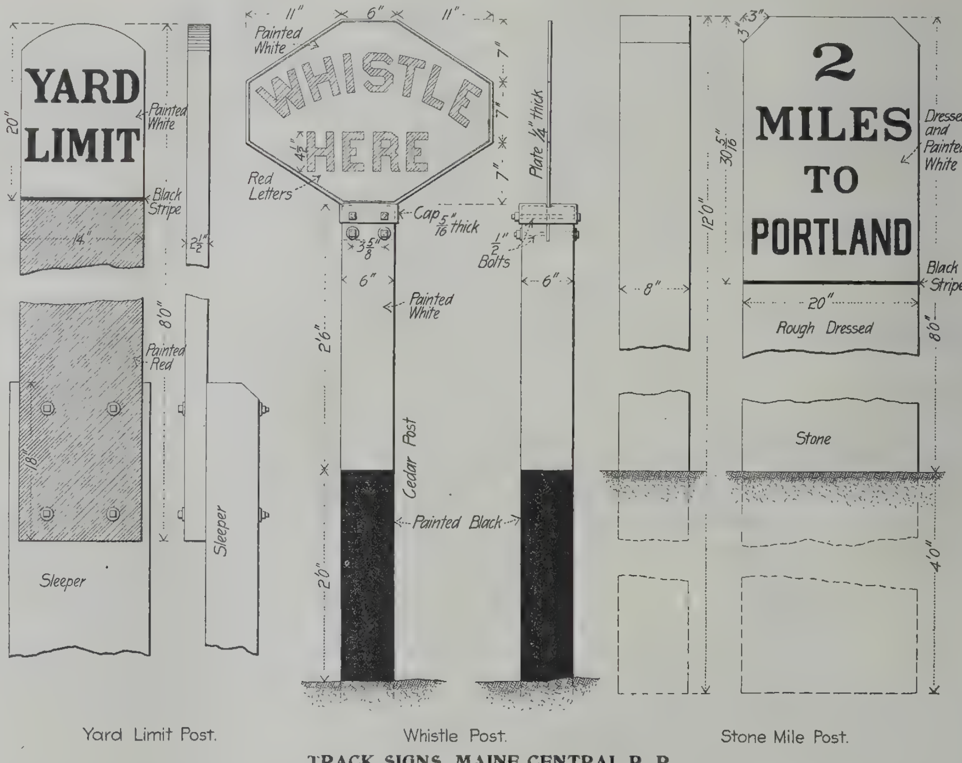
The investigating committee also called in Mr. O. H. Tittman, assistant in charge of the office of the U. S. Coast and Geodetic Survey at Washington. He compared the maps and the ordinance, and testified as follows: That the maps do not contain the width of streets, lanes and alleys, and the length of blocks in feet and inches, nor elevations at street corners, etc., as required by the ordinance. None of these details could be found on the 25 published maps. The committee also called attention to the cost of the survey, which has been $160,000 up to the present time, or about $9.50 per acre of the area covered. As a partial explanation of this excessive cost, more than that of other topographical surveys, it is stated that several thousand dollars were expended in correcting a distance given, in error, by the U. S. Coast and Geodetic Survey, between the Washington Monument and Bay View. The committee deems the money spent in correcting this error as unnecessary, as the distance given was as nearly correct as was required for any operations called for by the ordinance. The committee, in conclusion, recommended a complete suspension of the personnel of the survey, and the suspension of all work until a reorganization can be effected. And this report and recommendation were unanimously adopted on Oct. 12.

* * *

TRACK SIGNS; MAINE CENTRAL R. R.

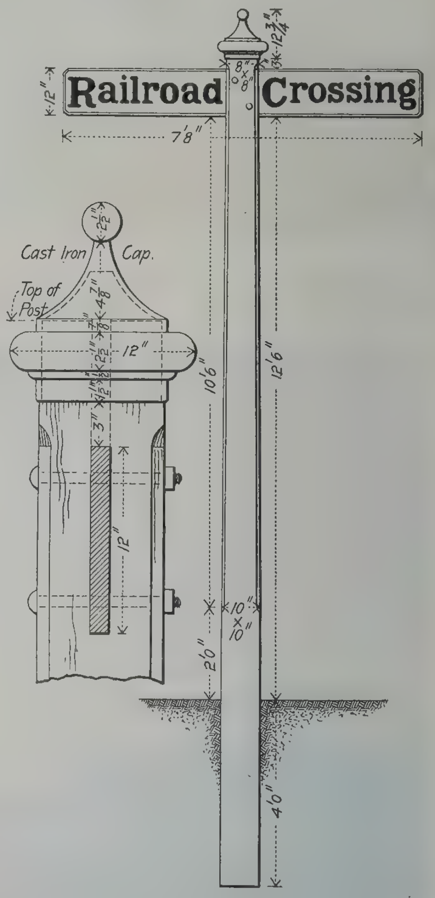
In designing track signs the principal objects to be aimed at are simplicity, durability, and a style that will make them conspicuous. These objects appear to have been attained in the signs illustrated herewith, the blueprints of which we received some time ago from the late Mr. William A. Allen, Chief Engineer of the Maine Central R. R.

The mile post is a rough-dressed stone slab, 12 ft. long, 20 ins. wide and 8 ins. thick, set 4 ft. in the ground, and having 30 ins. at the top dressed smooth for lettering. The unusual height is evidently on account of the heavy snows encountered. The dressed faces are painted with three coats of white lead, with lettering in black and a 5-16-in. black stripe. The post is lettered on both faces, the one shown being lettered "249 miles to Vanceboro" on the back. The yard limit sign is a 2½-in. plank, 14 ins. wide and 8 ft. long, with the bottom bolted to a post or sleeper. The lower part is red and the upper part white, with black letters and a black stripe. The whistle sign differs from the usual style in having the words "Whistle Here" instead of merely a W. It is a ¼-in. iron plate of diamond form, 28 × 21 ins., let 4 ins. into a 6 × 6-in. cedar post whose top is 4 ft. 6 ins. above the ground and is covered with a cap. The bottom of the plate is secured by four ½-in. bolts, the upper ones 7¾ ins. and the lower ones 7¼ ins. long. The post is painted black to a height of 2 ft. above the ground, and thence white. The plate is given two coats of red lead and four coats of white lead, and is lettered in English vermilion.



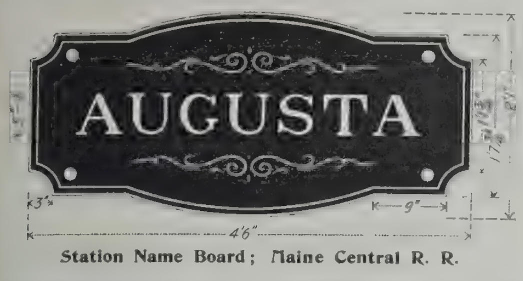
Yard Limit Post. Whistle Post. Stone Mile Post.

TRACK SIGNS, MAINE CENTRAL R. R.



Grade Crossing Sign, Maine Central R. R.

The grade crossing sign is a 1¼-in. board, 7 ft. 8 ins. long, and 12 ins. wide let into the slotted top of a post about 18 ft. 2 ins. long, set 4 ft. into the ground. The post is 10 × 10 ins. to a height of 2 ft. above the ground and then diminishes to 8 × 8 ins. at the top, which is covered by a cast-iron cap. The board is secured by two bolts. The post and board are painted white and the board has a 3-16-in. black border stripe ¼-in., from the edge. The capital letters are 7¾ ins. and the small letters 5¼ ins. high. The station sign is made of two thicknesses of ⅞-in. pine boards, the back board 25 ins. wide at the middle and 19¾ ins. at the ends, and the face board slightly smaller. The boards are put together with four screws and have their edges beveled. The face of the sign is painted black and sanded. The letters are white, with gilt edging, and the scroll work is gray. Over the corner screws are 1½-in. gilt caps. This sign would be better if made with a rectangular board and having the painted flourishing omitted. In this connection it may not be amiss to refer to the almost universal insufficiency of station signs, especially at night, when the board on the platform or hung from the eaves of the platform shed roof is usually in the dark.

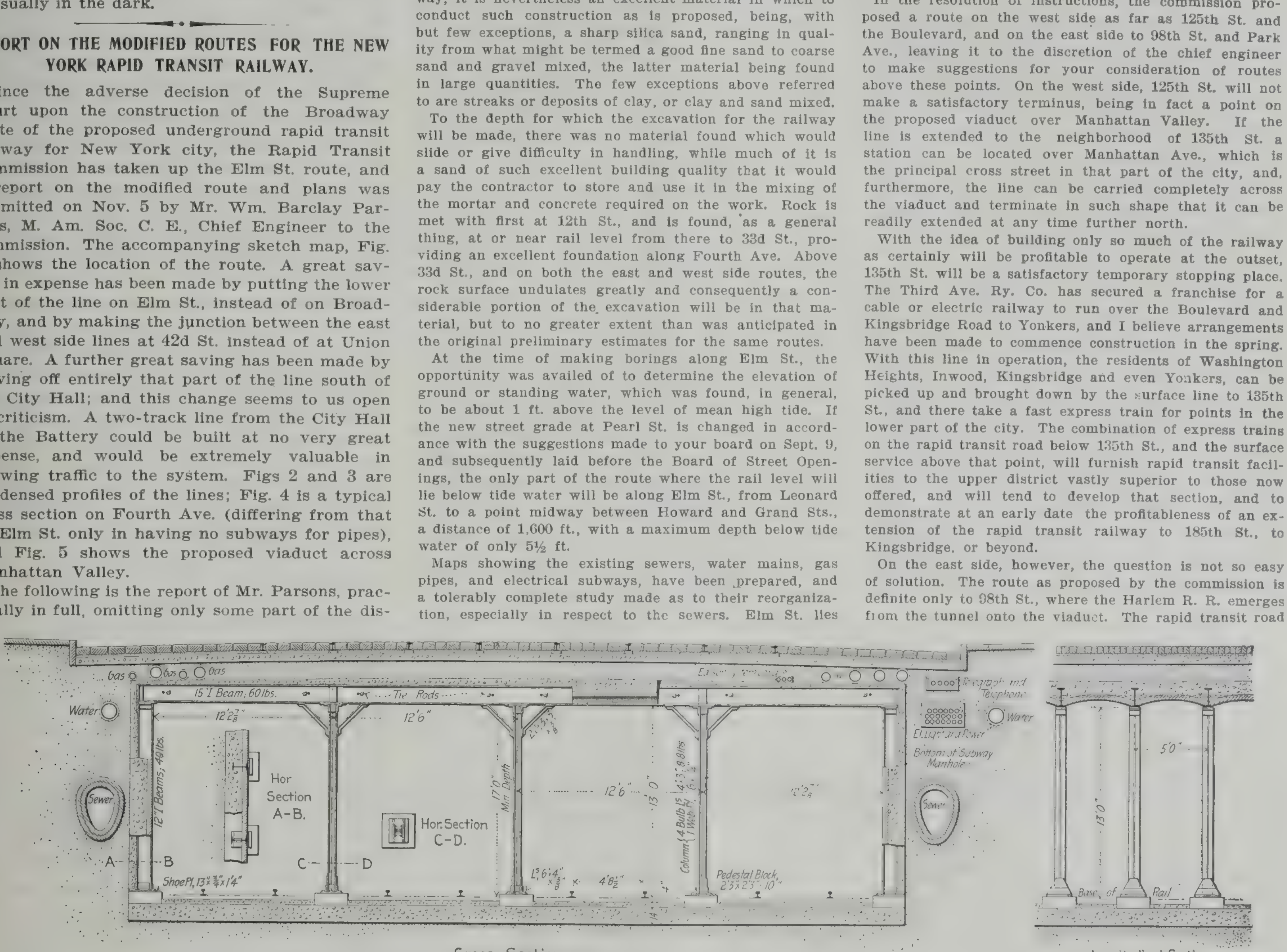


Station Name Board; Maine Central R. R.

REPORT ON THE MODIFIED ROUTES FOR THE NEW YORK RAPID TRANSIT RAILWAY.

Since the adverse decision of the Supreme Court upon the construction of the Broadway route of the proposed underground rapid transit railway for New York city, the Rapid Transit Commission has taken up the Elm St. route, and a report on the modified route and plans was submitted on Nov. 5 by Mr. Wm. Barclay Parsons, M. Am. Soc. C. E., Chief Engineer to the commission. The accompanying sketch map, Fig. 1, shows the location of the route. A great saving in expense has been made by putting the lower part of the line on Elm St., instead of on Broadway, and by making the junction between the east and west side lines at 42d St. instead of at Union Square. A further great saving has been made by leaving off entirely that part of the line south of the City Hall; and this change seems to us open to criticism. A two-track line from the City Hall to the Battery could be built at no very great expense, and would be extremely valuable in drawing traffic to the system. Figs 2 and 3 are condensed profiles of the lines; Fig. 4 is a typical cross section on Fourth Ave. (differing from that on Elm St. only in having no subways for pipes), and Fig. 5 shows the proposed viaduct across Manhattan Valley.

The following is the report of Mr. Parsons, practically in full, omitting only some part of the discussion as to the definite route for the northern or suburban parts of the line:



Cross Section. Longitudinal Section.

FIG. 4.—SECTION OF NEW YORK RAPID TRANSIT RAILWAY ON FOURTH AVE., NEW YORK CITY.

On Aug. 6, 1896, the Board of Rapid Transit Railroad Commissioners passed the following resolution:

> Resolved, that the chief engineer be and he hereby is directed to submit to this board, at as early a date as possible, the routes and general plans for a rapid transit railway, which shall conform to the following conditions:
>
> 1. The total cost, after abundant allowance for contingencies, not to exceed $30,000,000.
>
> 2. The route to proceed from the southern terminus at or near the Post Office, under City Hall Park and Park Row, Elm St. and Fourth Ave., to or near the Grand Central Station, and there to divide into an east side and a west side route. The west side route to proceed under 42d St., Broadway and the Boulevard to a point above 125th St. The east side route to proceed under Park Ave. and over private property to the Harlem River, and across and beyond the Harlem River to as great a distance as the proposed limit of cost will permit.
>
> 3. The railway to have four tracks to the junction of the east and west side routes, and above that point to have two tracks on each route, except that a third track for express service shall be added on both routes where conveniently and economically possible.
>
> 4. The road to be in tunnel, except on the east side route north of 98th St. and on the west side at Manhattan Valley.
>
> 5. The plans to be so drawn as to permit of extension in the future from the southern and northern termini, and of widening the two-track and three-track portions into four-track systems, without unnecessary expense or interruption of traffic.

Along the critical portion of the proposed route, i. e., Elm St., there was no information at hand showing the kind of material that would be encountered in excavating. I therefore caused to be made a series of borings, similar to those made along Broadway. This system of borings commenced at the corner of Chambers and Elm Sts., and extended to the corner of Fourth Ave. and 33d St., so that definite knowledge has been obtained as to the subsurface material. Above 33d St. the result of inquiries made of architects and builders, and the recorded data of sewer excavations of the Department of Public Works, have been sufficient to determine the probable rock line, with enough accuracy for this stage of the proceedings.

While the soil underlying Elm St. is very variable in character, more so in fact than was the case in Broadway, it is nevertheless an excellent material in which to conduct such construction as is proposed, being, with but few exceptions, a sharp silica sand, ranging in quality from what might be termed a good fine sand to coarse sand and gravel mixed, the latter material being found in large quantities. The few exceptions above referred to are streaks or deposits of clay, or clay and sand mixed.

To the depth for which the excavation for the railway will be made, there was no material found which would slide or give difficulty in handling, while much of it is a sand of such excellent building quality that it would pay the contractor to store and use it in the mixing of the mortar and concrete required on the work. Rock is met with first at 12th St., and is found, as a general thing, at or near rail level from there to 33d St., providing an excellent foundation along Fourth Ave. Above 33d St., and on both the east and west side routes, the rock surface undulates greatly and consequently a considerable portion of the excavation will be in that material, but to no greater extent than was anticipated in the original preliminary estimates for the same routes.

At the time of making borings along Elm St., the opportunity was availed of to determine the elevation of ground or standing water, which was found, in general, to be about 1 ft. above the level of mean high tide. If the new street grade at Pearl St. is changed in accordance with the suggestions made to your board on Sept. 9, and subsequently laid before the Board of Street Openings, the only part of the route where the rail level will lie below tide water will be along Elm St., from Leonard St. to a point midway between Howard and Grand Sts., a distance of 1,600 ft., with a maximum depth below tide water of only 5½ ft.

Maps showing the existing sewers, water mains, gas pipes, and electrical subways, have been prepared, and a tolerably complete study made as to their reorganization, especially in respect to the sewers. Elm St. lies nearer the dividing ridge of the city's drainage system than does Broadway, and the taking care of the sewers will therefore be of less serious moment. The Canal St. sewer can be treated in a similar manner to that proposed in the case of Broadway, and approved by the Engineer of Sewers of the Department of Public Works; that is to say, to cut it at the place where the railway crosses, and build a new sewer to the East River, and to turn into that stream the flow from the district lying north of Canal St. and east of Elm St., which now passes west through the Canal St. sewer into the Hudson River. The amount of sewage so diverted will be less than was proposed with Broadway, as the district affected is not so great, and therefore the new sewer will be of smaller size than was previously anticipated.

No part of the route as herein contemplated is a main thoroughfare for water and gas pipes, or electrical subways, while Elm St., being at present with no outlet at either end, contains no pipe of large size, and what pipes are there now, will all be replaced on the opening and construction of the new street. At Fifth Ave. and 42d St. there occurs the most serious pipe crossing along the route, as the large Croton water mains run down the avenue. Fifth Ave, however, at that point forms a decided ridge, the surface of 42d St. falling rapidly both to the east and west. In order to have suitable grades for operating a railway, it would be desirable to pass sufficiently below the level of the avenue to leave all the water and gas pipes undisturbed overhead.

The portions of the proposed route that formed a part of the route previously adopted, were recognized as presenting no serious difficulty in construction. The physical investigations and survey of the newly considered portions show that they contain no features that will cause the road to be excessively expensive, slow, or difficult to build. The proposed route, therefore, escapes entirely the difficulties of construction which were present along Broadway, incident to the heavy traffic, cable railways, complications of sub-surface structures and the care of abutting buildings. The work can be attacked at as many points as can be conveniently operated at once, and the whole brought rapidly to completion at the same time.

In the resolution of instructions, the commission proposed a route on the west side as far as 125th St. and the Boulevard, and on the east side to 98th St. and Park Ave., leaving it to the discretion of the chief engineer to make suggestions for your consideration of routes above these points. On the west side, 125th St. will not make a satisfactory terminus, being in fact a point on the proposed viaduct over Manhattan Valley. If the line is extended to the neighborhood of 135th St. a station can be located over Manhattan Ave., which is the principal cross street in that part of the city, and, furthermore, the line can be carried completely across the viaduct and terminate in such shape that it can be readily extended at any time further north.

With the idea of building only so much of the railway as certainly will be profitable to operate at the outset, 135th St. will be a satisfactory temporary stopping place. The Third Ave. Ry. Co. has secured a franchise for a cable or electric railway to run over the Boulevard and Kingsbridge Road to Yonkers, and I believe arrangements have been made to commence construction in the spring. With this line in operation, the residents of Washington Heights, Inwood, Kingsbridge and even Yonkers, can be picked up and brought down by the surface line to 135th St., and there take a fast express train for points in the lower part of the city. The combination of express trains on the rapid transit road below 135th St., and the surface service above that point, will furnish rapid transit facilities to the upper district vastly superior to those now offered, and will tend to develop that section, and to demonstrate at an early date the profitableness of an extension of the rapid transit railway to 185th St., to Kingsbridge, or beyond.

On the east side, however, the question is not so easy of solution. The route as proposed by the commission is definite only to 98th St., where the Harlem R. R. emerges from the tunnel onto the viaduct. The rapid transit road can be carried up Fourth Ave. along the side of the Harlem R. R. to the Harlem River, as was proposed before. This suggestion, however, met with the strenuous opposition of the abutting owners. If the line be carried to the east of Fourth Ave., it will be brought into close traffic conflict with the Second Ave. and Third Ave. elevated lines, and as these two roads already exist, it seems to me that the people residing in that neighborhood can be served at much less expense, and more immediately, by improving the facilities of those lines, rather than by building new ones.

In studying this question, I have considered the existence of the elevated railways, and have deemed that the best results for the city at large and for the parties who will construct and operate the rapid transit railway, will be obtained by building the new railways as far removed as possible from the present lines, leaving the latter free to take care of their legitimate traffic, but by improved and extended facilities if necessary. The business of the street railways (including the elevated railways) in this city, is increasing at a rate 2½ times as fast as the population. The normal increase in traffic will not only provide a profitable business for the rapid transit road without drawing from existing lines, but makes it appear certain, if the past is any guide to the future, that at no very distant date both the existing lines and that proposed in this report, will be insufficient to properly care for the travel. I have, therefore, endeavored to study out a location that will allow the new and old systems to be developed from independent territory.

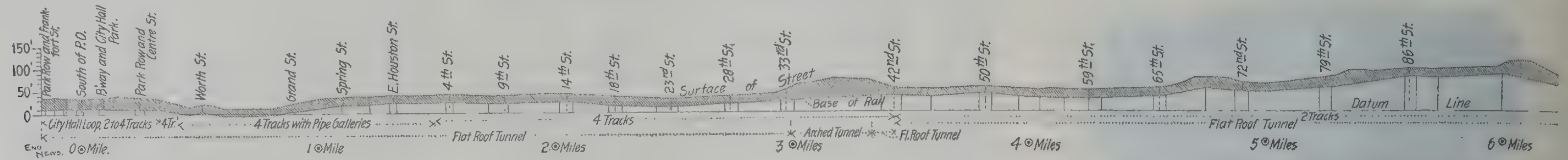


FIG. 2.—PROFILE OF RAPID TRANSIT RAILWAY,

The Board of Experts under Mr. Hewitt, when considering this question, made a suggestion in regard to the desirability of laying out a line in the neighborhood of Lenox Ave. and north of Central Park. North of 110th St., between Eighth and Third Aves., is a portion of Manhattan Island which now supports a large population, and which is capable of supporting a still larger one, but which is wholly without rapid transit lines. This is the best field in New York city for creating traffic. If, therefore, instead of carrying the new route through and along Fourth Ave., or to the eastward of it, it should be carried to the westward of Fourth Ave., it would be removed from the existing railways and serve to create its own traffic, and would at the same time provide rapid transit facilities for a portion of this city's population which is now at an inconvenient distance from the elevated railways.

This region can be served by carrying the rapid transit railway up Fourth Ave., alongside of the Harlem R. R. to 110th St. From that point two alternatives are presented: (1) By laying out an elevated railway along some cross street, as for example 110th St., to Lenox Ave., and thence along and over that avenue to the Harlem River. Lenox Ave. is practically the only street that could be used for that purpose, as Madison and Fifth Aves. are prohibited by law, and Seventh Ave. is open to the same objection that Fourth Ave. would be, namely, that it is too near one of the existing lines of elevated railway. The other alternative would be to branch off at or near 110th St., pass through the rear of the lots abutting say on 110th St., to a point to the east of Lenox Ave., but sufficiently far to the west of Mount Morris Park to avoid the valuable residential property abutting on that square; thence turning to the right with an easy curve and running straight to the Harlem River, parallel to Lenox Ave. The right of way for this purpose from 110th St. would have to be acquired by purchase. This line prolonged across the Harlem River would reach the Annexed District at about 150th St.

The topographical conditions in the Annexed District are peculiar. The tracks of the New York Central, Harlem and New York, New Haven & Hartford railways, with the large yard at 161st St., divide the 23d and 24th Wards in two parts. To the east of the yard there is already a large population; to the west of it, and bounded on the east by the yard and a high dividing ridge, and on the west by another ridge, lies what is known as Jerome Valley, with Jerome Ave. running through the center of it. This valley covers nearly one-half of the two wards, and is entirely without transit facilities. Its surface is such that houses can be erected cheaply and close together, and it provides an area that could, and should, supply homes for a great number of people.

This section, and the other lying east of the railway yard, above mentioned, are two separate and distinct districts and it is impossible for one line to serve both. The easterly district, however, now has the Suburban Elevated Ry. and the Portchester Branch of the New York, New Haven & Hartford R. R., which latter, in connection with the Third Ave. and Second Ave. elevated lines of the Manhattan Ry. system, does a local business with trains at 30-minute intervals.

The Manhattan Ry. has already made certain propositions to your board, looking not only to the improvement and extension of its suburban line, but to the building of a new line which will extend as far north as Mount Vernon and lie well to the eastward of the suburban line. These extensions should be made at an early date and afford immediate relief to the populated portions of the 23d and 24th Wards, and if at the same time a third track were laid on the Third Ave. line, as the Manhattan Ry. Co. proposes, and so enable it to run a continuous express service, the upper part of the city would receive almost immediately a fair rapid transit service—much more quickly than it could by waiting for the rapid transit road itself. It would seem to be wise, therefore, to leave the district lying east of the Harlem R. R., to be served for the present by the improved facilities which can be afforded by the Manhattan Ry. Co. The extension through Jerome Valley could, therefore, be properly taken up as the line of the proposed rapid transit railway. It would be a direct northerly extension of the Lenox Ave. line and would secure for itself a large territory free from competing railways. There are two ways in which a line can be built in this territory. One would be, after crossing the river to build an ordinary elevated railway along Girard Ave. to its intersection with Jerome Ave., and then an elevated line along Jerome Ave. northward to such point as may seem desirable. The other would be, to acquire private property and build a railway (elevated, depressed, or on an embankment enclosed between retaining walls, as the topography of the land will indicate). In my judgment, Burnside Ave. would be a proper point to which to lay out the first installment of construction of this line, although in my estimate I have included the cost of the work to Fordham road. In my opinion, however, this additional outlay would serve a better purpose if applied to the construction of an extension from the Post Office to South Ferry.

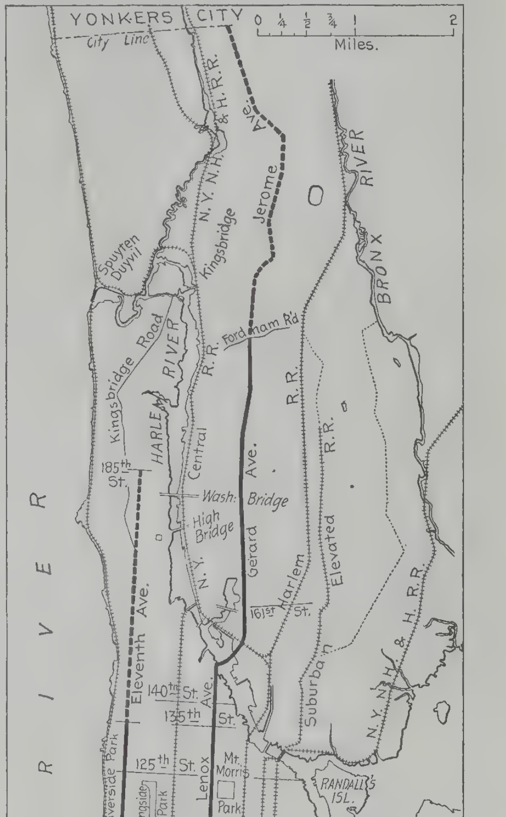


Fig. 1.—Map Showing New Routes for the Underground Rapid Transit Railway; New York City.

The board, in its resolution, determined that four tracks should be constructed to 42d St. On the easterly extension, northward from that point, there is room for but two tracks on the west side of the Harlem R. R., and under or over Park Ave. to 110th St. On the line to the westward, from 110th St. to or near Lenox Ave., I have continued the two-track section, but from 111th St. northward to the Harlem River, I have estimated on a third track to be used for express trains. The station at 125th St. could be so arranged, by proper cross-overs, that an express train could either make a stop at 125th St., or could run through on the third track at high speed, in which case it would have an unbroken run from a point say 1,000 ft. north of the Harlem River, to a station at Fifth Ave. and 110th St., or over 2¼ miles.

On the west side line, I have estimated for a two-track road through 42d St. and up Broadway to 58th St., and a three-track road from there to 98th St. Stations at 60th and 96th Sts., at which points the board had previously laid out express stations, could be arranged in a similar manner to the station at 125th St. on the east side line, so that an express train could stop at either or both of these stations, or, if desired, could make a continuous run from 103d St. to 53d St., a distance of 2½ miles.

As soon as the traffic warrants it, complete four-track roads can be constructed on both the east and west side lines, so as to give a continuous express service, both north and south, at all hours. On Park Ave., north of 42d St., the space on the east side of the Harlem R. R. can be used for the additional tracks.

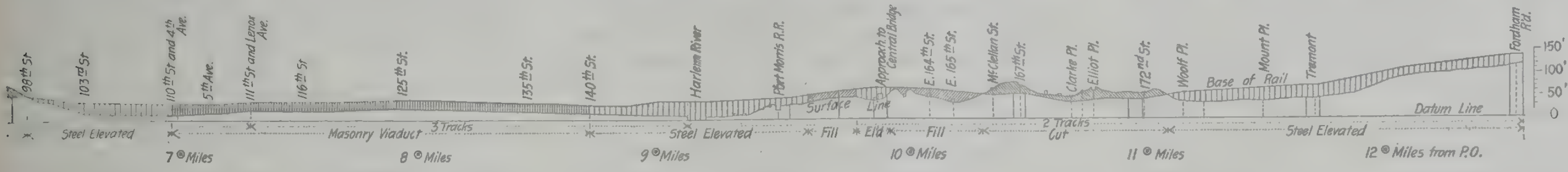
Supposing, however, the trains to stop at 125th St. on the east side, and at 60th and 96th Sts. on the west side, the following schedule, it is believed, could be successfully operated:

East Side.		
City Hall to 42d St.	5½	minutes.
City Hall to 125th St.	21	"
City Hall to north side of Harlem River	24	"
City Hall to Fordham road	35	"
West Side.		
City Hall to 60th St.	11	"
City Hall to 135th St.	21	"

If the 125th, 96th and 60th Sts. stops were omitted the running time from the upper points would be reduced.

The construction designs have been carried only sufficiently far to form a basis for estimates. For the greater part of the route the construction would naturally be in conformity with the detailed plans previously worked out. Along Elm St. pipe galleries have been designed somewhat similar to those previously drawn for the Broadway route. The number of pipes to be contained in these galleries will not be as great as those that would have been provided for in Broadway, and the Elm St. galleries need not, therefore, be quite so capacious. Along Lafayette Place and Fourth Ave., where the street is 100 ft. wide, a plan of construction similar to that previously designed for Fourth Ave. can again be adopted, the pipes resting either directly on the roof of the tunnel or at the side, between the outer walls and the curb lines.

The two and three-track portions of the railway can be widened into four-track systems at any time, without interfering with the traffic, and an extension south from the Post Office under Broadway, as well as extensions north from the suggested east and west terminal, can be made in like manner. The only radical change in construction from the previously considered plans, is the viaduct portion through the blocks north of 110th St. The part of the railway built on private property could be erected on brick arches supported on concrete piers. The streets could be spanned from house line to house line by steel arches, the masonry construction forming suitable and efficient abutments. These arches are designed to give, as the minimum of headroom, 12 ft. at the curbs, and 14 ft. at the centre of the roadway, which is greater than the minimum clearance of the Manhattan Ry. This arch construction, although costing considerably more than ordinary steel elevated spans, gives a structure that will be very economically maintained, one that will bear the heaviest and most severe traffic, one that will be almost noiseless, and one that will diminish the unsightliness of the railway to the minimum. The design is closely allied to the design of the famous Stadt-



NEW YORK CITY. (CITY HALL TO FORDHAM ROAD).

bahn in Berlin, which is very properly considered the finest piece of urban railway construction, where the objections to other similar railways in respect to noise and appearance have been so eliminated that high-class and expensive private residences have been built in its immediate neighborhood.

South of the Brooklyn Bridge Station, at City Hall, a complete loop can be constructed, so that there will be no switching or crossing of express and local trains. As the most convenient location for this loop would be around the Post Office, the opportunity is afforded to have a station in Broadway at that point. The cable pits of the Third Avenue Ry. Co. compel the line under Park Row to be depressed, and it will probably be found convenient to have the Post Office Station a few feet lower than the ordinary stations elsewhere, and thus the pipes in Broadway can be left undisturbed overhead. Two tracks have been projected to serve the Post Office on the Mail St. and Park Row sides, so that direct and constant communication can be had between the Post Office and Grand Central Station and much time saved over the present system of transfer by vans. Other tracks for the storage of trains or for sidetracking temporarily disabled trains can be provided. Should the newspapers whose offices are on Printing House Square and Park Row, desire it, it is possible to construct for them a special track on which, during the night, cars can be set, one or more for each newspaper, and into which the morning editions can be loaded directly from the press rooms through the vaults under the sidewalk. These cars can be taken to the Grand Central Station in five minutes on express trains and so save over half an hour on all papers sent north and east.

In estimating upon the plans herein proposed, the cost of real estate, as well as construction proper, had to be taken into account, as private property to a large amount will have to be acquired. To ascertain the probable cost of construction, profiles covering all the routes have been prepared, and stations located corresponding to the stations previously decided upon by your board in connection with the Broadway plans. The actual quantities of the different classifications of material to be excavated and the value of the material entering into the work, have been carefully computed. Prices have been assigned to the various items after consultation with large contractors and after taking into account the prices used in previous estimates, or as modified by the experience gained in similar work in Boston, or by recent large street excavations made in this city. The quantities taken and the prices allowed are, in my judgment, amply sufficient to complete the work.

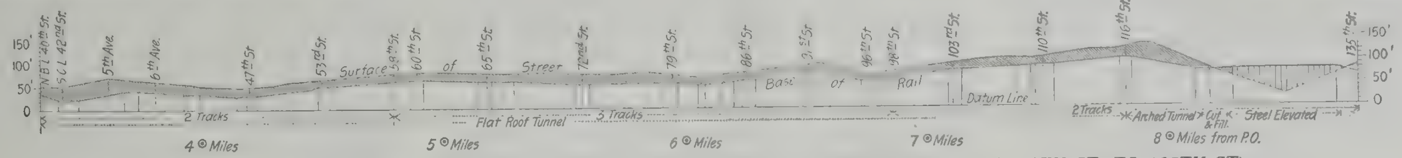


FIG. 3.—PROFILE OF RAPID TRANSIT RAILWAY, NEW YORK CITY. (WEST SIDE LINE, 40TH ST. TO 135TH ST).

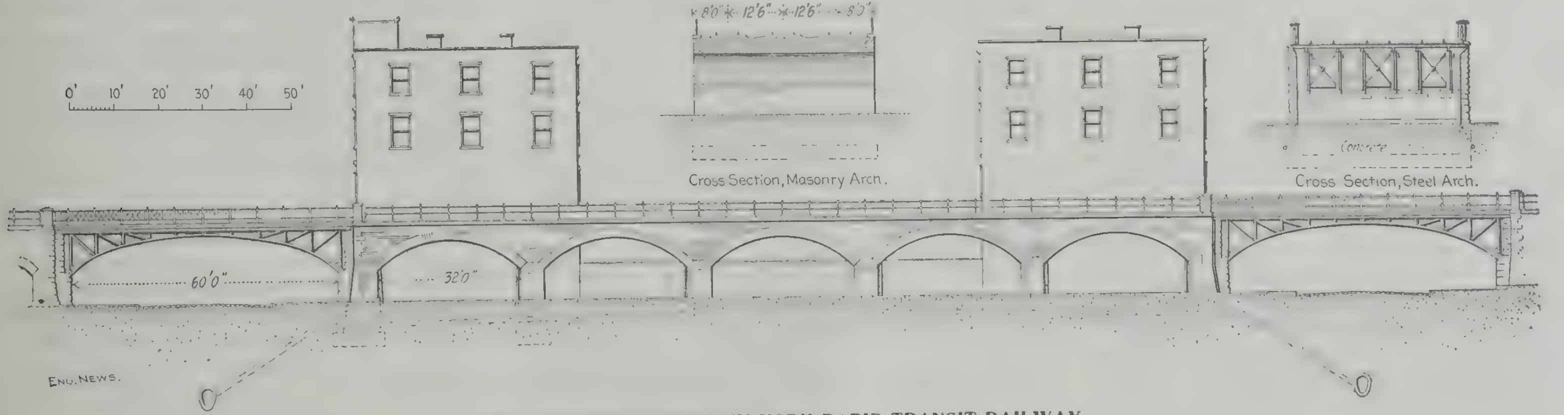


FIG. 5.—VIADUCT FOR NEW YORK RAPID TRANSIT RAILWAY.

The total mileage contemplated by this report is as follows:

Two-track	10.90	miles.
Three-track	3.99	"
Four-track	3.03	"
Total	17.92	"

I believe that the work, as described in this report and its accompanying drawings, including proper terminals and storage places, can be constructed and built in the most substantial and approved manner for an actual cash cost of $20,048,000, with an extra allowance of $1,200,000 for interest during construction. Although, in my judgment, the work can be completed for the sum named, I should advise that an extra arbitrary allowance be made to cover extraordinary contingencies, and such extras as human foresight cannot see. To cover all such contingencies, an allowance of 20% would, in my opinion be amply sufficient.

In order to estimate the cost of the right of way, I procured the advice of those conversant with real estate values, and, acting under such advice as the best means of proceeding, I ascertained the assessed valuation of all land to be taken. From Fourth Ave. to a point near Lenox Ave., I have estimated on a right of way 25 ft. in width, sufficient for two tracks, to be taken from the rear of the lots abutting on 110th St. From 110th St. north, I have estimated on a right of way with a minimum width of 40 ft. and a maximum of 50 ft., according as the lot lines occur. This minimum width of 40 ft. would be amply sufficient for the construction of three tracks. I have had a careful search made of actual sales that have taken place in this neighborhood during the past three years, and on comparing the same with the assessed valuation, I found that the ratio of assessments to sales reported (exclusive of those set down for a nominal sum) is about 50%. Although advised by real estate operators that an allowance of 10% would be sufficient to cover the increased valuations or improvements between now and the probable construction of the road, I have added in order to be liberal, 20%, as in the case of the construction estimate.

North of the Harlem River, a right-of-way width of 50 ft. has been assumed in order to allow for slopes in the cuts and fills, and to provide an ample margin for the addition of a third and fourth track in the future. There will be two other points on the road where property will have to be acquired, first at 9th St. and Astor Place, where the line will pass under the corner of a bloc order to diminish excessive curvature; and the other on Park Ave.,, between 97th and 99th Sts., where the line emerges from the tunnel to the viaduct and where two tracks will take up the whole of the roadway between the buildings and the wall of the Harlem Railroad.

A certain strip would have to be acquired between those two streets in order to make a new roadway. The actual value of the real estate, determined on the basis as herein described, amounts to $3,000,000, and the cost of the railway complete, would therefore be as follows:

Construction	$20,048,000
Real estate	3,000,000
Interest	1,200,000
Total	$24,248,000

If to this be added the very ample amount for unforeseen contingencies already suggested, we have as an outside estimate of money which should be in hand for the work, the sum of $29,097,600.

If the board should prefer to occupy the streets with an elevated railway, instead of using private property, the above estimate will have to be altered to some extent. For the masonry viaduct between Park Ave. and 110th St., to 140th St. (above which point to the Harlem River a steel viaduct will probably be constructed, curving to meet the bridge), the estimated cost is $1,665,040, interest and contingencies included. To build a high grade steel viaduct of the same capacity in regard to tracks, would cost $1,251,792, extras likewise included.

The cost of the right of way in this portion of the route is estimated at $2,537,600, but if an elevated railway were constructed in the street, damages for abutting property would undoubtedly have to be paid. What these damages will amount to I cannot, of course, precisely say. I have conferred with lawyers and real estate experts who have had experience in damage suits against the Manhattan Ry., and they are agreed that it is impossible to foretell, except within wide limits, what amount of damages the courts would be likely to award. The assessed valuation of the abutting property is $6,274,900, and, therefore, on the ratio of 50% between the assessed and actual valuations, the latter would be to-day $12,549,800.

North of the Harlem River the portion of the line which crosses private property to the point where it will reach Jerome Ave., is estimated to cost $698,328, extras included. The most reasonable elevated structure that it would be advisable to construct along Girard and Jerome Aves. for the same distance, would amount to $753,024, or $54,696 more. The right of way over this portion of the route is estimated to cost not over $230,000. As to whether this cost of land will be offset by abuttal damages on Girard and Jerome Aves., it is impossible to state. Probably some damages would have to be paid, but they are not likely to be excessive. The estimate for an outside provision of money falls short of the $30,000,000 stated in the resolution by $902,400. But I understood this limit to be set arbitrarily by your board, as a maximum limit not to be exceeded, and on the other hand not necessarily to be equalled by the estimated cost, provided satisfactory plans could be obtained for a less figure.

I have made no provision for abuttal damages for the portion of the road in the tunnel. In my opinion there would be no damages, or, if in exceptional cases there were any, they would be of insignificant amounts. From 98th St. to 110th St. on Park Ave. a claim for such damages might have more apparent justification, but as Park Ave. between these streets is already a railway street, and as the presence of the rapid transit road on Third Ave. has been considered to augment rather than depreciate the value of abutting property, there would not, in my opinion, be any reasonable claim for material damages here. If, however, any claim for abuttal damages were made and sustained, it is in my opinion clear that it would be met several times over by the sum of $5,000,000, which the Rapid Transit Act added for that purpose.

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The new plan for the New York Rapid Transit railway, which is given in full in another part of this issue, differs from the old plan, which was thrown out by the Supreme Court, chiefly in comprising only those lines that are immediately necessary, and leaving the remaining portions of the system to be added as the growth of traffic makes necessary. The substitution of the Elm St. route for the Broadway line, between City Hall and Union Square, is one which this journal has always advocated. Its effect is to move the line eastward a distance of only 300 to 500 ft. over a distance of less than two miles, but it will make a saving of several millions in the cost of the road, because the road can be built in Elm St. simultaneously with the widening and reconstruction of that thoroughfare. Further than this, the abandonment of the line through the mercantile district on Broadway, will entirely avoid the opposition of the property-owners along that section, which was the main cause of the defeat of the last Rapid Transit plan. It will settle the disputed question of injuries to the buildings along the route, for it was only along this part of Broadway, where the buildings are old and the foundations are shallow that any real question on this point arose. It will also dispose of the opposition due to the proposed appropriation for the road of the sidewalk vaults along the line.

Further than this, the construction and operation of this road in such a manner as to give New Yorkers real rapid transit, will at once bring about a public opinion in its favor that will result in the early extension of three-track or four-track lines to the entire territory which the system is designed to cover.

New York has now a better opportunity than ever before to secure the transit facilities that it has so long needed. The work is in charge of a capable commission, possessing in the highest degree the public confidence, and assisted by thoroughly competent engineers. It is hampered only by the legislation under which it is working, which prescribes a plan for the construction and operation of the road that is difficult and complicated to carry into effect, and which is not calculated to secure to the city the greatest return from its investment. It is to be hoped that the new legislature, when it assembles, may remedy these faults and enable the Commission to proceed unhampered in its work. It can no longer be said that what is proposed in New York is wholly without precedent. Boston has been quietly building during the past two years a subway under its downtown business streets, not to secure rapid transit, properly speaking, but to avoid the blockade in its narrow streets due to the great numbers of electric cars. It has already rented this to the West End Ry. Co. at a price which will make the work pay for itself ultimately without cost to the city.

From a financial point of view, New York's proposed enterprise is far less risky than that which Boston has undertaken and successfully carried out, and it is to be earnestly hoped that the present plan may be carried out without delay.

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The present status of the topographical survey of the City of Baltimore, as set forth elsewhere in this issue, is unfortunate, to say the least. As a preliminary to the development of annexed territory and the general improvement of the older portion of the city, an accurate and detailed survey of the existing area was ordered. This work was placed in the hands of an engineer of experience and reputation and up to the present time $160,000 has been expended upon it. The survey was generally supposed to be nearly completed upon a most exact and refined basis, but late objections made to the results as published have caused an investigation by a committee of the City Councils and the finding of this committee is now made public. The expert examination made shows that the triangulation and the precise levelling of the territory in question have been most thoroughly and accurately done, with results which are possibly even more exact than the requirements of the city ordinance would demand. But while the basis of the survey was thus elaborated it is charged that the filling in of the detail was accomplished by methods which could not, and do not give accurate results. The maps made are in error in part and do not give the detailed dimensions in feet and inches, as required by the ordinance, and fail to contain the very information for which the survey was originally ordered.

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The experts appointed charge the errors found, varying from 1 to 17 ft. on some sheets, to the adoption of the metric system in the detail work and the reading of stadia rods, in most cases, only to the nearest meter. They object also to the instruments used, stating that they were unstable and not properly equipped for the critical work demanded, and they generally condemn the methods of field work as unreliable, so far as the detailed dimensions are concerned. As a result of the investigation the survey is practically suspended and is being reorganized. A general examination of the reports of the survey and the results of the investigation would seem to indicate that the engineers responsible for this work misunderstood the chief purpose in making this survey. No engineer will object to the extreme care exercised in laying down the basic lines of the survey, nor to the precise levelling done for the establishment of bench-marks for future use; even though this refinement may have cost more money than the city authorities deemed necessary for the purposes intended. But equal care should have been observed in filling in the details of the survey. After all, the valuable and essential result was the preparation of a series of maps accurately showing the detailed surface conditions, with the exact dimensions and elevations plainly expressed upon the maps in a scale sufficiently large for practical use. These maps were intended as a basis for laying out and grading new streets, for designing a comprehensive drainage system and as a record of all existing streets, blocks, structures, water distribution, sewers, etc. It is evident that for work of this character extreme accuracy of measurements was essential and errors of even a foot would be annoyingly felt. The use of the stadia for general topographical work is proper enough, and with careful methods and proper tools the results attained are usually quite as accurate as those obtained with the steel tape and much more rapid and economical. But we believe there is a limit to the refinement to which stadia work can be pushed, and that this limit was passed in Baltimore. With an ordinance calling for the determination and record of dimensions in feet and inches a telemeter reading to the nearest meter, or nearly 40 ins., could not possibly give the results demanded. In the St. Louis topographical survey the stadia was extensively used, but we are told that few buildings or street corners were thus located. With very well equipped and stable instruments, properly graduated stadia rods and the exercise of extreme care, very accurate work can be done; but the report of the experts would indicate that these conditions did not exist in the Baltimore survey and gross errors are frequent. The cost of the Baltimore survey is also excessive enough to have apparently secured more thorough work in all branches. The general cost, including triangulation and levelling, was about $9.50 per acre; while the cost for topography alone is set down at $1.50 per acre, as compared with 73 cts. for St. Louis, and 50 cts. per acre for a survey of 3,000 acres, including mapping and the location of all buildings, fences, railways, etc., in the vicinity of Madison, Ill. The more accurate survey of our older cities is to be always encouraged, and work of this character can not be too well done. But if economy in first cost is absolutely necessary, it may be said that a probable error of even more than 1 in 15,000,000 in a base line is much less likely to affect the useful and practical end of such a survey than an inefficient and inaccurate method of securing detailed dimensions. The trouble in Baltimore seems to have been that the engineers, in aiming to secure an exceptionally accurate and a most creditable base for their survey, either expended too much money upon this preliminary work, or failed to properly appreciate the practical value and necessary uses of the more detailed portions of the survey.

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In our report of the test of the Roebling system of fireproof floor construction, in last week's issue, we stated that the maximum deflection of the floor before the water was put on was about 4 ins. We should also have stated that this deflection was greatly diminished after cooling. The day after the test a load of 600 lbs. per sq. ft. was placed on the roof without apparent injury, and when it was removed the deflection, or permanent set, of the roof was found to be only 1⅝ ins.

HONESTY IN THE MANAGEMENT OF CORPORATIONS.

It is a fact which is not always realized at the present day, that the corporation is an essential factor in the modern industrial and economic world. The public, as is well known, is unfriendly to corporations; and it has reasons for its prejudice in the abuses that have attended corporate management; but the fact is that there is scarcely a feature of our modern industrial system which has worked such a vast body of good to the world at large as the corporation. We use the word in its broadest sense, of course, to signify any association of persons, organized according to law, to co-operate with each other in carrying out common ends and sharing common responsibilities, but without the risk which a partnership entails. In fact, "corporation" and "co-operation," though of different etymological origin, have a similarity in significance as well as in sound. It is only by the co-operation of large numbers of men, banded together in a corporation, that the great and beneficent enterprises of this century have been possible. The railway itself, in its present form at least, would be an impossibility without the corporation.

It is seldom realized, either, what an enormous proportion of the world's business is at the present day carried on by corporations, public and private. Every city and organized village or borough is a corporation.. All our railways and street railways, and nearly all our lines of water commerce are carried on by corporations. With a few unimportant exceptions we can say that all the lighting by gas or electricity, all our systems of water supply, and the great bulk of our mining operations, are carried on by corporations.

In the field of manufacturing and of buying and selling, the corporation is a less necessary factor; but here also corporations conduct the bulk of the business and are all the time tending more and more to displace the partnership arrangements which were so common earlier in the century. Corporations conduct also all our banking and insurance business, such necessary factors in the modern business world.

The great transformation in methods of business, which has accompanied the transfer of business from private hands to the hands of corporations is also not fully realized even by intelligent people. For example, nothing is more common than to hear as an argument against a city undertaking the work of lighting its own streets, or even furnishing itself with a water supply, the statement that such things should be left to private enterprise, so that the man who carries them out will be influenced by self-interest to perform the work in the best and most economical manner. The fact of the case is, however, as every one realizes who will stop to reflect, that the actual carrying out of such work, is, and must of necessity be, put into the hands of men who have no financial interest in its results, no matter whether the city does the work or some private corporation. We thus arrive at the truth that the carrying out of the great bulk of all modern enterprise must of necessity be done by corporations, either public or private; and the difference between the two classes is not so great as is sometimes claimed.

In the change which has taken place from individual enterprise to corporate enterprise, at least one great sacrifice has had to be made. We have had to part in some degree with the motive of self-interest as an incentive to good work. The man who runs his own business will ordinarily try to carry it on in the best manner possible, so that he may get the greatest returns. The man who in managing the same business on a salary has no such incentive. But in practically all industries carried on by corporations, this sacrifice must be made. The managing officers of railways, electric light plants, gas companies, etc., have as a rule no financial interest in the companies which they serve. Even when they do own some of its stock they have opportunities to make a hundred dollars by playing false to their trust for every dollar they could make through honest management in the shape of increased returns upon their stock. In fact, the temptations which beset the officer of a great railway corporation, for example, are in many respects similar to those which are set before city officials. We hear a great deal of corruption in municipal affairs; but we question whether the percentage of fraud and acceptance of "commissions" among city officials is any greater than it is among the officials of private corporations of similar size. Or, since we by no means believe in the total depravity that is frequently charged against city officials, let us say that we believe that the honest and faithful administration of positions of trust is as high among the responsible officials of cities at the present day, as among the responsible officers of great corporations.

It will be noticed that we are especially confining our comparisons between the public and the private corporations to those of large size. It is of course true that there are very many minor corporations in which the active manager is also the principal owner, and in which therefore the principle of self-interest as an incentive to good management is operative. But the tendency of the times is not in this direction; but all the other way. The great corporations doing business on an enormous scale are the ones that survive in the competitive struggles; and in the cases where a keen business man builds up a great industry of which he is the owner and manager, it is almost invariably the case that the lapse of a few years sees its ownership in the hands of his heirs and its active management in the hands of men who own no interest in the business.

Further, as respects our great corporations, we are very far from saying or believing that their active managers are, as a rule, false to their trust. On the contrary it is a remarkable evidence of the improvement in public morality and business integrity which has gone on during the present century, that it should be possible to place such a vast proportion of the world's industries in the hands of men whose moral integrity is the sole guarantee of faithful service. Every thoughtful observer of modern life cannot fail to be impressed with the fidelity with which thousands of men carry on the business entrusted to them year after year, handling affairs and funds of great magnitude with the same interest and zeal as if the business were their own, and content to receive a not always generous salary as their sole reward.

But there is another side to the picture, and in fairness that also must be drawn.

The responsible managers and heads of departments of a great corporation have always before them temptations to make gains, which if not dishonest, are at least incompatible with a high sense of moral integrity. It is very often possible to so manage a corporation's business as to cause the market price of its stock to move up or down, and the man who can cause these fluctuations can reap sure profits on the stock exchange. Again, every great corporation must of necessity have important agreements with other or subsidiary concerns, and there are mines of wealth here to the unscrupulous official. We may take for example the operation of freight cars owned by private car companies. It is well known that these cars return great profits to their owners, and are kept running while cars owned by the railways themselves are left to stand idle. It is claimed that ownership of the stock of these private car companies by officials high in authority in the railway companies is one reason why the practice continues despite efforts for reform. In another field, it is well known that the profits made by "construction companies" are not seldom recorded by a "vest-pocket" bookkeeping, which for good and sufficient reasons is never made known to the holders of the corporation's securities. Shrewd observers believe that a good part of the incentive for the great railway construction of the years 1885 to 1890, as well as of the present rage for electric railway construction, is not so much the profits that will accrue to those who own and operate the completed railway, as the fortunes to be reaped by contractors, construction companies, land companies and similar organizations from the building of the lines.

But there is no need for us to specify in detail the methods by which corporation officers can if they will grow rich on small salaries. The main point we wish to show is that these temptations exist; and that a certain percentage of men yield to them to a greater or less degree.

Turning now to the case of city corporations, we find that those who have drawn the charters of most of our cities, have apparently been wiser than the directors of private corporations, with respect to their appreciation of the temptations which beset corporation officers. The officers of almost all cities are obliged by law to let all contracts of any magnitude by public advertisement. Definite specifications must be prepared upon which bids must be received and publicly opened. We are aware that this requirement is considered a burdensome one by some engineers, especially when coupled, as it sometimes is, with the requirement that the proposal of the lowest bidder must be accepted. But the actual results of this system during many years have proved so satisfactory that we believe the directors of private corporations might well inaugurate a similar practice. It is an old and true saying, that the best way to make men honest is to keep them honest. Many men have yielded to temptation who would never have done so had not they felt that they were absolutely secure from being found out. Experience has proved that the best safeguard against frauds and dishonest transactions in business of every sort is thorough publicity. The general adoption of this principle has done wonders in the purification of the business of our cities, and it is equally applicable to the affairs of private corporations.

It will not be overlooked that the public advertisement and letting of contracts operates also as some check against loss to the corporation through the mere inertia, conservatism or lack of enterprise of its managers. In how many cases is a contract awarded by a private company without any attempt to secure competition and lower prices? The excuse given for this proceeding is a familiar one. The officer who let the contract knew the parties to be a reliable firm, who would do a good piece of work and so he gave them the contract rather than bother with several other firms which he knew nothing about. But if we suppose a case of importance where a large amount might have been saved by open competition, was it not his business to secure it and provide proper safeguards to ensure responsibility and good workmanship? Have not the stockholders of a corporation as much of a right to the benefit of the lowest possible price as have the taxpayers of a city?

We are well aware that in the case of cities the method of open competition is often objectionable from its lack of flexibility, which is one of the evils which seem to be inseparable from any business which is carried on by a governmental body. The red-tape and its delays are often irksome and costly.

But the private corporations in adopting this system are held by no such restrictions, and can have its benefits without its drawbacks. It is as effective, for example, for a board of directors to advise their executive officers to let all contracts in open competition, except when good reasons exist against so doing, as it would be to pass a mandatory resolution.

As most of our readers are aware, the practice of publicly advertising contracts of all classes is rapidly growing among private corporations. We believe that as the likeness between these organizations and municipal corporations becomes more generally realized the custom will become still more common, to the great advantage of the corporations' security holders.

LETTERS TO THE EDITOR.

A 54-in. Wooden Barrel Sewer.—Correction.

Sir: Permit me to call your attention to some errors in the description of the wooden outfall sewer in your issue of Nov. 5. These plans are not of sewers actually constructed in Brooklyn, but are adapted from plans of similar sewers of different sizes. The titles under the two illustrations were interchanged. The paragraph relating to creosoting should read: "The 'streaks' or staves are creosoted with 10 lbs. of dead oil of tar per ft. (of timber), weighing 8½ lbs. (per gallon), at 120° F." The error in the last paragraph is doubtless due to an oversight of my own. Yours very truly,

J. C. Meem.

Municipal Building, Brooklyn, N. Y., Nov. 6, 1896.

(The last paragraph states that the "sewers are built in elliptical or other shapes as well as circular, according to necessity."—Ed.)

The Cement for the Melan Bridge at Topeka, Kan.

Sir: In your issue of Oct. 29, I notice some further discussion of the cement for the Melan bridge at Topeka, Kan. In the original specification for cement for this work (which specification was fully discussed in your issue of May 7, 1896), there was a paragraph as follows: "It is not probable that any American natural Portland cement (so-called) will meet these requirements." It may be of interest to your readers to know that the later specification for the work in question, issued Sept. 2, 1896, is a revised form of the original one and does not contain the clause above recited, reflecting upon the character of American Portland cements.

This is no doubt due to the article originally published in your editorial columns and the discussion it brought forth. The thanks of American cement manufacturers are due to you for the fair treatment received in this matter. Yours truly,

American Cement Company,
R. W. Lesley, Vice-President.
22 South 15th St., Philadelphia, Nov. 4, 1896.

An Experience in Raising a Swing Bridge.

Sir: I have read your article describing "a device for raising swing bridges" with a good deal of interest, but think that Mr. Roemheld is late in mentioning it as his invention, as I made use of practically the same scheme nearly four years ago. In January, 1893, I was requested to examine the drawbridge across the Ouachita River, near Columbia, La., on the line of the Houston, Central Arkansas & Northern Ry. I found that the pier upon which the turntable rested had settled upstream to such an extent that the bridge was 1½ ins. out of line and ⅞-in. out of level. I was then 300 miles from Little Rock without any tools other than a hammer and a monkey wrench, and only a couple of men to assist me. I found some old plates in the yard where the iron for the bridge had originally been stored and with these and some stove-pipe iron proceeded to level up the span. In front of each of the six wheels, three of which were exactly under the vertical line of each of the two lower posts, on the low side of the drum, I laid a plate ⅛-in. thick, so placed that I had 3 ins. of room to make a run for the plates. The three wheels under each of the lower posts together covered one segment of the lower wheel tread. I turned the draw towards the plates, running each of the wheels, six in all, upon its respective plate, and then stopped. I next placed a ¼-in. plate behind each of the six wheels and reversed the operation, running the wheels up on the ¼-in. plates. I repeated this operation, see-sawing backwards and forwards until the drum was level. I then proceeded to level up the tread, which I did by forcing plates under each of the tread segments, excepting the two upon which the six wheels rested, spacing these supports about 12 ins. apart. In the middle of this operation it was necessary to open the draw for a steamboat to pass through, and although the tread was only supported with scrap iron we had no trouble, and at no time were trains delayed. Having the tread level all round the circle, I then tamped a rust joint under it, and took out the scrap iron plates, which of course had only been placed there temporarily. After the completion of the work every wheel in the circle took bearing in all positions of the draw. The span above referred to was a 360-ft. draw, single track. In comparing this method with that used by Mr. Roemheld, I prefer using the flat plates, as it is no trouble to run the wheels up on a plate ⅛-in. thick, and when it is there, there is no fear of its running back as is likely to occur in using wedges.

Yours truly, E. T. Terry,
Terry & Tench Construction Co.
Railroad Ave. and 135th St., New York city.
Nov. 7, 1896.

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Metallic Structures, Corrosion and Fouling and Their Prevention.

Sir: Will you allow me a few lines respecting your review, in your issue of Oct. 15, of "Metallic Structures, Corrosion and Fouling," as it impugns my professional status. I am not "a professional book-maker." In this country it would be impossible for an engineering one to exist, notwithstanding any liberalities of the publishers.

As far back as 1866, I was assistant resident engineer on the extensive Limehouse Dock Improvement Works, London, constructed without the intervention of a contractor. I have also had sole charge of the construction of many miles of railway and been engaged in general engineering practice, and in addition, for some 20 years, had much to do with anti-corrosive and anti-fouling paints, dozens of steamships and metallic structures having been attended to and coated through my instrumentality; the subject of corrosion and fouling has therefore been constantly before me.

In my books I record what I know and refer to the special experiments and unique experiences of others, acknowledging the source of information and so endeavor to offer as much news as possible, even though some paragraphs may appear to be contradictory. The subject is a very wide one, and to attempt to absolutely determine the relative corrosion of different kinds of iron under every condition of manufacture and use would only mislead. Flaws, which the microscope can alone reveal, have their influence, as you well know.

I am practically acquainted, as a civil engineer, with the subjects upon which I have written books, for they are connected more especially with railway and dock work. The book "Scamping Tricks," to which you refer, I wrote to record those I have seen and heard of on various works; and it was favorably reviewed in your columns. I trust writing a few books does not make one a "professional book-maker," or kind of engineering outcast.

I thank you for your review of "Metallic Structures," and for the expression, "the book contains a great quantity of useful information." I may say all the reviews in technical press here, some nine in number, have been most favorable. If attention and some light has been directed to the matter of corrosion and fouling and paints through my book (and I know of none other for engineers on the subject) I am satisfied; as, although I'm afraid you do not think so, the labor of writing such a work is very considerable and by no means professionally remunerative. Apologizing for trespassing on your valuable space,

I am, yours faithfully,
J. Newman, Assoc. M. Inst. C. E.
Logan Villas, Bath Road, Hounslow, England,
Oct. 27, 1896.

Swing or Lift Bridges for Heavy Traffic.

Sir: I have read with great interest your discussion upon movable bridges in your issue of Nov. 5, illustrated by the designs made for the Newtown Creek bridge. You say: "But when we come to narrow channels, and especially those where a large traffic is moving, the swing bridge is no longer so satisfactory." I beg to differ from your limitation "where a large traffic is moving." The swing bridge gives two passages of even greater width than can be given by any other system, through which two sets of vessels may pass at once, thus doubling the capacity of the bridge. The true place for a bascule or lifting bridge is over a narrow channel where the central pier would offer too much obstruction. Where there is room enough, it is my belief that nothing can excel the swing bridge for durability and certainty of operation.

The whole question was very carefully considered by Mr. Birdsall and myself in designing the two Harlem River bridges, and we see no reason to differ from the conclusion, then reached, that a swing bridge with two openings best accommodated the river traffic. For certainty and rapidity of action, we believe it excels any other form, and that best accommodates the land traffic.

A swing bridge can be so designed as to require the least possible power to move it. The real use of the power machines is to hold it against high winds.

T. C. Clarke, M. Am. Soc. C. E.
New York city, Nov. 7, 1896.

(The passage quoted from our editorial was somewhat ambiguous. What we should have said was, that a swing bridge is not so satisfactory for narrow channels, especially for narrow channels where the water traffic is heavy. In the case of bridges which are only opened once a day or once a week, we have no doubt that the swing bridge is the best type, even for narrow openings, where the pier has to be set to one side of the channel and a structure with unequal arms has to be built.

Our correspondent would limit the use of lift bridges to openings so narrow that a center pier would be an obstruction; but it is a matter of judgment as to when a center pier does become an obstruction. There come to our notice quite frequently accidents in the shape of collisions between swing bridges and vessels; and in a narrow and winding steam especially with a tidal or other current, it is frequently a difficult matter to tow a vessel or string of barges through the narrow opening without fouling something. Clear openings of the width of those on the Harlem River bridges, however, are probably wide enough to give all needful safety to traffic. It was openings of less width that we had chiefly in mind in our argument that the lift bridge should be considered as well as the swing bridge when the design of a structure is to be fixed.—Ed.)

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The Resistance of Concrete to Fire.

Sir: In reference to the tests of various systems of fireproofing now being conducted by the Department of Buildings in this city, your short editorial in your last issue hardly does justice to the importance of the knowledge gained by them. In it you mention in reference to the Roebling test, the ability of the cinder concrete to withstand intense heat and sudden cooling. This has now been definitely proved in a second test under even more stringent conditions than the above. In the Roebling test the concrete might have been sufficiently protected by the metal lath center which upheld the arch. On Nov. 7, in a test with a fire of equal volume and temperature, the cinder concrete had no such support whatever, being laid as a beam between the I-beams; and this so withstood the effects of white heat and the shock of sudden cooling under water at sufficient pressure for sufficient length of time to ordinarily dislocate a 12-in. brick wall, that after completion of the test it was in as perfect condition as it would have been had there been no fire at all and the water only applied. This should place at rest any doubt as to the fire resisting ability of such concrete. The tests were also valuable in showing the non-conductivity of the concrete. At no time during either of these tests was the upper surface of the material too hot to handle, and although no temperature was taken of the same, I doubt whether it exceeded 150° F., about the same as that of the outside of the 12-in. walls.

But next to these two points, the most important knowledge gained was the power of the beams to both carry the load and withstand sudden cooling under such conditions. In the Roebling test the deflection of 4 ins. was largely due to loss of strength in the beam carrying the flooring, due to its heating, and the diminution of deflection after cooling demonstrated the return of strength. But the suspended ceiling which was supposed to protect the beams, gave way early in the test, exposing the lower flanges directly to the intense heat. Immediately before the application of the water when the furnace was opened these were at a white heat. I feared at the time that the application of water would cause a "firecrack" in the steel, but the latter came through the ordeal practically uninjured.

Is it not now of as much importance to ascertain the action of the steel beams under intense heat as that of the materials hitherto designed to protect them? These tests are very interesting and of the utmost importance and the lessons we are learning are changing our ideas as to design of fireproof work. The result of tests when reduced to a unit of comparison will not longer be so much as to the resistance of the "fireproof" layer as to the relative resistance of the I-beams, with various methods of protection. The moment of resistance or maximum fiber strain of the beams as shown by deflections will be the guide for determination of results.

Yours truly,
Oscar Lowinson, Jun. Am. Soc. C. E.
39 Cortlandt St., New York, Nov. 9, 1896.

(The test of Nov. 7, referred to by our correspondent, is described on another page of this issue. We fully agree with our correspondent that these tests are of the greatest value to engineers and deserve careful study by everyone interested in any way in fireproof construction. The lessons learned from these tests will greatly influence the designs and specifications for fireproof construction in the future.—Ed.)

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Further Discussion of the Nicaragua Canal Survey.

Sir: Regarding the criticisms of the Nicaragua Canal route and the proposed new schemes, it must be apparent that their source is from persons whose knowledge of available data is either immature or entirely wanting. This is well stated in Mr. Le Baron's last letter in your issue of Nov. 5, referring to the report of the U. S. Commission. Its injustice, in view of the high standing of its members, in their criticism of the Canal Company's data, is only explainable by lack of complete information; although it is supposed they would have gathered some new data.

In my capacity as chief draftsman and chief of party for nearly four years in Nicaragua I can fully realize the justice of Mr. Le Baron's claims, although he is not familiar with the work of the last three years, which was very extensive. The problem of a location of the canal in the lower San Juan valley has been thoroughly investigated by many engineers eager to establish this possibility, and the experience of all fixes the impracticability of a dam of any height on the river lower than Ochoa. The only points at which such a scheme would be feasible on the Nicaraguan side are at Serapiqui, Tamborcito, and Tamborgrande. At the first there is a hill on the Costa Rican side which promises well but it is surrounded by swamps, as was proved by both Mr. Le Baron and Mr. Davis. These gentlemen ably investigated the Costa Rican side of the river at the other points with similar conclusions.

I was anxious to make the attempt to solve this problem and under the dircetion of Division Engineer Davis I made a careful examination of the south bank of the river from near Ochoa to Tamborcito, extending my work from two to three miles back from the river and found nothing available as a dam site except near Tamborgrande, and to my extreme disappointment the hills at that place have no connection with any spur from the Costa Rican mountains, except by connecting up various isolated hills across long stretches of very bad swamp. This district is well known to the rubber hunters, and I took every opportunity to question them both at Greytown and along the river; and all agree in saying there are no hills near the river. This is an established fact and the problem is reduced to operating a canal with low lift locks in conflict with the great floods, or the present route, avoiding these as far as possible. The latter offers the great advantages of less risk, less cost, greater facility for operating and greater permanency. These are things that must appeal to all men, irrespective of engineering training.

As to the Salinas Bay terminus for the canal, Mr. Miller certainly cannot devise any scheme for reaching it except by flying. As to the canal project in its present form: The engineer must make the best of existing conditions and there is abundant evidence to show this has been done with rare fidelity. No doubt some of the conditions are not ideal for a canal, yet the project is certainly most feasible. All the different schemes have had careful consideration and the present plan is merely the survival of the fittest, the result of most mature judgment and unquestionable ability, and in the light of many years actual contact with the data, and is not controvertible except in an equal light.

It has been my good fortune to become intimately acquainted with two of the great existing canals since leaving Nicaragua and the difficulties to be overcome there in comparison with these are apparent to me in quantity not quality. The cost estimated is most liberal in view of recent progress. Dredging, for instance, as low as four cents per yard; rock excavation at 79¾ cts. a yard now nets the contractor a large profit. The eagerness of contractors to take the work at estimated prices is a complete vindication against any criticism of under-estimated cost. As to quantities, no data for a work of such magnitude have ever been taken so carefully and completely, and in the case of earthwork, the data would serve for a final estimate to the contractor. As to the criticism regarding incomplete data; to obtain them with the nicety that seems desirable, would require many years and an enormous outlay, could be only comparatively accurate, and finally be only useful as dependent on the judgment of the engineer. Such nicety is only useful and obtainable in the abstract, not in dealing with the concrete, as is shown in dealing with all engineering structures. The devices of the successful engineer in treating with these problems may be quite questionable, depending as they do on his judgment; yet bridges, arches, etc., were built before science was formulated. The data for designing in all the problems of the canal are known within the limits of accuracy, so that they can be used practically, and the sole idea has been to give unquestionable safety, not to figure to a least cost basis at the expense of safety. This is not permissible where the slightest accident after completion might mean irretrievable ruin to the enterprise. If the abstract values of the gagings, etc., could be placed at the disposal of the most eminent theorist his conclusions as to use in design, without actual years of experience on the ground, would not only be faulty but even dangerous to follow.

The points I wish to emphasize, in addition to those presented by Mr. Le Baron, are: that the criticisms have in view only the abstract, when the problem is with the concrete, where the judgment of the engineer is supreme; that the supposititious claims thus far made long ago had faithful and complete consideration; and hence the work of the engineers must have been of rare fidelity considering the magnitude of the many problems and the difficulties of work in a tropical wilderness where the vision is limited by the range of the machete.

Yours truly, Boyd Ehle.

Tonawanda, N. Y., Nov. 6, 1896.

Specifications for Water Tube Boilers for the St. Louis Water-Works.

Sir: The editorial on this subject in your issue of the 29th ult. is quite interesting, although not altogether complete. Being familiar with this work, and my relations being close with all the parties interested, I take the liberty of adding something to the discussion.

The work was under the immediate supervision of Water Commissioner M. L. Holman, who is a Vice-President of the American Society of Mechanical Engineers, a member of the American Society of Civil Engineers, and an ex-President of the Engineers' Club of St. Louis. In my opinion the matter has been handled in strict accord with advanced engineering practice, and is deserving of proper credit.

You express surprise that bids were received on only a few of the water tube boilers which were admissible under the specifications. This was probably due to the requirements of paragraph 2, that no boiler would be considered which did not have an established record of 65% efficiency with common Illinois coals. Unfortunately, very few makers of this type of boiler have made sufficient study of fuel economy under these conditions, to establish particularly creditable records. The St. Louis Water Department has had some rather unpleasant experiences with boilers, which although possessing excellent records with good coal had not been adapted to lower grades of fuel, and it was to avoid further experience with untried boilers that this clause was inserted.

You take the position that there should be no material difference in efficiency between any of the boilers admissible under these specifications. In my opinion this is begging the entire question, eliminating as it does the problems of size and angle of tubes, draft areas, circulation, heating and grate surface per unit of work done, ratio of heating to grate surface, draft required, water areas, path of hot gases, etc. Experience has shown us that there is quite a difference between the different types, not only of water tube, but of all other kinds of boilers. Those manufacturers who have made a study of boiler efficiency with Western low grade coals have developed designs which appear to be materially better than those which have been designed and developed for Eastern fuels. In my own experience I have in one case easily developed a horse-power on 3.56 sq. ft. of heating surface, and in another found it difficult to do the same work with 11.

In the specifications referred to, you criticise the exclusion of what in your opinion are the most important features of a boiler—the dimensions of heating and grate surface. I cannot see what difference this makes when we specify the amount of water to be evaporated, the efficiency, the dryness of steam and the required smoke performance. It seems to me that—within reasonable limits, of course—it is absolutely immaterial whether the bidder furnishes one or fifty square feet of heating or grate surface to do a given amount of work. If there were to be any preference, it would seem to be in favor of the man who did the work with the least amount of material, thus occupying less space and requiring less looking after.

Neither can I agree with your implied criticism that both Illinois coals, and Thompson calorimeters, "are apt to be very erratic." Such an opinion is not borne out by extended experience. I recently read before the Engineers' Club of this city a paper on "Boiler Efficiency, Capacity and Smokelessness, with Low Grade Fuels," which is now in the hands of the publisher and will appear shortly. Accompanying this paper are a large number of calorimeter determinations and proximate analyses of Southern Illinois coals coming regularly to this market. These figures show a striking uniformity of the coal from the same mine and of the same grade, as well as a surprising harmony between the proximate analyses, and the calorimetric determinations made with the Thompson calorimeter. For instance, the entire range of Mount Olive coal, between screened lump and slack, shows a difference of less than 5% from the average, while coal of one size varies less than 3% from the average. Coals from different mines, and of different sizes from the same mine, vary considerably, but coal from a certain mine and of the same size, shows no variation which can be termed "erratic."

Neither can I see how there can be any uncertainty in bidding on work of this kind, and I must respectfully protest against the use of the term "guess-work" in this connection. When the kind of coal is specified, the mine from which it must come, its calorific value, the method of determining its calorific value—all are clearly stated—it seems to me that every reasonable cause of uncertainty is removed. If a boiler manufacturer has had much experience with coal of this character and knows what his boiler is capable of doing, there is in my opinion much less "guess-work" as to the efficiency he is going to secure than there would be, for instance, in estimating in advance what it was going to cost him to construct and erect the eight boilers in question. In the present case, considerable time was given in advance of receiving bids, so that interested boiler-makers could conduct investigations with a view of ascertaining what their boilers would do, and I happen to know that at least two of the bidders did conduct such trials; and I know also that it was the intention of the O'Brien Co. to set up a boiler in their works and conduct a further extended series of experiments upon it, to determine the exact conditions under which it would give the maximum efficiency.

I am fully convinced that if those boiler-makers who do not approve of this way of letting boiler contracts will take the matter up and study it further, they will find that it does them no injustice, but on the contrary promises to accomplish just what it is intended to do, namely, secure the most economical type of boiler that can be built. It is, of course, unfortunate that legal complications have prevented the installation of this plant under the original specifications, and I am in a position to assure you that Mr. Holman's change of plan is not due to any lack of confidence in the method, but merely because further procedure on any line admitting competition between the two types of boilers in controversy would undoubtedly reopen the legal complications which prevented the first letting. As the city wants boilers and not lawsuits, Mr. Holman is simply taking the most direct means to accomplish his purpose.

This plan of buying boilers is not at all new. It was used by Mr. Holman himself at the Chain of Rocks boiler plant some years ago, and more recently in my own practice in the case of the boiler plant in the new City Hall here, and the Y. M. C. A. Building. Neither is it uncommon to omit all reference to either heating or grate surface, simply specifying the work to be done, thus avoiding the controversy between different manufacturers as to the amount of heating surface required to do certain work. I repeat that when a steam user buys a boiler he wants ability to evaporate a certain quantity of water per hour, and not so many feet of heating or grate surface.

I am inclined to agree with you that the O'Brien bid included a rather larger amount of heating surface than was necessary, but these people being comparatively newcomers in the water tube field, felt that they could afford to be generous in their proportions.

Respectfully yours, William H. Bryan.

St. Louis, Mo., Nov. 7, 1896.

(We are glad to have Mr. Bryan's contribution to this discussion, even though we cannot agree with him. It is by presentation of both sides of a controversy that the truth is finally brought to light. Mr. Bryan says he cannot see what difference is made by the exclusion from the specifications of the dimensions of grate and heating surface when we specify the amount of water to be evaporated, the efficiency, the required dryness of steam and the required smoke performance. No doubt he is right if the question is judged from the standpoint of the ordinary customer who is not an engineer. What he wants is so much capacity and economy guaranteed by the seller; what does he know or care about heating and grate surface? But the case is different when it is presented to a consulting engineer. Suppose a client of Mr. Bryan's receives bids for 2,400 HP. from two boiler-makers, A and B. They offer boilers of identical construction in every respect, but A offers 10.27 sq. ft. of heating surface per HP. and asks the price of $25,000, while B offers only 6.94 sq. ft. with the price of $24,000. This is exactly the St. Louis case with a change in the prices. Would Mr. Bryan advise his client to accept the $24,000 bid because it is the lowest, and would he tell him "it is absolutely immaterial whether the bidder furnishes one or 50 sq. ft. of heating or grate surface to do a given amount of work;" and that if there were any preference it is "in favor of the man who did the work with the least amount of material?" We think not. He would be more apt to say "A's boiler is over 40% larger than B's. If B's boiler is 2,400 HP. A's is more. The $25,000 boiler is by far the cheapest, but it may be larger than you need. You had better call for new bids specifying the size of boiler, so that each bidder will bid on the same thing, and not on his idea of what that thing will accomplish."—Ed.)

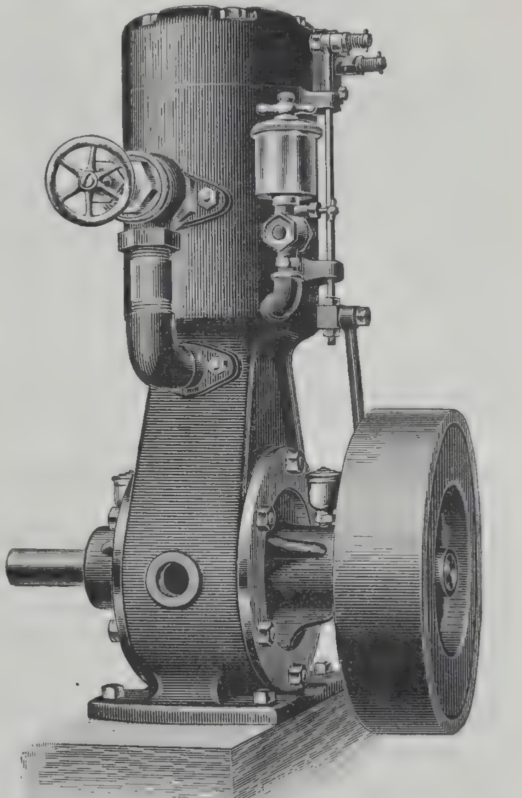
Notes and Queries.

A. W. C., Chicago, has a large body of magnetic iron ore in sand near the Chicago market, and wishes information concerning magnetic separation and briquetting the fine ore for blast furnace use.

THE SIMPLEX NAPHTHA LAUNCH ENGINE.

We illustrate in the accompanying engraving a naphtha engine recently put on the market by Chas. P. Willard & Co., of Chicago, Ill., and designed especially for launches and boats. In its general construction this engine does not differ from other vapor engines, but differs in its valve mechanism and other details, which are best explained in a brief description sent us by the designers.

The simplex naphtha engine differs from most other vapor engines on the market in not depending upon atmospheric evaporation for its supply of gas. It has attached to it a generator, which is heated by the exhaust from the cylinder, thus producing a uniform gas independent of atmospheric temperature or humidity, which, as is well known, strongly affects ordinary carburetters. Owing to the method of generating the gas, lower grades and less volatile oils may be used. The Simplex engine uses successfully naphtha as low as 60° specific gravity, and produces as good results as with the highly volatile forms. In starting, no fire is used to heat the generator, it being provided with an improved vaporizing arrangement, which furnishes the engine with the vapor used in starting up. After running a few minutes, the generator is sufficiently heated to produce a generated gas to take the place of the vaporized gas.


THE "SIMPLEX" NAPHTHA LAUNCH ENGINE.
Chas. P. Willard & Co., Chicago, Ill., Builders.

In the Simplex engine the gases are admitted to the cylinder through an ordinary throttle valve, and by means of this the speed can be varied at will, owing to the uniform quality of the gas and the ability to successfully fire a very small charge under low compression with the aid of an improved electric igniting device which is a combination circuit opener, closer, and sparker, and is so constructed as to permit the spark to be fired at any desirable point of the stroke. The electric circuit is held open about nine-tenths of the time when running, but this too can be adjusted as desired. The engine can be run in either direction, and in skillful hands the best method of reversing is by means of the electric switch. All that need be done is to cut out the electric switch and the engine immediately slows down, and when the piston is just reaching the point of highest compression, which can readily be seen when the engine is moving slowly, the switch is closed and the engine instantly starts in the opposite direction. This result is accomplished by the firing of the charge before the end of the stroke is reached, thus causing the crank to be propelled in the opposite direction to that in which it has been running, but in unskillful hands this method of reversing can not always be depended upon and the makers furnish a reversing device which is placed inside the boat and is operated by a lever.

Broadly speaking, the advantages claimed for this engine for boat use are: the absence of flame or fire in the boat and the necessity of carrying but a small amount of low grade naphtha. The engines are made in 2-HP., 4-HP. and 6-HP. sizes, and cost $275, $400 and $550, respectively. If high rotary speed is desired the engine can be speeded up to 500 revolutions per minute, but for general practice a speed of 300 revolutions is advised. Owing to pending patents the details of the valve mechanism and other parts cannot be made public at this time.

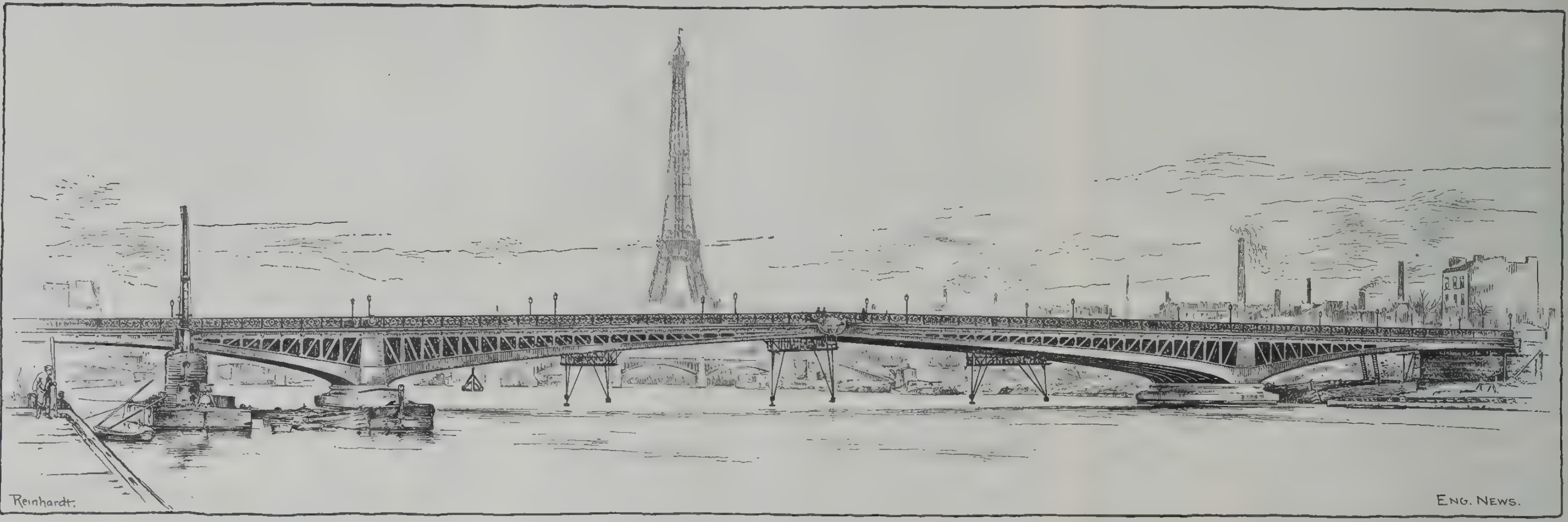


FIG. 1.—MIRABEAU CANTILEVER BRIDGE, PARIS.

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AN OVERLOOKED STAND-PIPE INCIDENT AT ATLANTIC CITY, N. J.

While on a recent visit to Atlantic City a member of the editorial staff of this journal learned from Mr. W. C. Hawley, Assoc. M. Am. Soc. C. E., superintendent of the city water-works, that one of the stand-pipes connected with the works had a narrow escape from destruction a few years ago. This stand-pipe was built by the Atlantic City Water-Works Co., whose works, together with those built in 1889 by a rival company, were recently bought by the city. Mr. Geo. T. Prince, M. Am. Soc. C. E., now Chief Engineer of the Omaha Water Co., was in charge of the plant of the Atlantic City Water-Works Co. when the incident occurred. In response to a request from this journal, Mr. Prince has very kindly sent us the following account of the incident:

I believe it was on Sept. 12, 1889, that the occurrence took place, at a time when there was an exceptionally high tide, probably 3 ft. above the normal high water. This resulted in overflowing the basins of the water company, located about six miles from Atlantic City on the mainland, and, in consequence, the engineer was forced to stop his pumps, but was unable to advise the writer, who at that time was in charge of the works as superintendent, as the high winds had destroyed all telegraph and telephone communication between Atlantic City and the mainland. I, however, noted the fall in our water pressure indicated by the pressure gage in the office, and surmising the truth, hastened to shut off the stand-pipe and save as much of the water as possible. This was early in the afternoon. The wind was blowing a gale from the northeast, coming in violent gusts and causing the plates of the stand-pipe to be indented; this indentation seemed to take a spiral course around the pipe upward, going off at the top with a sharp report that could be heard several blocks distant.

The pipe is 25 ft. in diameter, 132 ft. high, and anchored, I think, with eight 1½-in. rods, which pass through and are secured below the heavy cut stone masonry and grillage upon which the pipe is founded. All of the rods upon the windward side were either broken or the brackets to which they were secured, allowing the pipe on that side to lift from its foundation. I did not think it safe to allow the men to approach near enough to the stand-pipe to close the valve located on its outlet pipe and but a few feet distant, but, instead, had them shut off a number of valves in the district. This lost us time and I judge there were probably 20 or 25 ft. of water remaining in the pipe after the valves were closed.

The wind continued to increase in velocity and was recorded, as I personally observed, by the instrument at the U. S. Signal Office at over 100 miles per hour. This force, however, came in gusts and would extend for a period of say five minutes, when for several minutes there would be a lull. In the middle of the night one of my men who had made an ineffectual attempt to leave Atlantic City to carry word to the engineer to start the pumps, regardless of brackish water, visited the stand-pipe and reported to me that it was lifting from its foundation fully 6 ins. On the following day I succeeded in getting the water pumped into the stand-pipe, and thus relieved the serious condition. The gale continued until the third day.

That the pipe, after being subjected to such a trying ordeal, did not show signs of leaking when afterwards filled, convinced me that it was of excellent material and well constructed. My recollection is that the top course is ¼-in. thick and the lower, ¾-in.; each course being 4 ft. high. It was constructed in 1882. Mr. Walter Wood, of the firm of R. D. Wood & Co., of Philadelphia, was at that time president of the Atlantic City Water-Works Co. My predecessor at Atlantic City was Mr. E. Graves, and under his direction the stand-pipe was constructed. Mr. Graves is at present Superintendent of the Camden Iron Works, of Camden, N. J.

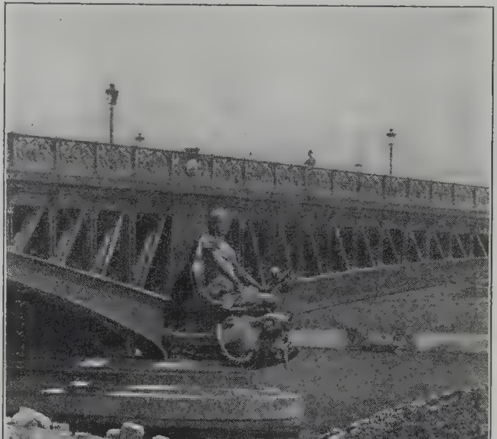


Fig. 6.—Mirabeau Bridge; Pier and Truss Decorations.

I never saw the specifications governing the construction of this stand-pipe, but understood from Mr. Graves that they were prepared by Mr. J. D. Cook, of Toledo, O., who acted as consulting engineer in the construction of the original plant, and were similar to those which he, Mr. Cook, had prepared for the stand-pipe at Sandusky, O.

It would be interesting to know whether the metal was rolled, after the old method, from piled iron, or the modern way of rolling from the ingot. An engineer of wide reputation who has had extended experience in the use of riveted wrought-iron pipe, covering a period of more than a quarter of a century, recently expressed himself to me as strongly in favor of the former and decidedly opposed to the latter method of rolling from the ingot, and is to-day insisting upon having his plates rolled from wrought iron wired in piles before reheating. He claims that any imperfection in any separate piece of iron in the pile does not extend through the entire thickness of rolled plate, but is confined to one layer, so to speak; whereas, in the case of the rolling from the ingot, any impurities in the steel are made to cover considerable area and extend through the plate, which objection, if well taken, is pertinent to the construction of standpipes.

Mr. E. Graves, now superintendent of the Camden Iron Works, has written us regarding the above incident, as follows:

Proof of Mr. George T. Prince's description of an incident in the history of the Atlantic City stand-pipe, together with your note of inquiry as to whether I could add anything of interest to same, is at hand. To this description there is but little more that I can say. As stated by Mr. Prince, the general specifications of this, as well as that of the first of the large stand-pipes, the one erected at Sandusky, O., in 1876, were prepared by Mr. J. D. Cook, and both erected under my personal supervision.

The plates in the Atlantic City structure are of steel, and were rolled by Park Bros., of Pittsburg. I have not before me data of the various thicknesses. Steel rivets were used, the stock for which was also made by Park Bros. The bottom of pipe is all ¼-in. thick, and is made up of a circular sheet with radial sheets joined to the first course of the shell by means of an angle. The holding-down bolts connect with lugs, which in turn are secured to the center of the first shell course at eight points in the circumference. When the tank was first completed it was found that the bottom did not lay flat on the foundation; that the pressing down of the buckles under the weight of water made leaks in the bottom calking. To obviate this difficulty a 6-in. diameter hole was cut in the center, and an ordinary half flange union secured to the plate by bolts. Into this flange was screwed a section of wrought-iron pipe some 3 or 4 ft. long, and liquid cement was poured in the top of this pipe until the bottom was raised and drawn tight by hydrostatic pressure—it assuming a spherical form with a rise in the center of perhaps 6 ins. After hardening of this cement the hole in the bottom was closed with a plug, and no further trouble was ever experienced through bottom joints leaking.

In a structure of this kind, having a semi-flexible bottom and a few feet of water in it, it can readily be seen that the weight of the water on the bottom holds back only to a small extent the first overturning motion; that as this motion increases, there is, on the windward side, a corresponding lifting of the bottom curb, carrying with it the ends of the bottom sheets. The further the ends of these sheets are lifted, the greater will be the suspended area and corresponding water load, resulting in an increasing resistance to overturning. This bottom being spherical, with an upward curve, allowed a greater swaying to top of tank than would have been the case had the curvature been downward, or had there been no slack in the bottom plates, and they had laid flat.

While this wind storm resulted in a severe test to the tank in question, that it sustained no material injury is hardly more surprising than that some tanks whose details have become familiar to the public through descriptions of their failure in Engineering News, stood long enough to be tested at all.

THE MIRABEAU CANTILEVER BRIDGE, IN PARIS.

This bridge, the first of the cantilever type erected in Paris, has recently been completed across the River Seine, but has not yet been formally opened to traffic. It connects the industrial quarter of Grenelle-Laval with the purely residential quarter of Auteuil on the right bank of the river, and the state and municipality equally shared the cost of erection, with a view of encouraging the present movement of population away from crowded centers and towards the new suburbs of modern construction.

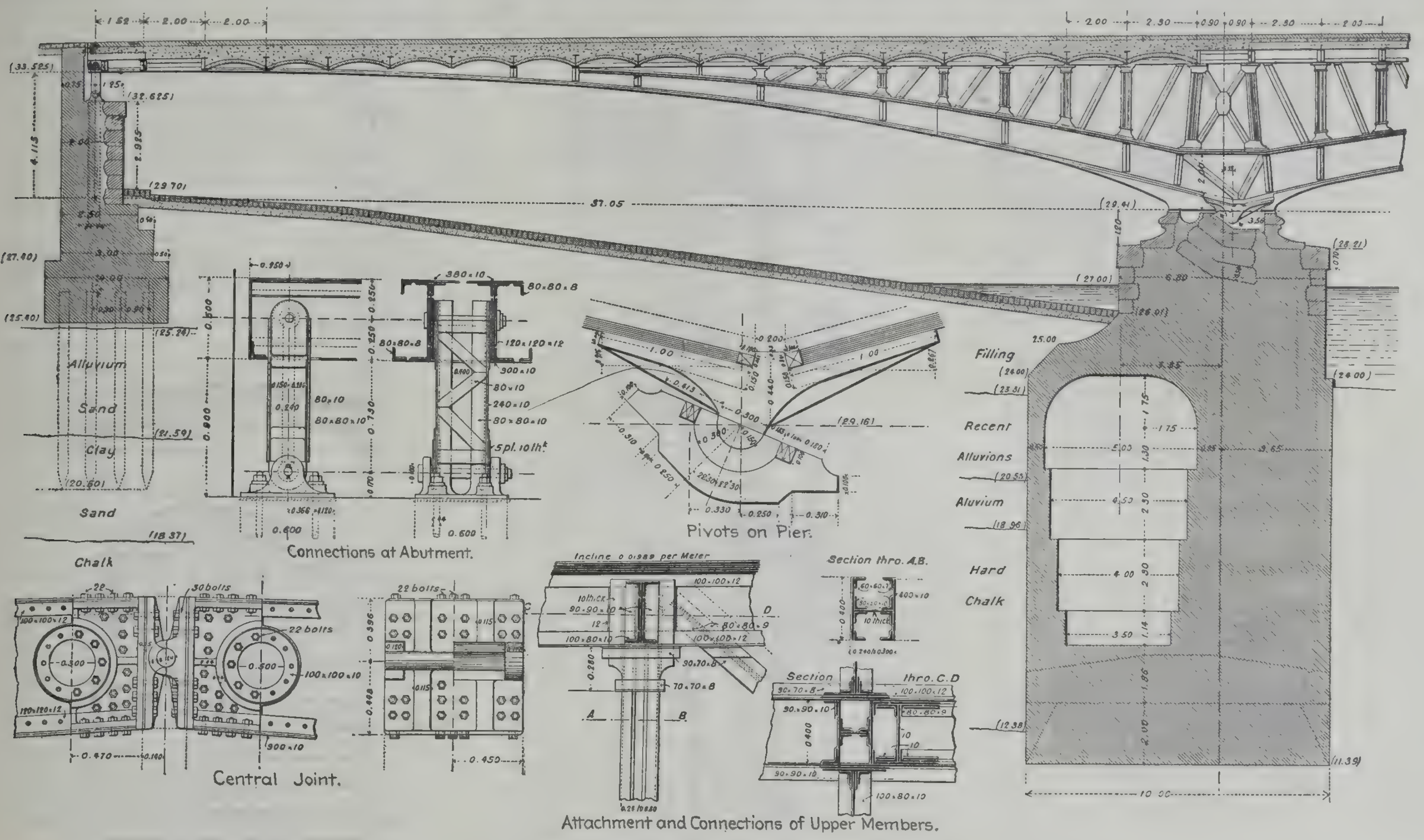


FIG. 2.—MIRABEAU BRIDGE; PIER AND HALF-CANTILEVER.

This bridge is made up of one center span of 328 ft. and two side spans of 118 ft. each, forming two cantilevers supported on pivots on two river piers and ending at two shore anchor-abutments. At the center of the river span the abutting arms are connected by a pin, or hinge. The width of the roadway is 39.36 ft., with two footways each 13.12 ft. wide. Each half of this bridge is made up of seven mild steel trussed arms, united laterally, as shown in Fig. 3, and spaced 9.84 ft. apart under the roadway, and 12.2 ft. apart under the footway. The height from the pier-pivot to the center of the bridge is 20 ft. 3 ins., and the under part of the frames takes the form of two semi-parabolas, with a horizontal axis. The depth of the frame is 17.54 ft. at the pier, decreasing to 2.75 ft. at the center and to 1.64 ft. at the shore ends. The framing of the two arms is continuous over the river piers, with the frame and arc made of box-girders. This is fixed on a steel pivot or balance, shown in Fig. 2, composed of two plates and a casting terminating in a half-cylinder, bolted to the arc of the frame. This half-cylinder rests upon a steel cushion imbedded in the granite pier. The central joint and the abutment connections are well shown in the cut, which is taken from "The Engineer," of London, along with a considerable part of this description.

The same journal thus describes the principle of equilibrium upon which the bridge was designed: Under the action of a symmetrical weight the two parts of the river span are subjected to a horizontal stress of only about 500 tons, as the weight of the shore spans compensate in great part for the weight of the river spans, and this condition makes possible the moderate depth given to the frames at the piers. Under the influence of loads this stress can be increased about four times above that produced by a permanent weight alone. The temperature also causes fluctuation in the pushing strains and brings into play the jointed anchorage. The pressure on the anchorage foundations, due to changes in temperature, varies from 71 lbs. to 206 lbs. per square inch, under the most unfavorable conditions.

The river-piers for this bridge are peculiar in construction, as shown in Fig. 2. These piers are 32.8 ft. wide and 91.8 ft. long from the river-bed downward, and rest upon a metallic caisson of the same horizontal dimensions, sunk by the use of compressed air to a hard-chalk stratum, lying about 54 ft. below the water. The sinking of these caissons, on the so-called Zschokke and Terrier system, is described as follows in "Le Genie Civil":

The top width of the pier is 22.2 ft.; but in order to increase the base area the pier was widened out by a curved offset, at about 10 ft. below the water level, and four wells were left within the base of the pier on the shore side, so as not to unnecessarily add to the quantity of masonry. The foundation material was sandy clay, soft clay and chalk, gradually increasing in hardness. The caissons are the same size as the piers, 91.8 ft. long and 32.8 ft. wide, the straight part of the sides being 68 ft. The working chamber is about 6½ ft. high and has four shafts. The two middle shafts, 2.8 ft. diameter, terminate in air locks of the Montagne system, and are used by the workmen. The two end shafts, 3.4 ft. diameter, are used for removing the material, and are fitted with the Zschokke and Terrier air locks (Fig. 4). The shafts are so placed with reference to the empty space in the pier that the masonry work can be nearly all completed before communication with the working chamber is shut off. The roof of the chamber is supported by lattice girders, as shown in Fig. 5. The working chamber is lighted by electricity. The first caisson was launched in August, 1893, and the masonry carried up to water level in two months; the working chamber was then filled with brick and rubble masonry between the girders, and all spaces filled with concrete. The second caisson was placed in November of the same year.

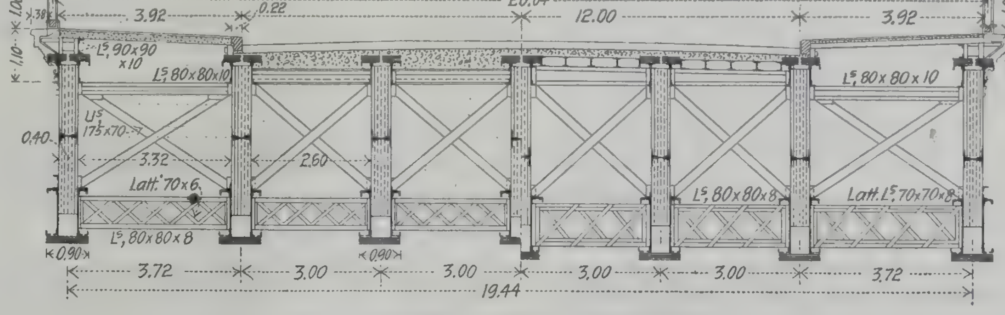
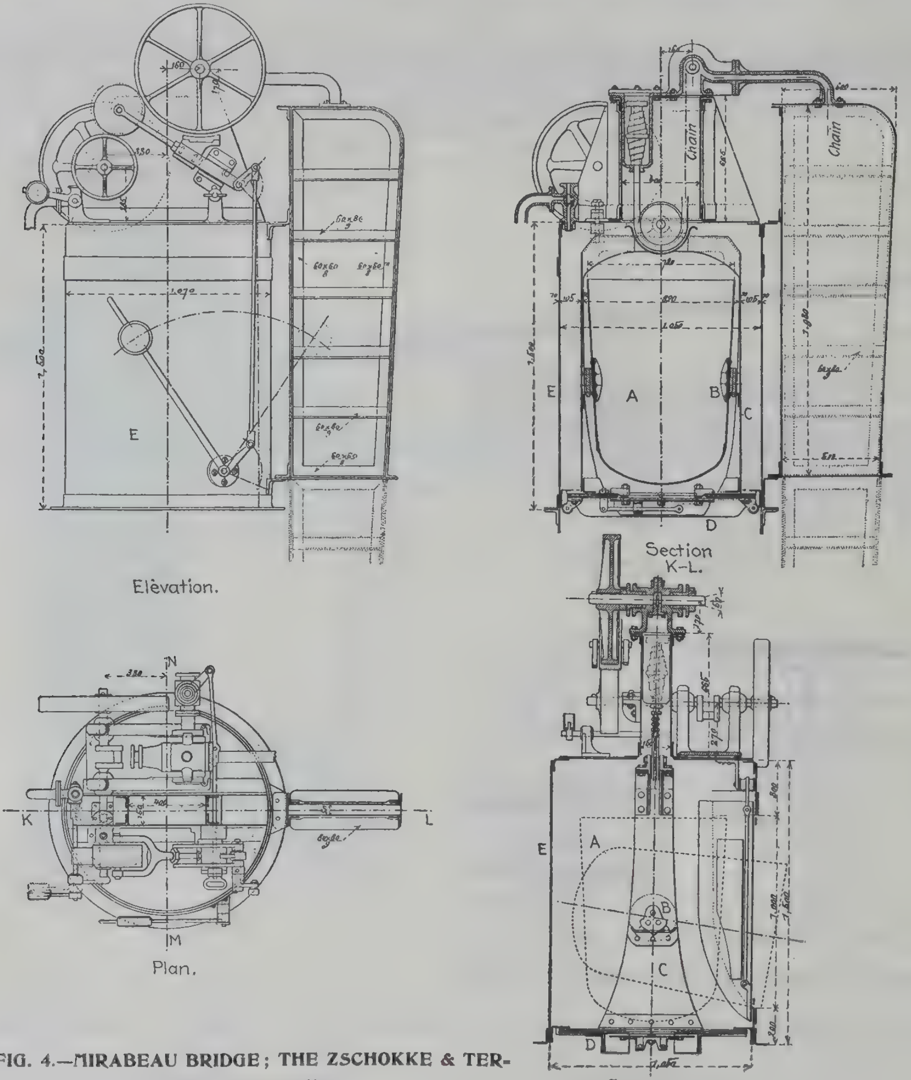


FIG. 3.—MIRABEAU BRIDGE; CROSS-SECTION.

The Montagne air locks for the workmen are operated in the usual way. The man enters the chamber on top of the shaft and closes the outer door; he then opens a valve admitting the compressed air, and when the pressure is equal to that in the shaft he can open the door in the floor of the chamber and descend by a ladder in the shaft. The Zschokke and Terrier air locks for the removal of the excavated material are much more rapid in operation, too rapid to be used by men, as the sudden changes in pressure would be dangerous. The bucket A, Fig. 4, rests on two trunnions on racks, B, attached to a frame, C, carrying at its lower part, D, a plate which closes the bottom of the chamber, E. This frame is suspended by a chain, one end of which is fixed to the top of the chamber, the chain passing under a pulley attached to the bucket frame, then over a small wheel in the top of the chamber, and then running down the shaft. This wheel has a pulley on the outer end of its axle (outside the chamber), which is driven by a friction wheel of a little compressed air engine, and thus raises or lowers the bight of the chain in which the bucket is suspended. The bucket being filled is raised by the chain; when it reaches the top of the shaft, the shaft is closed by the plate on the bottom of the bucket frame, fitting against a rubber-faced steel ring, and a valve is automatically opened to release the compressed air in the chamber. As soon as this is done the swinging door in the side of the chamber is opened and the bucket dumped. This door is then closed, and the friction wheel being thrown off the bucket runs down by its own weight.

The construction of the Mirabeau bridge was authorized in 1893, and the first caisson was sunk on August 8 of that year, and it was finished on Oct. 24. The second caisson foundation was completed between Nov. 10 and Dec. 30, 1893. On Sept. 1, 1894, the erection of the metal superstructure was commenced by means of a travelling crane with a reach of 85 ft. The bridge was erected upon false works, supported upon piles; commencing at the pier-pivot, parts of each adjoining arm were first constructed and then the river arm was completed, in accordance with the requirement that the first half of the bridge should be finished before the winter of 1894-95. This first half was finished in January, 1895, and the false works were removed and put up again under the other half by April 25, 1895. This second half was erected April 13 and August 24 in the same year. With the halves completed, the two river ends were brought into line and adjusted to the proper height and then the measurements were taken for the wedges to be placed on each arc between the center-hinge and the frames. When the wedges were prepared, the ends of the bridge were raised by jack-screws, the wedges put in and the ends allowed to fall into contact at the proper level. The roadway was then completed and on Dec. 5, 1895, the bridge was opened to pedestrians, having consumed about 18 months in construction. The superstructure weighs 2,744 metric tons, of which 2,077 tons are rolled steel, 385 tons rolled iron and 82 tons of forged steel; the remaining weight is in the ornamentation. The cost of this superstructure was about $247,000, and the total cost of the bridge was $413,400. The designer of the bridge was M. Resal and the work was carried on under M. Rabel, Chief Engineer of the "Ponts et Chaussees;" and M. Alby was the engineer in charge.



Elevation.

Section K-L.

Plan.

Section M-N.

FIG. 4.—MIRABEAU BRIDGE; THE ZSCHOKKE & TERRIER AIR-LOCKS.

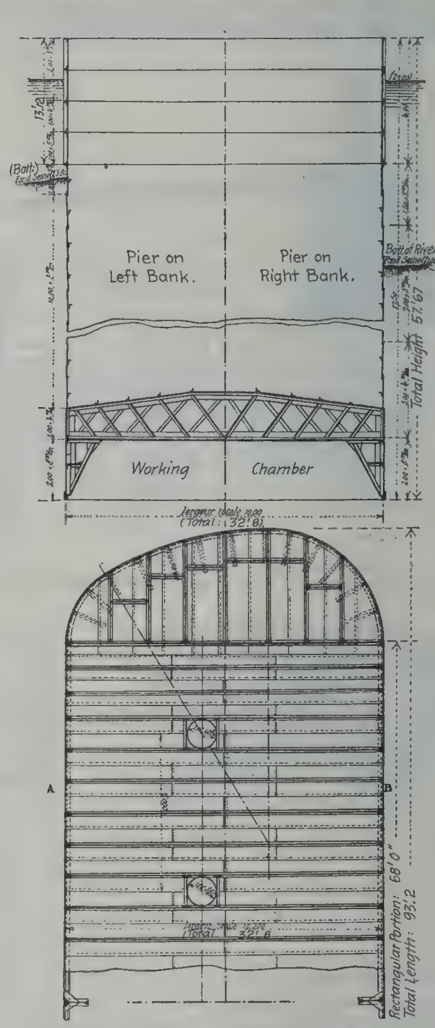


Fig. 5.—Mirabeau Bridge; Caisson.

STATISTICS OF STRIKES AND LOCKOUTS.

Volume I. of the tenth annual report of the Commissioner of Labor for the year 1894, which has just been issued from the government printing office is a bulky book of 1,373 pages, of which all but the first 32 pages are devoted to tables of strikes and lockouts in the United States between Jan. 1, 1887, and June 30, 1894. The tables are arranged by states, years and industries, and the headings include occupation, locality, cause or object, ordered by labor organizations, establishments involved, closed or not closed, date of beginning and ending, duration in days, succeeded or not, wage loss, assistance to employees, and loss of employers. The introduction to the volume contains an analysis of the tables, with general summaries for the period embraced in this report and also for the period covered by the third annual report, viz., Jan. 1, 1881, to Dec. 31, 1886. From

Causes of Strikes in the United States for 13½ Years.

Items.	Jan. 1, 1881, to Dec. 31, 1886.		Jan. 1, '87, to June 30, 1894.	
	Estblshmts.	%	Estblshmts.	%
For increase of wages	9,439	42.32	12,041	25.69
For reduction of hours	4,344	19.48	6,199	13.23
Against reduction of wages	1,734	7.77	3,830	8.17
For increase of wages and reduction of hours	1,692	7.59	3,095	6.60
For reduction of hours and against being compelled to board with employer	800	3.59	.....	.....
For change of hour of beginning work	360	1.61	.....	.....
For increase of wages and against the contract system	238	1.07	.....	.....
For 9 hours' work with 10 hours' pay	172	.77	.....	.....
Against increase of hours	138	.62	.....	.....
For reduction of hours and wages	126	.56	.....	.....
For payment of wages overdue	...	...	383	.82
For increase of wages and reduction of hours on Saturday	...	...	378	.81
Total	19,043	85.38	25,928	55.32
For increase of wages and against employment of non-union men	215	.96	.....	.....
Against employment of non-union men	162	.73	1,688	3.60
In sympathy with strike elsewhere	173	.77	3,620	7.73
For adoption of new scale	...	...	1,559	3.33
For adoption of union, etc., scale of prices	142	.64	.....	....
For adoption of union rules and union scale	...	...	783	1.67
For recognition of union	...	...	1,314	2.80
For adoption of union scale	...	...	844	1.80
For increase of wages and enforcement of union rules	132	.59	.....	....
For increase of wages and recognition of union	145	.65	686	1.46
To compel World's Fair directors to employ only union men in bldg trades	...	...	472	1.01
For reinstatement of discharged employees, etc.	124	.56	467	1.00
Total	1,093	4.90	11,413	24.40
All other causes (297) 1881 to 1886	2,168	9.72	.....	....
All other causes (376) 1887 to 1894	...	...	9,521	20.28
Grand total	22,304	100.00	46,802	100.00

these summaries we have abstracted the following figures:

Strikes and Lockouts in the United States From Jan. 1, 1887, to June 30, 1894; 6½ Years.

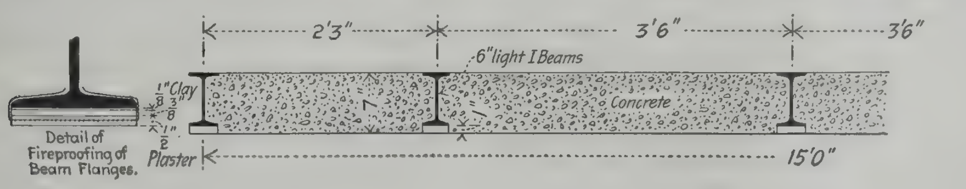
	Strikes.	Lockouts.
Total strikes and lockouts	5,909	244
Establishments	28,662	2,970
Employees thrown out employment	955,252	140,135
Wage loss of employees	$34,988,100	$12,108,463
Loss to employers	28,786,446	5,754,296
Assistance to employees[1]	4,590,177	671,818
From Jan. 1, 1881, to June 30, 1894; 13½ Years.		
Establishments	69,166	6,067
Average duration, days	25.4	47.0
Wage loss to employees	$163,807,657	$26,685,516
Assistance to employees[1]	10,914,406	2,524,298
Loss to employers	82,598,786	12,235,451
Establishments in which strikes or lockouts succeeded, %	44.49	40.33
Failed, %	44.23	47.75
Succeeded partly, %	11.25	9.58
Number thrown out of employment		Per cent.
in successful strikes	1,188,525	32.00
In strikes which failed	2,061,259	55.50
In partly successful strikes	462,777	12.46
In total strikes	3,714,231	.....

[1] By labor organizations.

The report contains two tables summarizing the leading causes of strikes for the two periods, Jan. 1, 1881, to Dec. 31, 1886, and Jan. 1, 1887, to Dec. 31, 1894. We have rearranged these two tables to make the one given below so as to place in contrast the figures for the two periods, and bring out a matter which does not seem to be discussed in the report, viz.: the apparent tendency to a change of the principal causes of strikes from those relating to differences of opinion between employers and employees concerning wages and hours of labor, to those relating to recognition of unions, employment of non-union men, "sympathetic strikes," etc. Of the several causes specified in the tables it appears that those relating simply to wages, hours, etc., comprised 85.38% of the total number of strikes (counted by establishments) in the first period, and only 55.32% in the second, while the specified causes of the second class, those relating to unions, sympathetic strikes, and the like, were only 4.90% in the first period and 24.40% in the second. The increased domination, or attempted domination of the unions, in recent years, of which these figures seem to give evidence is a subject well worthy of study by those interested in labor questions.

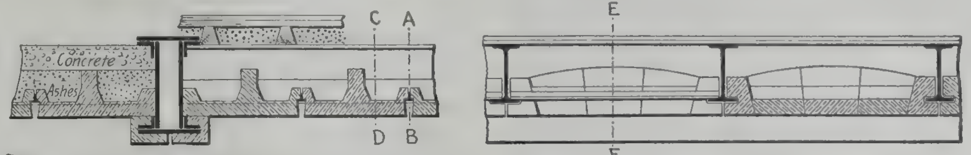
TESTS OF THE THOMSON AND THE McCABE FIRE-PROOF FLOORS.

Two additional tests in the series of fire and water tests of fireproof floor constructions, which is being conducted by the Building Department of New York city, were made during the past week at the testing grounds, 68th St. and Avenue A. Mr. Frank Rutherford was the expert of the Department in charge. The first test, made on Nov. 7, was of the floor designed by G. H. Thomson & Co., No. 51 East 44th St., New York. The test was made in a brick building similar to those used in the tests of the other floors which have been described in our columns in the past few weeks. The interior size of the building is 11 × 14 ft. and the walls are 1 ft. thick. The floor tested, which formed the roof of the building, was constructed of 6 in. light I-beams, 12 ft. long, spaced as in the accompanying sketch, the space between the beams being entirely filled, as shown by a concrete made of 1 part of Dyckerhoff Portland cement, 2½ parts clean sand and 6 parts ashes, and treated by a chemical preparation the nature of which has not been made public. The underside of the flanges of the beams was protected by two layers of hardened clay preparations of different constitution, the first ⅛-in. and the second ⅜-in. thick; and further by ½-in. of cement mortar, held in place by wire netting. The underside of the floor or ceiling was then plastered with a coat of about ½-in. of ordinary lime plaster. The most important difference between the construction of the Thomson floor and that of the other concrete filled floors before tested is in the disposition of the beams, which are only 6-in. I-beams, weighing 13 lbs. per ft., 12 ft. long between centers of supports and 3 ft. 6 ins. apart c. to c. In the other tests the beams were 10-in., 25 lbs. per ft., 15 ft. long between supports and spaced 4 ft. apart. The beams in the Thomson test were therefore subjected to a much greater fiber strain for a given load per sq. ft. of floor than those in the other tests. Before the test the central panel of the floor was loaded with 6,300 lbs. of pig iron, or 150 lbs. per sq. ft.

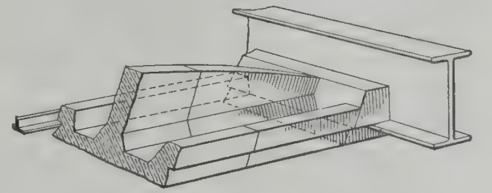


CONCRETE FIRE-PROOF FLOOR CONSTRUCTION.

Designed by G. H. Thomson, M. Am. Soc. C. E., New York City.



Section E-F. Part Section A-B. Part Section C-D.



Isometric View.

CONCRETE AND PLASTER OF PARIS FIRE-PROOF CONSTRUCTION.

Patented by Peter McCabe, New York City.

The test was begun at 10 a. m. by lighting the fire of cordwood. The temperatures were taken by a Uehling & Steinbart recording pyrometer. By 10.45 a temperature of 1,775° F. was recorded, and at 10.57 2,200° F. The highest temperature was 2,250° F. at 1.45 p. m., and from 11 a. m. to 3 p. m. the temperature remained above 2,000°, except when the doors were opened for charging firewood. A double grate was used as in the earlier tests, so that the air supplying the upper grate might be heated by passing through the lower fire. At 3 p. m., after five hours of continuous firing, a strong stream of water supplied by a fire engine was directed against the underside of the ceiling, and when the interior of the building was sufficiently free from steam to be observed, it was found that the concrete filling between the beams was practically uninjured, the plaster coating, where the full force of the water struck it having been torn off. The maximum deflection of the floor observed during the test was only 1.82 in. at 2.57 p. m. After cooling this had reduced to 0.7 in. On Nov. 10 a load of 600 lbs. per sq. ft. was placed on the floor, and it developed only 0.37 in. deflection.

The next test was made on Monday, Nov. 9. It was made at the same place, and in a building of the same style as those used in the previous tests. The floor tested was designed and patented by Mr. Peter McCabe, of McCabe Bros., 33 West 64th St., New York city.

The floor is constructed as follows: The I-beams, 10-in. medium weight, 15 ft. long, running lengthwise of the building, are spaced 4 ft. apart c. to c. Upon their lower flanges is built a series of flat arches, made out of ribbed blocks of the shapes shown in the accompanying cuts. These are made of a composition of plaster of paris and ashes. After the arches of plaster blocks are laid the spaces between their upward projecting ribs are filled with dry ashes, the upper surface being rounded off to the arched form of the top of the rib. The whole space between this rounded surface and the level of the top of the upper flange of the 10-in. I-beam is then filled with a cement concrete, made of 1 part Portland cement, 2 parts sand and 4 parts ashes. The lower sides of the plaster blocks extend about 2½ ins. below the flanges of the I-beams, as shown. Light T-irons, inverted, are laid on the lower flanges of the I-beams for the purpose of supporting the arch blocks while they are being laid, and possibly of contributing to the strength of the floor.

The middle panel of the floor having been loaded with pig iron to the amount of 150 lbs. per sq. ft., the test was begun at 10 a. m., and continued five hours. By 11 a. m. the temperature had reached 1,500° F., by 11:20 it was 2,000°, and by 11:30, 2,250°. The highest temperature attained was 2,325°. Between 11:20 a. m. and 3 p. m., the temperature was kept above 2,000°, except for short intervals, while fresh wood was being charged. The maximum deflection during the test was only 0.33-in., which is much less than that found in any of the floors previously tested. Its small amount is no doubt due to the greater thickness of the construction, as compared with that of the other floors, and to the very complete protection of the lower side of the beam. On cooling very little change in the deflection was found. At 3 p. m., the floor was cooled by a stream from a fire engine, about 15 minutes being required. When the steam had cleared away it was found that small portions of the plaster blocks had fallen out in three places exposing the concrete arch above, and that a portion of the plaster blocks under the flange of the I-beams had also fallen off. It is probable that most if not all of this damage was done by the force of the fire stream. The concrete arch where it was exposed appeared to be entirely uninjured.

◆

TWO JAPANESE CRUISERS are to be built in the United States, one by the Cramp Ship & Engine Company, of Philadelphia, and the other by the Union Iron Works, of San Francisco. While the contracts have not yet been formally signed, the proposals of the American firms have been accepted. The new cruisers are to cost about $1,250,000 each, and the proposals call for a speed of 21 knots and 17,000 I. HP. Each cruiser will have about 5,700 tons displacement, with a length of 335 ft. on the water line, 51 ft. extreme beam, and 20 ft. mean draft. The main battery is to include four 8-in. and eight 5-in. rapid-fire guns, with a secondary battery of twelve 6 pdrs., six 1 pdr. and four Gatling guns. The Japanese government is said to be about closing contracts with the English shipbuilder, Armstrong, for two first-class battle ships and one armored cruiser; besides these, it is contracting for five 150-ton 24-knot torpedo boats and several torpedo boat destroyers, in England, five torpedo boats of the same class in France and five more from German firms.

◆

THE TIDAL SURVEY of the Gulf of St. Lawrence has been in progress for three years. The first season was occupied in examining the Belle Isle and Cabot Strait entrances and in fixing the general relation between the tides and currents of the gulf and the ocean. The second season was devoted to the St. Lawrence entrance between the Gaspe coast and Anticosti and the nature of the currents were traced across the southwestern side of the Gulf to Cape Breton. During the present year the northeastern arm of the Gulf, from Anticosti to Belle Isle, has been under examination. This arm of the Gulf has an area equal to that of the English Channel and through it passes all the Atlantic trade taking the Belle Isle route. Tide tables are now published covering the approach from Halifax to Quebec, the first tables which are based upon direct observations.

WHEELER-STERLING ARMOR-PIERCING PROJECTILES were tested at Indian Head, on Oct. 30, against a 12-in. Carnegie nickel-steel plate. The shell was 12 ins. in diameter, and represented a lot of 75. It was fired with a velocity of 1,800 ft. per second and though it pierced the plate it was badly shattered. The lot was rejected under the present regulation requiring the shell to not only penetrate the plate, but to pass through the trial without splitting or breaking up. The late trial is said to have brought about a change in this regulation, calling only for penetration without regard to the final condition of the shell.

◆

THE SUBMARINE TORPEDO BOAT, invented by Mr. John P. Holland, which is now being built at the Crescent Shipyards, Elizabethport, N. J., is expected to be launched about Jan. 15. It is a cigar-shaped vessel, 50 ft. long and 10 ft. diameter, constructed of double steel plating 7-16-in. thick forward, tapering to 5-16-in. aft. The motive power will be electricity and compressed gas, either of which may be used separately, or they may be coupled when the highest speed is desired. The only superstructure will be a telescopic conning tower, 3 ft. diameter and 1 ft. high. The displacement of the vessel will be 66 tons. Her armament will consist of a gun for throwing aerial torpedoes containing 200-lb. charges of high explosives, and her magazine will contain, in addition, six or seven "Whitehead" torpedoes. Her speed below the surface will be nine knots for twelve hours, or twelve knots for four hours, while being operated by electric current, and when awash she will develop eight knots under gas pressure. When launched, she will be fitted with a 50-HP. gas engine, but at a later date a 300-HP. motor will be used, which is expected to generate a speed of 16 knots. The cost of construction will be about $75,000. The larger boat of the same class, which is being built under contract with the U. S. Navy Department at the Columbian Iron Works, in Baltimore, and which was described in our issue of March 12, 1896, is expected to be completed in February.

◆

THE MISSISSIPPI JETTIES are in danger, says the New Orleans "Times-Democrat," from the existence of a crevasse, 3,000 ft. wide, leading from Pass a l'Outre to Garden Island Bay and to the Gulf. The South Pass, the one opened by the jetties, lies between the Pass a l'Outre and the South West Pass, and Mr. Eads laid mattresses across the mouths of both of the other passes to divert the water towards the center pass and to keep up the scour in that channel. But the mattress across the end of the Pass a l'Outre has been broken by floods and a deep channel formed at the mouth which leads a large volume of water into the northern arm of the delta. A crevasse has also been formed in the south bank, about 1½ miles below the head of the pass, and by making a shorter route for the water and decreasing the fall, it is estimated that about 52% of the volume of the river water now empties into the Gulf by this north channel and 25% goes through the crevasse. This output decreases the flow in the South Pass and it is said to be growing shoaler and narrower at an alarming rate. The crevasse occurred in 1891 and there is now a gap 1,200 ft. wide and 84 ft. deep between the end of the Pass a l'Outre mattress and the South Pass works. The executors of Mr. Eads, at their own expense, attempted twice to close this gap, but without success. Major B. M. Harrod, of the Mississippi River Commission, says that the crevasse at Pass a l'Outre, should be closed at once. But it must be done by the government, under a special Congressional appropriation, as there is nothing in the Eads contract compelling them to perform this work. Major Harrod favors the immediate improvement of the South West Pass, which is now deeper than the South Pass, when work was commenced upon it, for it has 12 to 14 ft. over the bar, as compared with 8 or 9 ft. in the original South Pass. The necessity for speedy action by the government is made more apparent by the fact that the Eads contract expires in July 1899, and something must be done, either to preserve the channel at the South Pass, or to secure a wider and deeper entrance at the South West Pass.

◆

THE UNITED STATES EXPORT ASSOCIATION, incorporated "to encourage the consumption of American products in other countries," has issued its fourth bulletin, designed for circulation in the English colonies. It sets forth the advantages possessed by American manufacturers in special lines and gives a long directory of American business houses. Mr. F. B. Thurber, the President of the Association, together with his assistants, are actively at work, and they already have the co-operation, as members, of a large number of leading houses in many lines of business. An information bureau has been organized by the Association which will answer free of charge any queries put to it, both from buyers and sellers of goods. The purpose of the Association is a most laudable one; and properly aided by those most interested, American producers, it should accomplish in this country what a similar persistent effort and organization has done for European producers. The offices of the Association are at 143 Chambers St., New York city, and application to that address will obtain fuller details as to the purposes and progress of the work.

THE BRUSSELS INTERNATIONAL EXPOSITION is to be held between May 24 and Oct. 31, 1897, under the auspices of the King of Belgium and the municipality of Brussels. The exhibits will include those usually seen at expositions of this character, and the Commissioners of the United States, Messrs. J. H. Gore and Thomas Wilson, call the special attention of American manufacturers to this opportunity for extending their trade by proper exhibits. Application for space must be made before Jan. 1, 1897, and the general rules for admission, classification, etc., may be obtained by addressing the Commissioners at Columbian University, Washington, D. C. An effort is also being made to obtain special freight rates for exhibits from the Red Star Line to Antwerp, and full particulars can be obtained by addressing this company at 6 Bowling Green, New York city.

◆

AN INTERNATIONAL EXHIBITION is to be held in Guatemala from March 15 to July 15, 1897. Information can be obtained from Mr. Joaquin Yeto, Consul-General of Guatemala, New York city.

◆

THE DECIMAL GAGE for measuring the thickness of sheet metal and the diameters of rods and wires which was adopted last year by the American Railway Master Mechanics' Association was also adopted by the Association of American Steel Manufacturers at its regular quarterly meeting in New York on Oct. 23. A committee of the Association presented a report in which they gave a number of reasons against the adoption of the U. S. Standard Sheet Metal Gage of 1893 and in favor of the decimal system of gaging, which report was formally indorsed by a resolution of the Association. An extended abstract of the report is given in "The Iron Age" of Oct. 29. In the decimal system of gaging, gage numbers are not used, as in the old systems, but the actual thickness in thousandths of an inch is used instead. For convenient shop measurements a notched gage is used, of sheet metal, 0.1 in. thick, and of elliptical shape, 4 × 2½ ins. Such a gage with 38 notches is furnished by the Pratt & Whitney Co., of Hartford, Conn., for $5. The gage has been adopted in the shops of all the principal railways of the United States and Canada.

◆

THE URBAN POPULATION OF THE UNITED STATES is discussed in "Scribner's" for October. It is stated that more than one-third of this total population now live in cities. In some states this percentage is much exceeded, as it is 70% in Massachusetts, 60% in New York, 54% in Connecticut, and 52% in New Jersey. In 1790 there were only six cities of more than 8,000 inhabitants; in 1890 there were 448 such cities. In 1840 there were only three cities with more than 100,000 inhabitants; in 1890 there were 28 cities of this population. In 1896 the 3,200,000 inhabitants estimated for the Greater New York almost equal the population of the 13 United States in 1789.

◆

THE CHEMICAL PROFESSION appears to be badly overcrowded in England, if we may trust an editorial in "The Engineer." We quote from it as follows:

> There are fifty chemists clamoring for every insignificant appointment in this country; and large numbers of German chemists are working here for salaries which would scarcely pay the tailor's bill of an Englishman. In few words, it does not pay in this country to make your son a chemist. If he has nothing but the income derived from the practice of his profession to rely upon, he will have to live a life of genteel poverty, cursing the hard fate which made him and his parents select a profession which pays no one properly at the beginning and leads to nothing at the end. No doubt a few chemists have made fortunes. In like manner a few large nuggets have been picked up in Australia, and a few large diamonds in South Africa. For the great mass of chemists in this country an income of about £150 a year represents the ultimate life return for a large outlay of time and money.

◆

PROJECTS FOR THE UTILIZATION OF COMPRESSED air in street cars and motor carriages are being "boomed" at a lively rate, but details of the apparatus used are carefully withheld from the public. Experiments are said to have been carried on for several months at the works of the American Wheelock Engine Co., in South Worcester, Mass., on a motor adapted for heavy wagons, cabs and private vehicles. At the same works experiments are being made on street car air motors for the Metropolitan Traction Co., of New York. A trial trip of a carriage motor was recently made in Worcester, at which a speed of 25 miles an hour is said to have been made. It is stated that if the experiments are successful, a stock company will be formed for the purpose of operating a system of air motor cabs in some of the large cities.

◆

THE MAKING OF GAS FROM ANTHRACITE COAL dust is being exploited in Scranton, Pa., by the "Anthracite Gas Producer Co.' Mr. J. Gardner Sanderson, the inventor of the gas producer read a paper before the Scranton Board of Trade on Oct. 19, describing the process in which he made the following statements:

> Now as to what we are able to do, with the millions of tons of waste coal scattered through the coal regions. After working over the piles and extracting all the marketable sizes, the earth will still be encumbered with millions of tons of unmarketable stuff. With this I am prepared to make a gas as valuable for fuel as the best prepared coal, and far more efficient in power-using gas engines than the best of coal with steam engines. Special devices were necessary in the use of culm. It could not be made in any of the producers before made. * * * * These provisions being worked out, we are able to produce gas with this material without more trouble or cost than with prepared coal, and this we have been doing for several months. By actual measurement we produce and store from 88,000 to 120,000 cu. ft. of gas with one ton of fine waste from the washing. With culm from the pile, after taking out all the sizes from buckwheat, we get about 140,000 cu. ft. per ton. Fifty cu. ft. of gas in a gas engine is a large allowance for one HP. per hour, hence one ton of culm will furnish 2,800 HP. per hour, or 230 HP. for ten hours, and there is no waste of fuel when the power is not in use. No boilers to care for, insure or explode, and but little expensive water required.

The figure 230 is probably a misprint for 280. It would be interesting to know what kind of gas it is that can obtained from anthracite culm in such large volume as 140,000 cu. ft. per ton, and the statement that 50 cu. ft. of gas per HP. per hour is a large allowance, might also be made more definite if the quality of the gas were stated. The number of pounds of coal to the ton is not stated, but if we assume 2,240 we obtain the following: 2,240 lbs. culm furnishes 2,800 HP. for one hour, which is equivalent to $2,240 \div 2,800 = 0.8$ lb. of culm per HP. per hour. This beats even what is claimed for the Bates Thermic engine, described in our issue of Oct. 22, and we beg to be excused from believing it without further proof than the statements of the inventor.

◆

THE BRIDGE OF ALEXANDER II., which will be built across the Seine, in Paris, as a part of the Exposition of 1900, is thus briefly described in "Le Genie Civil": It will have a single arched span of 110 m., or 360.8 ft., with a rise of 21.32 ft. and a width of 131.20 ft. The arch will be built of mild steel, and will be hinged at the center and at the two abutments. The Emperor and Empress of Russia laid the corner-stone during their recent visit to Paris.

◆

INSUFFICIENT FORCE OF INSPECTORS of the Building Department is becoming a common complaint in our large cities, especially since the erection of tall buildings of structural steel has become common. Mr. John B. Brady, Building Inspector of Washington, D. C., in his recent annual report requests that the number of his field inspectors be increased from two to seven. The constantly increasing amount of work of a miscellaneous chararacter that the department must look after makes the additional force necessary.

◆

DRIFTING SANDS are gradually encroaching upon Provincetown, on the extreme northerly point of Cape Cod, and the Massachusetts Harbor and Land Commissioners are now attempting to reclaim this area by grass planting. The State owns 3,000 acres of this land which is divided into two well-defined strips; one belt heavily wooded, and the other and larger one made up of shifting sand dunes lying next to the sea. This sand belt is continually moving southward and upon the timbered land. By planting beach grass and other hardy fibrous plants about 45 acres have been reclaimed since 1894 on an annual appropriation of about $3,500.

◆

A NEW TROUGH FLOOR CONSTRUCTION which is claimed to offer several advantages over the styles at present in use has recently been patented by Mr. M. F. X. Foley, 257 So. 4th St., Philadelphia. It is made up of standard steel shapes and requires only four rows of rivets per trough, all of which can be machine driven, as compared with eight rows of rivets in the troughs built up of plates and angles. The troughs can be made of any desired depth, and the cost of manufacture, it is claimed, can be made so moderate as to considerably increase the use of this type of floor.

◆

THE LOAD ALLOWED ON FLOORS of buildings used for the sale, storage and manufacture of merchandise, and of public livery, sale and boarding stables, according to the rules of the New York Building Department, is required to be stated on a placard publicly displayed on each floor. Efforts are being made by the Department to compel a rigid enforcement of this rule.

◆

THE CONSUMPTION OF COAL BY THE WARSHIPS of the United States Navy in the last fiscal year, according to the report of Commodore Chadwick, Chief of Naval Equipment, was 116,903 tons, costing $620,131. Of this amount 61,741 tons were purchased abroad. Only 45% of the total was used for steaming purposes, the remainder being used for auxiliaries, including electric lighting, ventilation, etc. A cargo of Pocahontas coal has been placed at Honolulu for the re-coaling of vessels at that point at a rate which allows it to compete successfully with coal from Canada or from Australia.

◆

A PLANT FOR THE MANUFACTURE OF FUEL GAS by the Burdett-Loomis process has been erected at Bridgeport, Conn., by the Citizens' Gas Co. It is said to be the largest city plant for making fuel gas in the world. At present it supplies fuel for 300 homes and for several factories, including those of the Yost Typewriting Co. and the Monumental Bronze Co. The price charged is 50 cts. per 1,000 cu. ft., with liberal discounts, according to the amount used, ranging from 20% for small bills to 50% for bills for 50,000 cu. ft. and upward per month.

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THE WRIGHT IRRIGATION DISTRICT LAW of California was upheld as constitutional by the United States Supreme Court on Nov. 16. This act authorizes owners of irrigable lands to form irrigation districts, levy taxes, issue bonds and construct irrigation works. It has been subjected to repeated attacks in the courts of California, but has always been upheld there. About the middle of 1895 Judge Ross, of the U. S. Circuit Court for the Southern District of California, declared the law unconstitutional, in that it took away private property without due process of law. The U. S. Supreme Court now reverses this decision, Judge Peckham, in his opinion, not only stating that property taken under the act is appropriated to a public use, but that if it were otherwise, any general irrigation scheme would be impossible. Ex-President Benj. Harrison appeared for the irrigation districts in the suits. Comments on the decision will be found in our editorial columns.

◆

THE NEW ORLEANS DRAINAGE COMMISSION proposes to start work as soon as possible, in accordance with recommendations just submitted by Maj. B. M. Harrod, Vice-President Am. Soc. C. E. The work involved in these recommendations is largely the extension and improvement of canals, but also includes two pumping stations, each estimated to cost $150,000. The estimated cost of the canal work now proposed is $630,000. The commission has nearly $600,000 of cash in hand and from $200,000 to $300,000 more available within two years, while it may issue $500,000 of bonds, if necessary. The commission is constituted as follows: President, R. M. Malmsley; W. C. Flower, Mayor of New Orleans; A. Brittin, President, C. F. Claiborne and L. Cucullu, members city council; Otto Thomas, President, Paul Capdevielle and M. Abascal, members Levee Board; and J. C. Morris, member Board of Liquidation, City Debt. Maj. Harrod, as already stated, is Engineer, and Mr. A. F. Theard is Chief Draftsman of the commission. Mr. A. C. Bell is now City Engineer of New Orleans, having succeeded Mr. L. W. Brown, who carried on much of the investigation preliminary to the drainage work.

◆

BIDS FOR STREET CLEANING AND GARBAGE disposal at Philadelphia will be received until Nov. 25. The contract runs for only a year, and as large garbage disposal plants are now owned and operated by the present contractors it seems likely that there will be but little change in the contractors for this service.

◆

THE BROOKLYN GARBAGE contract has been awarded to the Brooklyn Sanitary Co., of which Mr. F. L. Cranford, of Brooklyn, is President. The contract is for the collection and disposal of ashes for five years, from Jan. 1, 1897, and the prices for the successive years, from first to fifth, are as follows: $113,000, $117,000, $120,000, $125,000, $130,000. The Arnold system of garbage utilization will be used for disposal, the same as is now in use for treating a large part of the garbage of Philadelphia, and will soon be used for all the garbage of New York.

◆

THE VALVE AND HYDRANT EXHIBITION under the auspices of the Department of Public Works, New York city, noted in preceding issues, is in progress as we go to press, and promises to be very satisfactory. There are a large number of exhibits, as will be seen by referring to the detailed list published in the columns of "Industrial Notes" in our supplement. A large number of different makes and styles of hydrants and valves have been connected to a testing stand and each is being tested to determine the amount of water passing per minute, the pressure at the inlet and outlet, and possibly other features. After this test is completed, the several valves and hydrants will be taken apart and put together again, the time taken in each operation being noted. Besides valves and hydrants, pipe tapping, cutting and calking machines, cutting-in-specials, lead melting pots, and other devices more or less closely related to the valve and hydrant service are being shown. The exhibit will be judged by the following officials of New York city: Geo. W. Birdsall, Chief Engineer Department Public Works; Horace Loomis, Engineer-in-Charge of Sewers; Edw. P. North, M. Am. Soc. C. E., Water Purveyor; Hugh Bonner, Chief Fire Department; and Alonso S. Gear. General Foreman Corporation Yards. The water used in the test is being measured by Venturi and Crown meters and the pressures observed by means of gages made by the Ashton Valve Co., of Boston, Mass. The chief novelties in the exhibit are the large pipe tapping machine, tapping and connecting a 36-in. with a 48-in. main under pressure, and a steam pipe calking machine, regarding which we hope to say more in a later issue.

◆

BONDS FOR THE PURCHASE OF THE DULUTH Water-Works have been voted by the city. The present plant is owned by the Duluth Gas & Water Co., which, it is reported, will be transferred to the city for about $1,500,000. The city has for some months past been constructing new intake works.

◆

THE OHIO RIVER IMPROVEMENT ASSOCIATION held its first annual convention at Pittsburg on Nov. 10. The object of this association is the securing of legislation and immediate work tending towards the improvement, with dams and locks, of the Monongahela, Allegheny and Ohio rivers. Speeches were made by many interested setting forth the great commercial advantages of such improvement, and a resolution indorsing the proposed ship canal was prepared for presentation to Congress. The officers elected for the coming year are: President, John L. Vance; Secretary, E. P. Wilson; Treasurer, J. D. Parker, and for vice-presidents and executive council, Messrs. John F. Dravo, C. B. Hart, John Ingle, W. W. Hite, W. P. Halliday and F. A. Laidley.

◆

THE IMPROVEMENT OF THE POTOMAC RIVER, at Washington, D. C., says Gen. Craighill, Chief of Engineers, U. S. A., has cost $2,088,047 since the beginning of work in August, 1882. There is now a 20-ft. navigation channel in front of the city and old channels have been widened; besides this, a tidal reservoir, 8 ft. deep and covering 111 acres, has been dredged, 32,645 ft. of sea wall and 5,775 ft. of training dike have been built and 621 acres of land has been reclaimed by filling from 7 to 12 ft. above low tide. Gen. Craighill again calls attention to and recommends the rebuilding of the Long Bridge across the Potomac River.

◆

THE HARLEM RIVER SHIP-CANAL PROJECT, proposing deep water connection with Long Island Sound, is to be again presented to Congress, with a bill asking for $2,500,000 for this work. This canal would be 3,400 ft. long, improving Bronx Kills, a shallow water course about 300 ft. wide connecting the Sound and Harlem River around the north end of Randall's Island. The proposers of this enterprise claim advantages for a Sound entrance for ocean steamers, and contend that the demand for another entrance to New York is already apparent in the crowding of the lower bay. The improvement would doubtless be advantageous to property on the Harlem, or rather Port Morris water front.

◆

THE NEW YORK STATE CANAL improvements will be undertaken as soon as the canals are closed for navigation, which will be about Dec. 1. The blasting and excavation work will be prosecuted during the winter, and much of the other work can be done after the re-opening of the canals in the spring. Contracts have already been let for work aggregating about $4,000,000. The present average depth of the Erie Canal is 7 ft. and this will be increased to 9 ft., while some of the locks will be lengthened. The immediate result of the improvements will be that boats of 16 ft. greater length, 2 ft. greater draft and 100 tons more freight capacity can be used.

◆

THE NORTH RIVER BRIDGE CO., at its annual meeting, re-elected Mr. Jordan L. Mott as President and Mr. Samuel Rea as Vice-President; Mr. Charles J. Canda was made Treasurer and Mr. Thomas B. Rea, Secretary. This is the bridge company chartered by Congress to bridge the Hudson River with a New York city landing at Twenty-third St., on plans made by Mr. G. Lindenthal, M. Am. Soc. C. E., as Chief Engineer.

◆

A BRIDGE OVER THE OHIO RIVER, at Marietta, O., is proposed, and surveys are being made under the direction of Mr. Felkel, C. E., of Pittsburg, Pa. The bridge approach is to commence near the Marietta union station and terminate on the heights at Williamstown, on the other side of the river. It is to be a railway and highway bridge, forming a connection for a proposed railway to the mineral fields of West Virginia. The cost of the structure is put at about $3,000,000, and the bridge and railway projects are said to be backed by Mr. William Jutte. of Pittsburg.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment of an express train on the Louisville & Nashville R. R., near Montgomery, Ala., Nov 13. Train wreckers had removed a rail and piled ties on the track. Three persons were seriously hurt.——A head collision between a southbound passenger train and a northbound freight train occurred Nov. 14 on the New York, New Haven & Hartford R. R., at Naugatuck, Conn. Two men were injured and several cars were burned.

◆

A DYNAMITE EXPLOSION occurred Nov. 14 in the office of E. D. Smith & Co., contractors for the extension of the wheel pit of the Niagara Falls Power Co., Niagara Falls, N. Y. Three men were killed and three or four injured.——A dynamite explosion occurred Nov. 10 at Germantown, Pa.; a laborer was preparing cartridges for use in blasting on the Magnolia Ave. sewer when the explosion took place. One man was killed.

◆

A FLOOR COLLAPSED in the Atlantic & Pacific Tea Co.'s store-room on Vesey St., New York city, Nov. 11. Boxes of tea had been piled on the floor, causing a portion, about 25 × 35 ft., to give way. Nobody was hurt.

◆

A BRIDGE AND SCHOONER collision occurred at the Craigie Bridge, Boston, Mass., Nov. 11. The schooner was just preparing to pass through the draw when a sudden squall caused it to drift against the bridge, crushing in the side of the roadway and tearing down the wires of the West End Electric Ry.

◆

A BROKEN SHAFT on the steamer "Anchoria," of the Anchor Line, was repaired at sea during the latest voyage from Glasgow to New York. The accident occurred about 130 miles east of Sandy Hook.

◆

LANDSLIDES AND WASHOUTS are reported from a number of railways in the Pacific northwest as the result of recent heavy storms and floods. Between Tacoma, Wash., and Portland, Ore., a heavy landslide has blocked the Northern Pacific R. R., while about 50 miles of the Cascades Division of the Great Northern Ry. have been washed out. The Canadian Pacific Ry. has several washouts on its line through British Columbia.

◆

AN ACCIDENT HAPPENED TO A PASSENGER ELEVATOR in the 22-story office building of the American Tract Society, Nassau and Spruce Sts., New York, on Nov. 14, by which one man had both knee caps fractured and ten others were badly shaken but not seriously injured. The car was descending and was about to stop at the tenth floor, when the operator found that his lever had no control over the car. It continued down the shaft at a speed considerably higher than the normal, but yet not high enough to throw into gear the automatic catches, and struck on the rubber buffer stops at the bottom of the shaft in the cellar, rebounding several feet. The cause of the accident was the breaking of one of four bolts in the cover of a check valve, located in the pipe running between the hydraulic pressure pump and the hydraulic cylinder, which allowed the gasket of the cover to blow out and the water to leak out of the cylinder through the opening thus made. A high pressure hydraulic elevator plant is in use in the building, the pressure being about 900 lbs. per sq. in.

◆

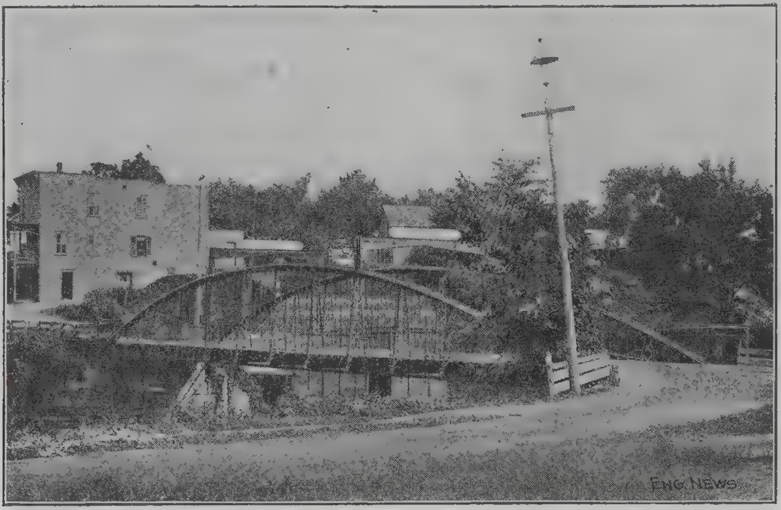
A REMARKABLE ELECTRIC WIRE ACCIDENT took place in Calais, France, on Nov. 6. While a huge boiler was being drawn through the streets by 16 horses the upper portion of it came in contact with overhead electric-light wires, breaking them. Some of the wires caught on the boiler and the framework of the truck, and in an instant all the horses were knocked down. Several of them were killed. The men engaged in transporting the boiler received violent shocks, some of them being probably fatally injured.

◆

THE BOSTON ELEVATED RAILWAY CONTROVERSY has come up again, through the desire of the Boston Elevated Ry. Co. to lease the West End Street Ry. Co. The charter of the former permits the use of either the Meigs or the New York systems of construction, but no definite route or plans have yet been adopted.

A BRIDGE TRUSS WITHOUT DIAGONAL MEMBERS.

We are indebted to Mr. G. Leland FitzGerald, M. Am. Soc. C. E., for a photograph of a somewhat remarkable highway bridge in Hoosick Falls, N. Y., which is here reproduced. It has a span of 117 ft., with a rise of 12 ft. at the centre, and the top and bottom chords are connected by vertical members only. As nearly as can be learned from the photographs forwarded the arch is made of Phoenix columns; but just how the connections are made is not plain. In view of the absence of all diagonal members in the truss, it is not remarkable that a conspicuous sign on one of the two transverse overhead "stiffeners" should give warning that a fine of $5 is imposed "for driving over this bridge faster than a walk." Mr. FitzGerald writes that the bridge responds, by vertical vibrations, "with impartial nimbleness to a heavy load or a few children." It was built in 1869 by the Continental Bridge Co., of Philadelphia, under the patent of Joseph G. Henszey, and is still in use. To the best of our knowledge it is the only bow-string truss actually erected without diagonals or their equivalents, and it is interesting as a reminder of the "queer things" in bridge construction, which were accepted by the generation just past.



A CURIOSITY IN BRIDGES AT HOOSICK FALLS, N. Y.

THE TRANS-SIBERIAN RAILWAY.*

(With inset.)

The Trans-Siberian railway unquestionably ranks as one of the most notable engineering works of this generation, both in magnitude and difficulty of execution. From time to time Engineering News has recorded the progress of this railway and given occasional technical details relating to its construction, but in view of the present advanced stage of the enterprise and the certainty, almost, that its completion is only the matter of a few years it seems desirable to consider the project in a somewhat more complete and comprehensive article. Owing to the easily understood difficulties of obtaining explicit information from a country of Russia's remoteness and character such a discussion must fail in presenting exact structural details, but enough is known to enable a fairly complete comprehension of the general type of constructions adopted, and of their magnitude and extent. In a future article it is hoped to present more detailed information.

Economic Questions.—To understand the economical significance of the Trans-Siberian railway, the possibilities of industrial development presented by the country it traverses must be understood, and there is considerable misconception upon this question. Because vast areas of Siberia are undeveloped and uninhabited, and because other vast areas have a climate of almost arctic severity, it is frequently assumed by people that Siberia as a country is a bleak, desolate region almost incapable of inhabitation and development. This is not true, as even a very cursory study of the climate, soil, mineral resources, and flora and fauna of the country will show. Space is not available to present the proofs of these statements here, but they are available in the greatest detail in various Russian Government publications and in other places. In a general way, however, a glance at the accompanying map will show that an enormous area of the country lies in mean geographical latitudes, and that within this area are included the meadow lands or steppes renowned for their fertility, and already competing with America in supplying wheat and other cereals to the European markets. Iron and coal, the two great factors of industrial development are found all over Siberia and in rich and often contiguous deposits. Mercury, lead, tin, copper, salt and other minerals also exist to varying extents, and where there are water routes are working with profit. The precious metals, gold and silver, are also found in a number of deposits much richer than the poorer deposits now worked in America. As yet none of these minerals have been worked in a thorough and extensive manner, owing to the small local demand and the lack of transportation facilities to outside markets.

Space to develop farther this presentation of facts will not be taken, but it will become evident, as the subject is more closely studied, that Siberia, over vast areas at least, is a country lacking development, and not a country incapable of development. The principal barrier to this development has been a want of transportation facilities, and realizing this the Russian Government has planned the Trans-Siberian railway, and, besides, is vigorously pushing other railway, waterway and colonization schemes. There is little doubt that questions of both national and international politics also enter very extensively into the Trans-Siberian railway scheme, or else the immediate expenditure of $270,200,000 in a project, which will not for a long time prove remunerative in the strict monetary sense of the word, would not have been undertaken so cheerfully. This, however, should not make us construe the Trans-Siberian railway solely as a military project, as is sometimes done. What should chiefly concern us is that this road serves to open up to the markets of the world vast natural advantages and resources which will ultimately compete with the advantages and resources of the North American countries in supplying European markets. The road means that Europe is to be connected to the Pacific and the far east, with Japan and China, by an uninterrupted line of railway communication. It opens a new route for the world's trade, as well as for Russian trade, across the country which has been aptly called the "Russian Canada."

Little more than a hint at the economic questions involved in the construction of the Trans-Siberian railway has been attempted here, for the purpose has been simply to invite attention to possibilities, which, so far as published evidence goes, Americans in general have not adequately considered. This being done we may turn to the more technical features of the enterprise.

Inception of the Enterprise.—As early as 1857, schemes were proposed by various persons for the development of railway lines in Siberia. One or two of these hinted at a Trans-Siberian line, but for the most part the proposed lines were comparatively short extensions of the railway system of European Russia into the western territories of Siberia. None of these projects were carried out in their entirety, but as the European system developed, its lines occupied portions of their proposed routes. It is not necessary to trace this development in detail, but by the end of 1890 the Russian railway system projected east in three lines whose extreme eastern terminations were Tiumen, Miass and Orenburg. By the same year the advisability of a Siberian extension of the European system had become more patent to government officials and the problem of construction had been placed in the hands of a special commission. After thoroughly canvassing the relative advantages of the above-named towns for a starting point it was finally decided to make the extension east from Miass. The eastern terminus was fixed at Vladivostok without question, as other point there was none in any way suitable for the purpose.

In consequence of this decision the construction of the road was determined upon on Feb. 21, 1891, and on March 17 this decision was affirmed by an imperial rescript. On May 12 this rescript was promulgated by the Grand Duke, the Czaravitch, now Czar Nicholas II., and on the same day His Imperial Highness formally began the great work of construction. In the same year surveys were commenced from both termini of the route, and by the end of the year the order of construction had been finally settled.

Route and Country Traversed.—The route finally adopted for the Trans-Siberian railway is shown on the accompanying map. From Cheliabinsk to the Obi River, the line, with few exceptions, runs through a fertile zone, where the climatic conditions are favorable to the cultivation of cereals, and encounters very few obstacles to easy construction. At the crossings of the rivers Tobol, Irtysh, Ishim and Obi there will be rather large and expensive bridges. The limiting grades do not exceed 1 in 740 and the minimum radius of curvature is 1,750 ft. To the River Obi from the starting point is 877 miles. After crossing the Obi the line as far as Achinsk, 364.7 miles, traverses a hilly country with maximum grades of 1 in 800 and curves of 1,750 ft. radius. Bridges of considerable size are required at the rivers Obi, Tom, Yaya, Yiya and Tchulim.

Further on, from Achinsk to Irkutsk, 788 miles, the character of the country completely changes and assumes a mountainous aspect. Besides several large rivers the line crosses numerous small tributaries near their summit levels and much heavy construction is required. The largest bridge, 3,150 ft. long, is across the Yenisei River, at milestone 1,356; but between milestones 1,279 and 1,312, before reaching this bridge, there are several grades of 1 in 150 and curves of 1,050 to 840 ft. radius. After crossing the Yenisei River the line begins its ascent to the summit level, winding through the valleys of the Berezovka and Sitik Rivers, which have steep and rocky sides, so that frequent cuttings, slope paving, and stream diversions are required. Within a distance of 44 miles here, there are 82 small bridges and culverts. Near milestone 1,500, the River Kan is crossed by a bridge 1,400 ft. long, which will have to be built on caisson foundations. From this structure to milestone 1,710 there is considerable heavy embankment work and two wooden viaducts 140 ft. high and 805 ft. and 875 ft. long, respectively, over ravines. Proceeding to the town of Uktouisk the line passes over a level tract of country with grades of 1 in 900 and curves of

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*The information from which this article has been prepared has been collected from Russian Government publications, U. S. Consular Reports, the technical press and the proceedings of various engineering societies, and only in the case of the government publications does it bear the stamp of official authority, but a careful attempt has been made to eliminate all incongruities in the unofficial information, and as a description of the broad general features of the work it is believed to be substantially accurate.

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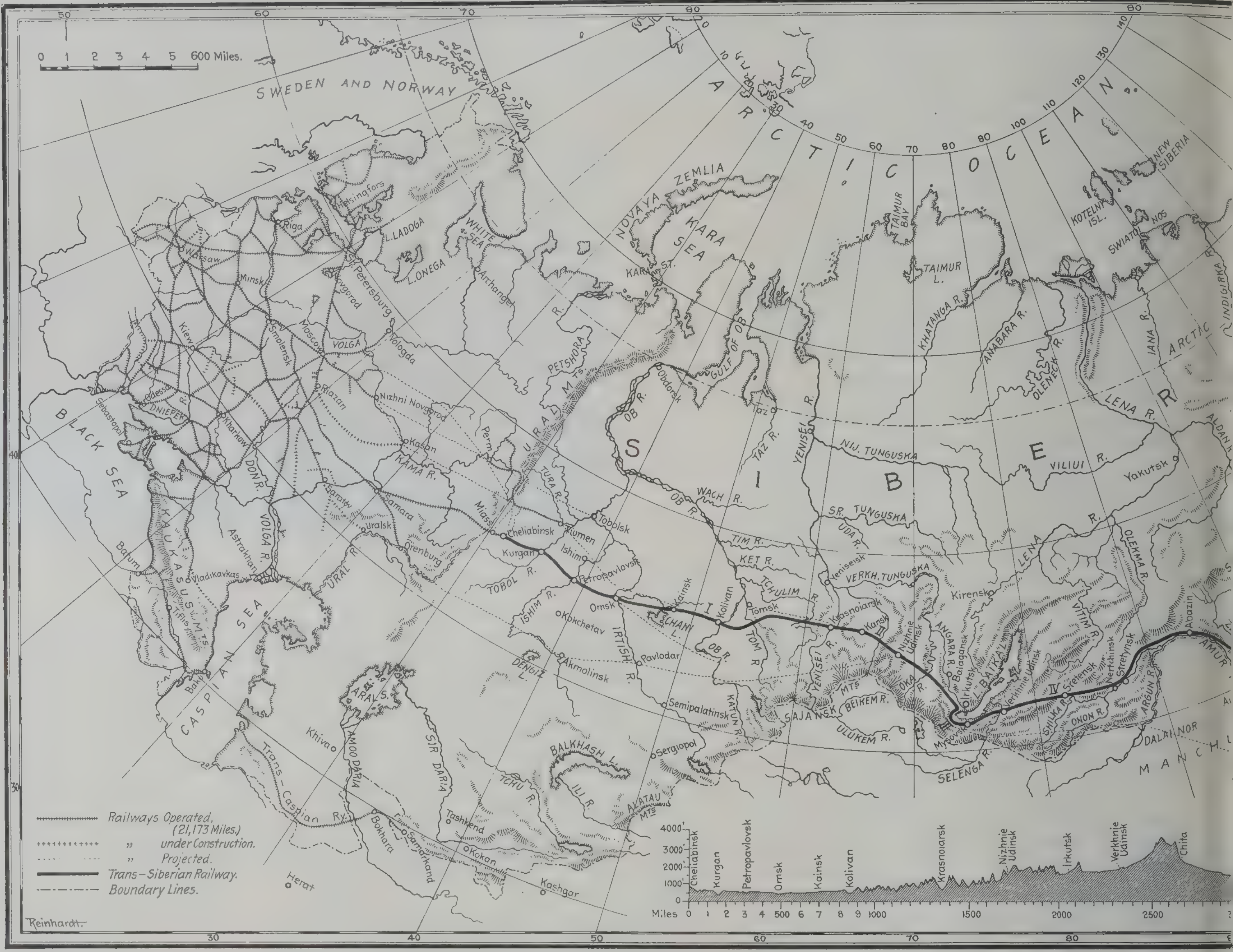
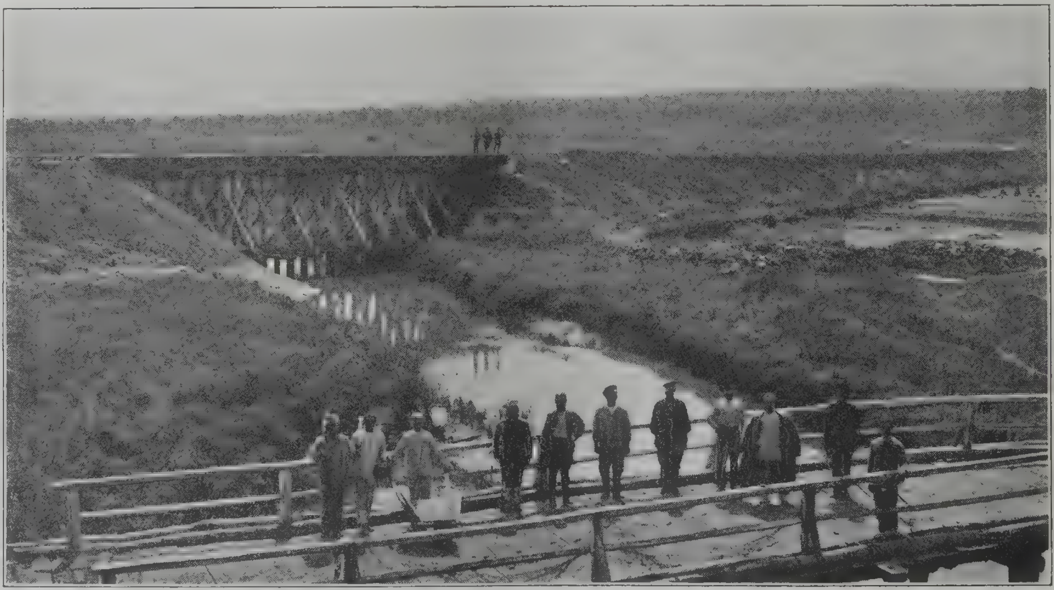


MAP OF RUSSIA SHOWING ROUTE OF TRANS-SIBERIAN RAILWAY, THE RAILWAY LINES OF EUROPEAN RUSSIA, AND PRIN

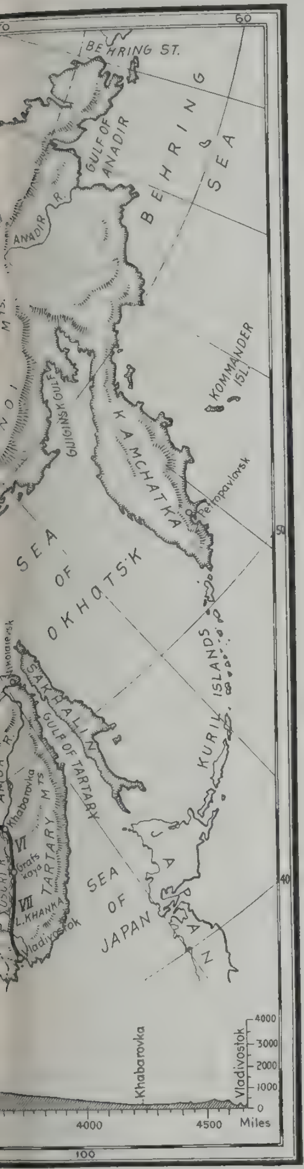
(Drawn From an Official Map Published by the Russian Department of Trade and Manufacture.)



A SUMMER VIEW ON THE TRANS-SIBERIAN RY.

A TY

THE LONGEST RA



IAN CITIES.

LOCOMOTIVE AND DECK TRUSS BRIDGE, TRANS-SIBERIAN RY.

RIVETED TRUSS BRIDGE OVER THE USURI RIVER TRANS-SIBERIAN RY.

AL STATION ON THE TRANS-SIBERIAN RY.

MASONRY CULVERT AND HIGH EMBANKMENT,
TRANS-SIBERIAN RY.

LINE IN THE WORLD.

1,750 ft. radius and no heavy embankment, but with three bridges 1,050 ft., 700 ft. and 875 ft. long, respectively, crossing the rivers Uda, Iya and Oka. From the Oka River to Polovina another mountainous section is traversed, but thence to Irkutsk the grade is about 1 in 900 at a maximum, with only one bridge of any size. This is 875 ft. long and crosses the River Belaya.

From Irkutsk, along the shore of Lake Baikal, to Mysovsk the work is quite difficult, as the line passes through a frequently flooded valley and thence into the rocky gorge of the Irkut River, where numerous dikes and retaining walls and one tunnel, 224 ft. long, are required. Between milestones 2,093 and 2,095 there will be a tunnel 12,530 ft. long. Continuing beyond this tunnel the line runs through the narrow rocky gorge of the Ilcha River, where it must occupy part of the river bed, and be built on embankment held by retaining walls, and thence through a mountainous country to milestone 2,126. Along the whole mountainous section all the cuts will be in hard rocky ground and in some places the embankment must be of stone, as no soft soil is available. The greatest cuts are from 77 ft. to 105 ft. deep, and the deepest fills are about 118 ft. From milestone 2,126 along the shores of Lake Baikal the country loses its mountainous character, but as the line in many places is close to the lake shore a very considerable amount of protecting cribwork is demanded, and there are also numerous bridges and culverts crossing streams flowing into the lake. To protect the roadbed from water will be the greatest task along this whole shore line.

A few figures will aid in understanding the difficulties described in the preceding paragraph. From Irkutsk to Mysovsk is 107 miles, and the construction of this length of line will require 12,700,000 cu. yds. of embankment, 2,749,000 cu. yds. of excavation, and 315,000 cu. yds. of masonry. The section through which the line passes is completely desert except for a few small settlements along Lake Baikal; but the heavy fall of snow prevents the deep freezing of the soil which is encountered further along the line, as will soon be noted.

Beyond Mysovsk the line gradually leaves Lake Baikal and climbs the Yablonovoi Mts., where at milestone 2,610 it reaches its highest point, and it then descends to Sretensk on the River Shilka. The work on the whole is very difficult mountain construction, the line hugging the mountain declivities or passing along the frequently submerged river banks. The length of the Mysovsk-Sretensk section is 668 miles and on it there are 25,800,000 cu. yds. of excavation and embankment, nearly 3,800,000 cu. yds. of which is in rocky ground. The deepest cuts are about 116 ft., and the greatest fills about 75 ft. About 711,000 cu. yds. of retaining wall will be required to support the embankment at various points.

Added to all else is a climate of great severity, and either a desert or dense virgin forest country totally uninhabited over vast tracts. For example, in the Yablonovoi Mts., the temperature rises to 77° F. in day time and falls to 23° F. at night during June and July. At the town of Verkhneoudinsk in 1886 the temperature was above freezing for only three months; in 1887 it was above freezing for one month and at almost freezing for two months. From 1886 to 1888, inclusive, the highest temperature recorded was 98° F. and the lowest -52.6° F. As the atmosphere is dry and very little snow falls, the ground is frozen all the year round. According to investigations made in the valley of the Chita River, through which the road runs, the depth to which the soil freezes averages about 24½ ft. In summer the top soil is thawed to a depth of about 12⅔ ft. so that the remaining 11¾ ft. is eternally frozen. These are by no means the records of greatest severity.

From Sretensk to Khabarovka, 1,324 miles, the country penetrated is topographically about the same as that through which the Mysovsk-Sretensk line just described passes, being desert and dense forest. But from Khabarovka to Vladivostok, 482 miles, the country is more open, though quite a number of large bridges and other important constructive works will be required. In a few places the grades will be 1 in 150, but generally about 1 in 800.

The topography of the route and the character of the construction required throughout the whole distance from Cheliabinsk to Vladivostok, 4,708 miles, have now been described in their general features, and attention may be turned to the constructional features of the road.

Construction.—For purpose of construction the line is divided as follows:

No.	Section.	From and to.	Miles.
I.	Western Siberian..	Cheliabinsk to Obi River....	878
II.	Central Siberian...	Obi River to Irkutsk.......	1,162
III.	Baikal............	Irkutsk to Mysovsk	194
IV.	Transbaikal.......	Mysovsk to Sretensk	667
V.	Amoor............	Sretensk to Khabarovka....	1,325
VI.	North Ussurisk....	Khabarovka to Grafsk	230
VII.	South Ussurisk....	Grafsk to Vladivostok......	252
	Total		4,708

Note.—These divisions and distances are those given by a Russian Government report published in 1893. In several more recent, but unofficial statements, the lengths of some of the divisions are somewhat different, but as the total length of line is practically the same in all cases the older official statement is given here.

Work was begun on the West Siberian and South Ussurisk Sections in 1891. In 1893 work was begun on the Central Siberian Section. According to a recent statement, made by Prince Hilkoff, Imperial Minister of Transportation, 1,950 miles altogether have been completed, of which 1,550 miles are on the line east from Cheliabinsk, and 400 miles on the line north from Vladivostok. Between Lake Baikal and the Amoor River, about 600 miles, about half the grading is finished, and all the grading is finished between Lake Baikal and the end of the rail on the west side. It is intended to have the rails laid for the whole line (except the 1,400 miles down the Amoor, and the loop around Lake Baikal) in two years. The Amoor line may be completed in four years, but this is a little uncertain. For the loop around Lake Baikal a car ferry is to be substituted for the present, and when the ice is too thick for navigation rails laid on the ice will take the place of the ferry. For about half the year a steamboat line may be substituted for the Amoor line, and it is entirely possible that the railway will never be built if it is possible to build a favorable line across Manchuria. Recent surveys show that the substitution of the Manchuria line would shorten the total line about 665 miles, with a considerable reduction in engineering difficulties and some gain in traffic from a fairly well settled and quite productive country.

The Trans-Siberian railway, passing through an enormous expanse of country having widely differing topographical conditions, could not all be included under one type of construction. The basis adopted was always a good reliable construction, but one varied to suit the different conditions. In the level country sections the limiting grade was fixed at from 1 in 600 to 1 in 800, and the limiting radius of curvature at 1,750 ft.; but in the mountainous sections these limits were increased to grades of 1 in 150 to 1 in 174, and curves of 840 ft. radius. The width of roadbed is 16.45 ft. on embankment, and 15.4 ft. in cuts, with side slopes of 1 to 1.25. For the passage of water under the line and for crossing small streams, cast-iron pipes and stone culverts and wooden bridges are used, while the larger rivers are spanned by iron bridges with permanent masonry foundations. The track is on the Russian standard gage of 5 ft., or more accurately, 4 ft. 11¾ ins., and has 49-lb. rails on 0.875-ft. of ballast. The stations, section houses and other buildings are generally of wood, of simple construction, but in some places brick stations are built. The greatest distance between stations is about 40 miles. Water supply will be had only at stations. It should be noted that the foregoing applies to the first construction only, for as the country becomes more thickly populated and as the traffic increases additions and improvements are to be made as needed.

The illustrations here used are engraved from photographs forwarded to this journal from Irkutsk. They are especially interesting as showing the substantial character of the work done by the Russian engineers in this remote region, in high embankments, masonry, bridge construction and station buildings. The view at the stations looks familiar to the American railway builder, with the rails spiked down to wooden ties, the water tower, station platform and general arrangement.

Based upon this construction the estimated cost of the work is given in the accompanying table, a study of which will also give a very good understanding of the relative difficulties of construction on different sections. This table has been compiled from a Russian Government report published in 1893. Unofficial figures published more recently give slightly different amounts, arising partly from a different value given to the Russian rouble and partly it would seem from erroneous calculation. In order that the proportion of the cost which is entailed by large bridges and tunnels may be understood the following table of the costs of the more important of these structures has been compiled from the best available information:

Bridges.

All over 700-ft. span:		All over 700-ft. span:	
Irtysh River ...	$1,275,000	Oka River	$396,100
Obi River	2,100,000	Balaya River ...	405,900
Tom River	1,050,000	Calinga River (1).	2,175,000
Tchulim River..	544,200	Kirtcha River (1).	349,000
Yenisei River...	2,362,500	Amoor River (1)..	6,000,000
Kan River	749,200	Ussuri River (1)..	337,500
Birinsa River ..	758,700	Other bridges	2,250,000
Uda River	345,500		

Viaducts.

Two on Central Siberian Section 863,500

Tunnels.

Two, total length, 12,754 ft. 2,049,800

Thus far the work has been done partly by labor imported from European Russia and partly by local labor, the material being shipped in by the completed line partly, but generally by boats capable of traversing the various navigable rivers. The simplest means are used to do the work, hand labor, carts and wagons alone being used. As many as 150,000 laborers have been employed at one time during the summer months. The plan for shipping material proposed, and the plan thus far followed in a general way, is as follows: For the Khabarovka section, by sea to Vladivostok, and then by the completed line; for the Trans-Baikal section, partly by sea to Vladivostok, then by rail to Khabarovka, and then by the Amoor and Shilka Rivers to Sretensk and also partly by rail to Irkutsk, and then by the Angara River and Lake Baikal to Mysovsk; for the Baikal section

Table Showing Estimated Cost per Mile of Different Classes of Work on the Trans-Siberian Railway Compiled from the Official Estimate.

Classes of work.	Cost, per mile. I. Cheliabinsk-Obi Line.	II. Obi-Irkutsk Line.	III. Irkutsk-Mysovsk Line.	IV. Mysovsk-Sretensk Line.	V. Sretensk-Khabarovka Line.	VI. Khabarovka-Grafsk Line.	VII. Grafsk-Vladivostok Line.	Total Line.
Expropriation of land	$342	$200	$197	$581	$585	$256	$759	$421
Making of tract	5,149	8,611	28,845	15,350	16,380	15,451	11,377	12,418
Construction works	7,869	11,393	28,518	11,445	17,550	11,197	8,143	12,905
Laying the line	3,457	2,978	2,973	3,399	3,510	4,533	3,646	3,388
Appurtenances of the line	157	172	147	195	187	293	191	183
Telegraph	324	239	282	281	281	351	363	287
Buildings along the line	626	566	789	682	585	1,060	669	638
Station buildings	1,773	1,846	2,230	2,166	2,106	2,974	3,586	2,115
Water supply	544	869	716	739	702	842	971	741
Station appurtenances	580	500	790	852	819	819	1,220	722
Rails and fastenings	7,562	7,704	7,481	7,470	7,469	7,600	7,489	7,552
Rolling stock and workmen included..........	7,124	7,132	6,698	6,510	6,566	6,465	4,170	6,673
Carriage of rails, fastenings, etc.	2,253	3,336	3,677	5,872	5,596	4,571	2,630	4,166
General, administrative and miscellaneous....	3,965	3,686	6,054	6,274	6,435	6,669	8,907	5,405
Total	$41,725	$49,232	$89,397	$61,816	$68,770	$63,081	$54,121	$57,614

Note.—In calculating this table from the Russian weights and measures, the verst was taken as 0.662 mile, and the rouble as 77.2 cts. This latter is the value of the gold rouble; the silver rouble while nominally of the same value as the gold, passes for only about 38 cts. in foreign exchange.

by rail to Irkutsk; and for the Amoor section, partly from the east by the same route as for the Trans-Baikal section and partly from the west by rail to Irkutsk, thence by water to Mysovsk, and thence by the Trans-Baikal line to Sretensk. It will be seen by studying the map that according to this plan the first work consists in completing the line east to Irkutsk and also west to Grafsk; the second is to construct the sections between the navigable rivers, and finally the third is to close the open sections. It is, of course, possible that as the work advances and the country is opened up changes may be made in this order, but such changes are more likely to appertain to the details than to the plan as a whole.

Auxiliary Works.—Auxiliary to the railway construction a large sum of money has been and will be expended in constructions designed to develop local traffic, in waterway improvements and in colonization enterprises. Branch railways are planned to connect the main line with nearby mineral districts and favorable water routes, and wharves and docks are being built. Large sums are also being expended in geological and mineralogical work intended to exploit the mineral resources available, and similar work is being done to develop the agricultural possibilities of the country. As indicating the expenditure to these ends it may be noted that when the appropriation was made for the Cheliabinsk-Irkutsk and Vladivostok-Grafsk sections it was provided that 14,000,000 roubles ($10,808,000) were to be used in auxiliary works of the kind mentioned, and it is announced officially that the probabilities are that similar amounts will be so set aside in further appropriations.

General Conclusions.—A study of the foregoing indicates that the Trans-Siberian railway is notable rather for its great length than for the structural difficulties encountered, although the latter comprise some heavy mountain work, and are augmented on certain parts of the line by the severe temperature and the desert nature of the country traversed. The type of construction adopted is substantial but rough and in a degree temporary, the American practice of bending all energies to open the line for traffic and leaving the better and more permanent work to follow, seeming to have been adopted. It has been stated in fact that the immediate model studied by those who planned the road was the Canadian Pacific Ry. The total estimated cost of the road is 350,210,000 roubles or $270,362,000, or about $57,615 per mile, calculating the Russian rouble at 77.2 cts.

The ascendency of Russia at the Chinese Court, resulting from the diplomatic outcome of the Chinese-Japanese war, may make a radical change in the Pacific terminus of the Trans-Siberian railway. Vladivostok was selected because no other port in the Japan Sea was available at the time; but it is closed by ice for a considerable part of the year and a more southerly port, open at all seasons, would be preferable when this great railway is once opened to traffic. Rumor has it that an agreement now exists between Russia and China, fixing upon Port Arthur, in the Gulf of Pichili, as a final terminus, with a necessary extension of the railway to this point through Chinese territory. Whether a new line would be located from Lake Baikal east and down through Manchuria, or whether the present line would be extended from Vladivostok to Port Arthur, it is, of course, impossible to say. But the comparatively small amount of work done on the Pacific end of the Siberian railway and the importance of bringing the line as far south as possible, might lead to an entirely new locating at this end, were Chinese territory once available for this purpose. The climatic features of construction on the Trans-Siberian line will be better realized when it is considered that the most southerly portion of the present location, excepting the Vladivostok end, lies north of 51° N. latitude. On our own continent, latitude 55° N., would strike the southern boundary of Alaska, and of Hudson Bay, pass nearly 100 miles north of Lake Winnipeg and through the middle of Labrador.

Since writing the above the "Centralblatt der Bauverwaltung" announces that the line from Cheliabinsk to the Obi River was opened to traffic on Oct. 27. At present only mixed freight and passenger trains are run, at an average speed of about 17.5 miles per hour. About the first of the coming year, however, it is proposed to run express trains at a speed of about 20 miles per hour, traversing the 1,800 miles between Moscow and Kolivan in about 4¼ days, or from St. Petersburg in 4¾ days. The present fare from St. Petersburg to Kolivan, on the mixed train, is 53 roubles, or $40.92 for first-class, and 32.60 and 20.40 roubles, or $25.17 and $15.75, for second and third-class fares, respectively.

* * *

THE APPLICATION OF SUCTION PIPES TO THE HANDLING OF GRAIN AT MILLWALL DOCKS, ENGLAND.

The foreign grain trade of the United Kingdom of Great Britain and Ireland has increased from an average of 1,022,067 tons per annum, in the ten years ending in 1850, to an average of 6,157,276 tons per annum for the ten years ending in 1890. In 1893 the total quantity of grain and flour imported was 8,165,796 tons, valued at $255,901,855.

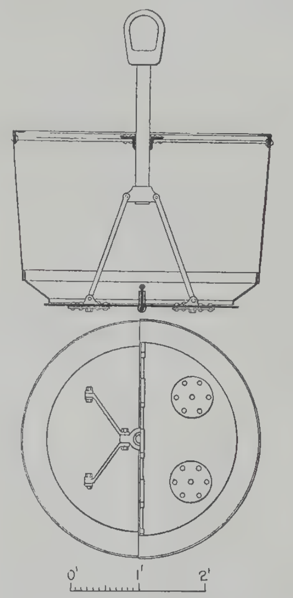


Fig. 1.—Grain Hoisting Bucket With Drop-Bottom.

The Millwall Docks, in London, opened in 1858, are much used by timber and grain-ladened vessels, and Mr. Frederic Eliot Duckham, M. Inst. C. E., has lately presented a paper to the Institution of Civil Engineers upon the "Grain Appliances at the Millwall Docks," from which the following abstract is made:

The first system adopted for the unloading of grain consisted in the erection of short stages, upon timber piling, parallel to the quay wall and sufficiently far from this wall to permit a vessel to lie between the stage and the quay. On both of these were stationed movable hydraulic cranes and hoppers, running on tracks of 7 ft. 6 ins gage. The grain was lifted from the hold of the vessel by grain-tubs and delivered to the hoppers on either side, as it was to be either stored on land or delivered to barges. The grain-tub used (Fig. 1) was remarkable for its extreme lightness compared with its capacity, as it weighed only 5 cwt., and carried 60 bushels, or nearly 3 cu. yds. The shell was of 3-16 in. steel, with a 1¾-in. angle iron rim inside the upper edge. The lower end was contracted for 6 ins., with the lower diameter 1 ft. less than the upper part of the shell. This bucket was suspended by a 3½-in. tube, passing through suitable guides and provided with an eye at the top, and it was connected by four rods with the two doors forming the tub-bottom. When the tub was suspended the weight kept the doors closed, and it was emptied by seating it upon the aperture in the top of the hopper having a diameter a few inches less than that of the tub-bottom.

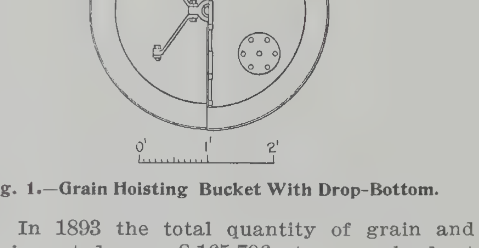


Fig. 2.—Suction Pipe for Moving Grain by Vacuum Process

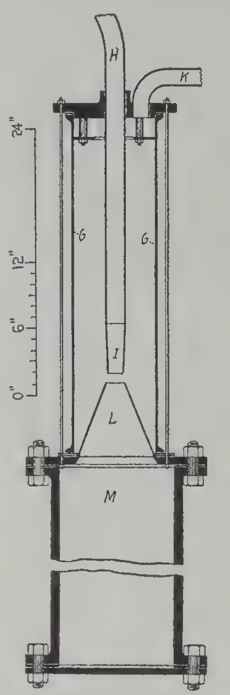


Fig. 3.—Device for Exhausting Air Without Removal of Dust.

These appliances, described in full by Mr. Duckham, were put in place in 1879 and worked successfully ever since; but time developed a number of disadvantages in this manner of handling grain. All of the grain had to be brought directly under the hatches to be shoveled into the tubs; hatches could not be kept open in wet weather without damage to the grain, long delays often occurred, and serious and sometimes fatal accidents occurred, as is apt to be the case wherever lifting gear is used. Mr. Duckham, in attempting to remedy these defects, conceived the idea of making use of air in discharging ships loaded with grain, and as the result of experiments he concluded that a suction process was better than the use of air under pressure. He ascertained by experiment the proper volume of air to be furnished to move a given quantity of grain when working with a certain vacuum and in Fig. 2 is shown the device finally adopted by him to regulate the proper working ratio of air to grain. The remainder of the description of the appliances used by Mr. Duckham we take from his own paper in the "Transactions" of the Institution, as follows:

> A flexible pipe, a, leading from the ship to the vacuum chamber, terminates in an inlet nozzle, b, surrounding which there is a sleeve, cc, of such diameter as to leave an annular passage between it and the nozzle of the same sectional area as that of the interior of the nozzle itself. By the screwed rods, d, the height of the sleeve above the mouth of the nozzle is altered according to the characteristics of various kinds of grain, the available degree of vacuum, etc. Regardless of the varying depth of immersion and other disturbing conditions, therefore, a regular supply of air is drawn down the sleeve. There can never be a greater body of grain to resist its progress towards the nozzle than that marked XX, which is carried on with the air while the surrounding grain continually flows down to refill the vacated space, to be in turn carried up by the nozzle. A wire grid or muzzle covers the mouth of the inlet-pipes when they are worked near the mats and similar divisions between different bulks of grain. The nozzle is made in various shapes, such as the bent form shown in Fig. 2, for use between decks and in similar confined spaces.
>
> The separation of the air from the grain was not difficult. In its imported condition, however, grain always contains a quantity of dust, husk and foreign matter, and during the early use of the machine, the exhaust air carried off some of the dust and lighter particles,

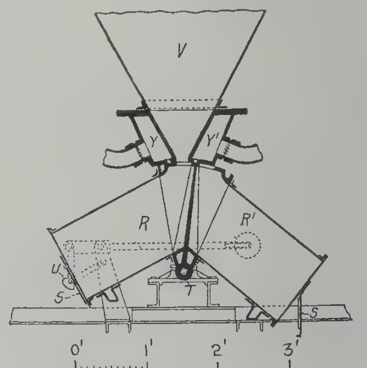


Fig. 4.—Air Lock for Discharging Grain.

with the result that, although the value of the grain was increased, its weight was diminished. Merchants who sold by weight upon a sample from the ship objected to the use of a machine which, though it improves the quality of the grain, deprived them of a small part of its weight. The improved condition of the grain had therefore to be sacrificed to the maintenance of the shipped weight, and so it became necessary to find some means of weighing and delivering the grain in the same condition as to dirt and dust as it arrived in the ship. Several methods were tried, including those employed in flour mills, etc., but with unsatisfactory results. In the course of the author's experiments a glass vessel was used, so that the action of the machine under various conditions might be seen. The arrangement is shown in Fig. 3, where GG is the glass vessel, H a flexible pipe leading from the dusty material experimented upon, and terminating in the adjustable nozzle I. A pipe, K, leading to the exhauster, L a funnel with its rim fitted air-tight in the closed chamber M. When in operation the partial vacuum of, say, 10 ins. mercury, drew grain-laden air in through the pipe H, at a speed of about 35 ft. per second, imparting to the solid particles such momentum that they were projected across the gap between the nozzle and the funnel into the comparatively still chamber M. But the air that had conveyed them was unable to penetrate or displace the somewhat denser air in the chamber M, so it is drawn off to the exhauster through the pipe K. No loss whatever could be discovered by the most careful weighing of a bushel of dusty barley before and after being passed through the apparatus. A loss of but ¼-oz. was found in 14 lbs. of fine, light dust. This apparatus on a larger scale was therefore added to the machine and a by-pass provided by which the dirt deposited in the closed chamber could be returned to and mixed with the grain in the vacuum-chamber. More recently, however, the disadvantage of this procedure has been recognized, and instructions are often received to keep impurities separate, and deliver the grain in its improved condition, which in some instances is represented by an increased value of several shillings per quarter.

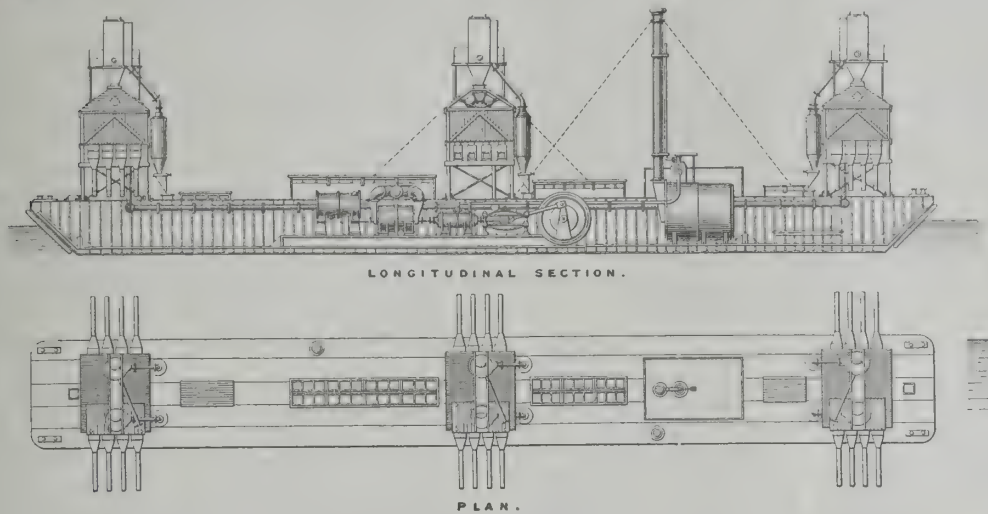


FIG. 5.—PLAN AND SECTION OF BARGE FOR MOVING GRAIN BETWEEN VESSELS AND STORAGE BINS BY VACUUM PROCESS.

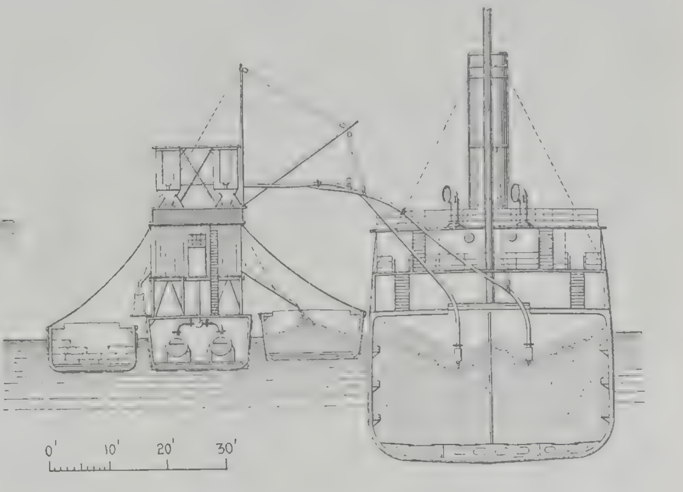


FIG. 6.—CROSS-SECTION SHOWING BARGE TRANSFERRING GRAIN FROM A SHIP'S HOLD TO BARGES ALONGSIDE.

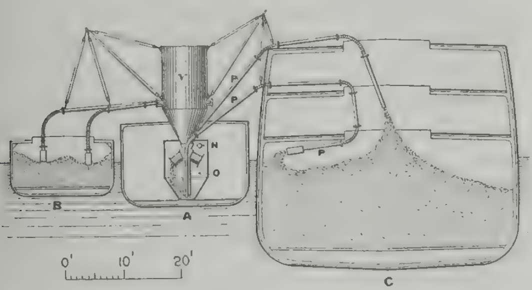


Fig. 7.—Section Showing Transfer of Grain From Barge to Ship's Hold.

The air-lock by which the grain discharges itself from the vacuum-chamber is shown in Fig. 4. It is a twin box, RR^1, mounted to rock on the trunnion T. Its upper side is machined to a segment of a circle with T as its center, and on this surface each box has its own oblong port for the admission of the grain. At the lower end of each box is an outlet closed at times by the flap-door S. To the lower end of the vacuum-chamber, V, is fixed a cast-iron outlet machined to make a practically air-tight joint with the segmental part of the rocking-box. The outlet from the vacuum-chamber has one oblong port corresponding with that in either box. With the box in the position shown in Fig. 4, the left-hand compartment, R, is under the same pressure as the vacuum-chamber, from which it would be receiving grain, while the outlet flap S would be kept closed by atmospheric pressure. When this compartment has received its full load it tips over and brings the right-hand compartment, R^1, into the loading position, the partial vacuum being broken and the grain discharging itself through the flap door. It was found that some detent mechanism was desirable to prevent the box rocking with so small a load as might lead to its sticking half way, and also that with the vacuum-chamber under vacuum and the box filled with air nder atmospheric conditions, the downward stream of grain through the port was retarded by the upward pressure of the expanding air which the box contained. To meet these difficulties the two auxiliary ports, YY^1, were added to the outlet and by means of a by-pass are kept under the same vacuum as the chamber V. Trigger-gear, U, was also fitted to each end of the rocking box to allow the loading-compartment to make a first stage of its movement unrestrained, and in doing so to bring the port of the compartment that has emptied itself into connection with the auxiliary port Y, its air being reduced to the same state as that in the vacuum-chamber. The loading continues until the weight in the box is sufficient to pull off its trigger; when the second stage of its movement is completed the flap-door opens and the other box is brought to its loading position and the operation repeated. The jockey-weights on the trigger steelyards are adjustable to approximately conform with any required weight of a box load of grain.

The machine as in use at Millwall Docks is shown in Figs. 5 and 6. To meet local requirements it is placed on a barge, the "Mark Lane," 170 ft. long by 18 ft. 6 ins. wide. A horizontal compound surface-condensing engine, with steam cylinders 15 ins and 28 ins. in diameter, with 4-ft. stroke, is used for exhausting. Each piston rod is continued through the back end of its cylinder and connected direct to two air-exhausting pumps 38 ins. in diameter. On the deck there are six sets of apparatus, each with its vacuum-chamber, its suction-hose for conveying the grain from the ship, and its rocking air-lock through which the grain discharges itself into an open hopper, and whence it is weighed and delivered either loose or in sacks. The capacity of such a machine is proportional to the power of the exhausters. The "Mark Lane" can transfer wheat from a ship to a barge at the rate of 90 tons per hour. The "Baltic," a similar machine now at work at the Royal Albert Dock, has steam cylinders 22 ins. and 40 ins. in diameter, and has lifted 180 tons per hour.

The amount of steam power employed to elevate a given quantity of grain is greater with this than with the ordinary elevating machinery, but the pneumatic process removes satisfactorily the objections already referred to, and possesses many advantages over the ordinary elevator. Its suction-pipes are taken to the grain wherever it may be, even in the bunkers and cupboards, and the trimming of grain on board ship is thus almost entirely obviated. By means of convenient suspended tackle, one attendant only can easily manage a suction-pipe lifting 30 tons or 40 tons per hour. As the conveying-pipe also occupies so small a part of the hatchway, other goods may be simultaneously unloaded by cranes or other tackle. During wet weather the hatchways are covered, room being left only for the pipe, the receiving-barge is protected by an awning, and the discharge proceeds uninterruptedly. No grain is spilt during the process, for it is conveyed within closed conduits from the ship's hold to the barge. The dangers attending the use of ordinary hoisting-gear are avoided, and the discharge of a cargo may be commenced within a few minutes of its arrival alongside the machine. The total cost of discharge, including labor, coals, wear and tear, and other charges, is considerably less by this than by any other existing method.

Machinery of this kind is as applicable to loading as to discharging cargoes. The loading may be effected either by raising the vacuum-chamber to a sufficient height to allow the grain to flow into the ship's hold by gravity, or it may be temporarily placed over the ship's hatch, or, preferably, in the case of ocean-going vessels, the arrangement shown by Fig. 7 may be adopted. In it the vacuum-chamber is placed as low as it conveniently can be on board the elevator-barge, and the oscillating air-lock is enclosed, and discharges its contents into the chamber O, to which air under pressure is admitted through the pipe N, and the grain is expelled through the pipe P into the ship's hold. A great advantage of this arrangement is that the grain is not simply dropped down the hatchway, but is carried by the pipe to any part of the ship, and there deposited quietly without trimming. Where it is required to weigh the grain during the operation of shipment, weighing machinery is inserted between the vacuum-chamber and the chamber O, and a second air-lock employed. There are other adaptations and combinations of the process for lifting and conveying any grain-like material afloat or on shore, and for transfer direct between ships and granaries. Steam-barges fitted with tanks to accommodate 800 tons or 1,000 tons of grain may empty themselves by air-pressure produced by their own propelling-engines. The limits of the capabilities of this process have not yet been reached, but wheat has been transmitted 800 ft., including a lift of 80 ft.

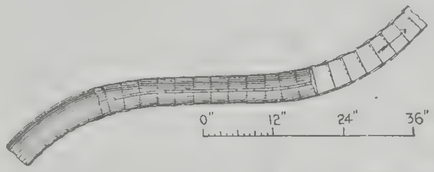


Fig. 8.—Flexible Steel Suction Pipe for Handling Grain.

The beneficial effects upon grain worked by the pneumatic process arise chiefly from the areating and brightening of the grain in passing through the pipes; but, in addition to this, the flow of exhaust air may be arranged, when required, to carry off much of the light husk and dust. This process has proved so successful that, over and above the ordinary operation of discharging cargoes, merchants often send their grain to the "Mark Lane" to be passed through it. The consequent increase in the value of the grain undergoing this process is considerable.

Great difficulty existed in obtaining flexible pipes to withstand the wear and tear of the grain passing so rapidly through them. Ordinary suction-hose with embedded steel-wire, lined with a composition of rubber, used as stencil masks in the sand-blast process, was the best obtainable, but was soon worn through. It was, however, found that satisfactory results could be obtained from rigid steel pipes. The author thereupon adopted the combination shown by Fig. 8, in which a number of truncated cones of plate steel are strung together by external tapes in such a way that the smaller end of one cone enters about ¼ in. into the larger end of the next. The steel rings resist wear by friction of the grain, and, being enveloped by ordinary rubber hose, are perfectly air-tight. The combination is so flexible that a 6-ft. length, 8 ins. diameter, may be bent through 90°. These have now been some time in use, and answer the purpose admirably.

THE GOLD MINES OF NORTH CAROLINA.

By Maxwell J. Gorman.[*]

The gold-bearing formations of North Carolina include nearly one-half its entire area. The productive portion of this area which has been worked, either commercially or experimentally, will not exceed 10,000 sq. miles; and while there are more than 350 localities which have been worked for gold, most of them prior to the war, and where work has not been resumed since, there are at present relatively few mines in operation.

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[*] Special correspondent of Engineering News, Raleigh, N. C.

Just when gold mining was first undertaken in North Carolina is not definitely known, but there are traditions that the auriferous character of the section was known prior to the Revolution.

The Oliver Mine, in Cabarrus county, and the Parker Mine, in Cherokee county, are two of the mines in the state which it is reasonably certain were "worked" before that period, the latter being said to have been "operated" by the Cherokee Indians long prior to the advent of white settlers in that section of the country. The Brewer Mine, in Chesterfield county, S. C., is another "old-timer" which is known to have been worked in some manner before the first period of which we have authentic record.

In the year 1799, a 17-lb. gold nugget was found on the Reed plantation in Cabarrus county, where since that date hundreds of pounds of gold in nuggets have been taken from time to time, one nugget valued at $7,000 having been found and sold during the past summer. One of the nuggets found some years ago was assayed as containing $18,000 worth of gold.

Within 25 years after, or about 1823, gold mining on an extensive scale was being prosecuted at various points along the entire Appalachian slope, from Virginia to Alabama. The placers and similar deposits were first worked, then the gossan outcrops of the veins, where crude appliances and little skill were necessary to effect profitable results. These easily-worked stores were about exhausted, apparently, about the time that the California gold excitement struck the country, and nearly all the miners of this section emigrated to the Pacific coast.

The mining industry had not fully recovered from the retarding influences of that exodus when the Civil War broke out and put an end to it all for the time being and for many years afterwards. In fact, not until within the last year or two has there been real evidence of a resumption of gold mining in North Carolina on an extensive scale, although there have been spasmodic attempts; but now the indications all point to a genuine, healthy growth of the industry.

So far as we have record, the total value of the precious metals produced up to date, by the mines of North Carolina, amount to $11,817,990. Of this amount $11,754,369 was gold and $63,620 was silver. It is known, however, that this amount is not nearly the whole output of the gold mines of this state—it is more likely to represent less than one-half the true amount. It is known that great quantities of the products of the mines were for years exported directly by foreign companies having headquarters abroad. It would be more nearly correct, geologists here and others in a position to know tell me, to say that the gold mines of North Carolina have turned out at least $25,000,000 worth of the precious stuff, and the late Prof. W. C. Kerr, who for many years was the State Geologist, frequently stated, that in his opinion there was, ten years ago, at least $100,000,000 of gold in the rocks of western North Carolina capable of being profitably mined.

The North Carolina gold is particularly pure and beautiful in color, and there has always existed an active demand on the part of native and other jewelers for North Carolina gold in the manufacture of costly jewelry, in preference to that mined elsewhere.

There are so many gold "mines" in North Carolina that it is impossible here to do more than barely describe a few of the most important and promising.

The writer is under many obligations to the State Geologist, Prof. Joseph A. Holmes, for the use of valuable material secured from him and his office—the gold mining interests of the state having this year commanded a large portion of his time.

Brown Mountain Mine, Burke County.

This mine is located about 12 miles north of Morganton, N. C., on Caney Branch. The mine openings are merely prospects, and consist of two shafts 20 and 25 ft. deep and one small open cut. Shaft No. 2, according to an assay of a sample taken therefrom, shows $15.42 per ton—gold, $12.40; silver, $3.02. This sample was furnished to the State Geologist by the owner, Gen. R. F. Hoke, of Raleigh, President of the Charlotte & Atlanta R. R. Professor Holmes states that a sample taken from the ore dump at the mouth of this shaft by his staff of surveyors this year showed only a trace of gold and 1 oz. of silver. The bed of Caney Branch was washed for gold in former years up to a point opposite the present shaft No 1, and yielded well.

The Redding Mine, Randolph County.

This is one of the most prominent and promising mines in North Carolina. It is at this particular time attracting much attention on account of the operations going on there, and the valuable finds which have been made.

A friend of the writer, who visited this mine within a month, describes it as follows:

> The Redding Mine is about a mile from the railway station at Cedar Falls: It was owned for years by Peter Julian, and during his lifetime was extensively worked for surface gold. Mr. Julian's books show that these mines took out over $75,000 in gold with the crudest kind of hand-rockers. No attempt at shaft mining was made until recently, when Mr. J. W. Lindow bonded this property and placed Mr. Harry Doub, a practical miner, in charge, and he is now sinking three shafts. Two of these shafts have only been sunk 10 or 15 ft. deep. One shaft, however, has been sunk 25 ft., and as far as has been reached, the ore is exceedingly rich. The other two, while not quite so rich, still show ore that will pay handsomely. In mine No. 1 a vein of gold was found near the surface that will mill from $1,000 to $2,000 per ton. This ore grows richer as the shaft sinks deeper. A number of very pretty nuggets have been found in the Redding, one of which weighed 23 pennyweights, the others ranging from 1 to 10 pennyweights. Mr. Lindow is having the shaft sunk deep enough to thoroughly test the ore. If this test proves as satisfactory as it has so far, steps will be taken to mine it on a large scale. An eminent mineralogist has examined this property and will make his report soon.

Cabarrus and Mecklenburg County Mines.

These are two of the principal gold-bearing counties of North Carolina, and there are nearly one hundred mines in each county which have been profitably worked at some time. Few of them are in operation now, not exceeding a dozen. At the Goodman Mine, in No. 6 township, Cabarrus county, work has just been resumed on a small scale. The old Goodman Mine was purchased in July last by a syndicate, and on Aug. 12 the few men put to work at first "struck it rich." Within two days, so the writer is informed, several thousand dollars' worth of gold, in ore and nuggets, were taken out. The vein is said to be the richest ever struck in Cabarrus county.

The value of some of the "old mines" of this state is something deserving special attention. Most of them when they were worked before—or rather "scraped over" by the crude appliances of the early days of mining—were by no means exhausted when work on them was abandoned. With the improved machinery of to-day many of these old mines could be made to pay even better than they did when first opened.

The Reed Mine in Cabarrus county is located ten miles southeast of Concord (the county seat). The first nugget discovered at this mine was in 1799. It weighed 17 lbs.. Four years later another nugget was found, weighing 28 lbs, which is said to have been the largest ever found east of the Rocky Mountains. Regular work on this mine began about 1804 and was prosecuted for a period of about 40 years, during which time the mine yielded large quantities of gold—the proportion of large nuggets (which are still being found occasionally) not being equalled on this side of the continent, according to the State Geologist. The main shaft is 120 ft. deep. The mine was operated in a fitful way from 1881 to 1887, when regular work was discontinued. In 1895, some prospecting was done and the mine has been developed some since. The old shaft has been opened and retimbered, and several openings have been made for placer work. A shaft has been sunk near the western limit of the property which has opened up a large body of low-grade ore that assays at $7.50 per ton in free gold, and $11.55 per ton of gold and sulphurets. Preparations are being made for active mining on a larger scale, the property having changed hands recently.

The Rocky River Mine is situated ten miles southeast from Concord. The last work at this mine was done in the summer of 1895 by Mr. Wayne Darlington, M. E., who prospected the property for some Philadelphia capitalists. Assays of the ore from this mine show $6 to $68 of precious metals per ton.

The Gold Hill Group of Mines.

These are chiefly in Rowan county. The village of Gold Hill is about 15 miles southeast of Salisbury, where the large shops of the Southern Railway system have just been erected.

The group comprises several mines located in a belt of auriferous schists, about 1½ miles long and ⅔ of a mile wide. None of them are now in operation. There are ten or twelve well-defined veins in the district.

The Randolph vein, on the northwestern edge, has been worked for a distance of 1,500 ft. and to a depth of 750 feet. The ore chimneys or shoots are very marked and are three in number, and extend to the lowest depths to which the mine has been worked. In 1856 (when the depth of this mine was 410 ft.) the thickness of the ore body was stated by Emmons to be from 6 ins. to 4 ft., and in one part 7 ft.

The Hunnicutt (one of the veins alluded to above) has yielded $101,665, of which account has been kept. Another, the Troutman, has yielded over $400,000, and has been worked to a depth of over 100 ft. The McMakin was worked to 180 ft. with profitable results, two of the assays in 1894 and 1895 showing silver, per ton, $317.95 and $646.50. The whole of the Gold Hill mines produced over $2,000,000 up to 1856, according to Professor Emons, in a report made some years ago. Up to 1874 the Gold Hill mines had produced an aggregate of $3,000,000 worth of free gold, which has been extracted from the ores, and which represents but 20 to 33% of the assay value of the ores.

The mode of extraction, until 1881, when a 20-stamp mill was erected, was by Chilean mills and rockers entirely. The last regular operations carried on by the New Gold Hill Mining Co. was in 1893 by Mr. Richard Eames and associates, when ores from the Barnhardt vein were worked in a 10-stamp mill near the mine.

Since that time work has been irregularly conducted, mostly by "tributers," who mill the decomposed material from the old dumps of the Barnhardt mill.

Although the Gold Hill ores are sulphuretted, no treatment other than that of simple amalgamation has been attempted, so far, although chlorination has been advised.

State Geologist Holmes states that there are probably still good ore bodies in these mines, and that certainly a careful examination is warranted. Improvements in the metallurgical treatment are advised, viz.: concentration of the sulphurets, after battery amalgamation, and subsequent treatment by a chlorination, cyanide or smelting process.

Some of the other mines in Cabarrus county can only be named as follows: The Mauney, 1½ miles from Gold Hill, which has assayed ores at $2 to $6 per ton; the Rocky River (10 miles from Concord), whose ores have assayed at from $3.17 to $64.59 in gold and $1.04 to $3.66 in silver; the Buffalo, pyritic, $3.50 gold per ton; and the Allen Furr, eleven miles from Concord, the ores of which have assayed at $7.75 to $51.70 per ton.

The Sam Christian Mine.

This mine is in Montgomery county, 12 miles from Albemarle. It has been productive of remarkably fine and large gold nuggets. The gold is found in old "channels" in gravel of a thickness of from 1 to 3 ft., and deeply covered with soil. It is very rarely found in the shape of dust. The nuggets weigh from 5 to 1,000 pennyweights.

In 1888, during 88 washing days 40 nuggets were found weighing 4,200 dwts. The method of work pursued at this mine consists of a removal of the soil resting on the gravel, followed by a very careful washing of the gravel in sluices and rockers. Where the overlay was very slight it was removed by simple digging, and in some cases it was washed away by hydraulic giants. The "harvest" periods were uncertain. Sometimes a few days' work, and often only a few hours', would suffice to obtain very profitable rewards for months of almost unproductive labor. The above-mentioned 40 nuggets were obtained from 1,070 cu. ft. of gravel.

This mine was operated also in 1893, and water was supplied from a pumping station on the Yadkin River, about two miles distant, the water being conveyed in 20-in. iron pipes.

Other North Carolina Mines.

The Rudisil Mine is one mile south of Charlotte. It is owned by Carson & Miller, of Charlotte, and preparations began a month or so ago to resume work. It will soon again be in active operation. For many years this mine was operated with great success. The ore was carried in pockets in the slates and was the richest and most easily mined brown ore of the region at the surface and for a considerable depth. At a depth of about 200 ft. the free gold largely disappeared. The "middle shoal" or ore body to which this mine chiefly owed its fame, was 100 ft. long and in places 15 ft. thick, composed chiefly of compact iron pyrites. The ore was uniformly of high grade, entire shipments sometimes reaching $180 per ton.

At the St. Catherine Mine, near the eastern end of the Rudsil lode, preparations to resume work are also being made. Mr. Obdyke, of New York, is the owner, and the mine is in charge of Mr. G. W. Pitcher, of Charlotte. This mine has been worked to a depth of 460 ft., but a large ore body is still to be removed between the 370 ft. level and the bottom. Assays of brown ores from this mine show $27 to over $100 per ton in brown ore, $52 to $73 per ton in first-class ore and $33 to $36 in second-class ore. Concentrates yield $40 to $135 per ton.

In 1883 a 10-stamp mill was erected. The ores were first subjected to a preliminary cobbing, which separated out the massive pyrites and lean ore, the latter going to the stamp mill. The free gold was caught in the battery and on the plates in the customary mode of amalgamation, and the tailings led directly to Frue Vanners, where the product was concentrated. The cabbed pyrites and concentrates were shipped north and elsewhere for treatment. The last work at St. Catherine, of which the writer is aware, was in 1887. But, as intimated above, preparations are now being made for a resumption of operations, and on a large and permanent scale.

The work of drawing off the water from the St. Catherine began a month ago, and it will be put in shape for work as soon as practicable. The shaft is now 450 ft. deep.

The deep mines of Montgomery county have been very prominent in the mining history of the state. The most important group is situated in the extreme northwestern corner of the county, in the vicinity of the village of Eldorado.

The Russell Mine is about 3 miles north of Eldorado. It has been worked more extensively than any other, and has, therefore, allowed better opportunity for study.

It is stated that the average ore, embracing the entire material from this cut, milled $2.27 per ton. There were some streaks, from 4 to 5 ft. wide, which went much higher (as high as $9.95), and still others where portions of the ore were so rich that it was carried out in powder kegs. A set of 17 assays show gold all the way from $2 per ton to $332 per ton. A 40-stamp mill in good condition is located on the property. Preparations are now in progress for the erection of a cyanide plant for the treatment of the ores.

The Appalachian (or Coggins) Mine is situated in close proximity to Eldorado. It has large bodies of low-grade ore similar to those of the Russell, yet ores that are easily within the limits of profitable work.

The depth of the last workings was 160 ft. A 40-stamp mill stands on the property. Several assays of the ore show its variation to be similar to that of the Russell.

The Trediwick Mine is 7 miles southeast of Charlotte. It has been prospected to a depth of 80 ft., and for a length of 200 to 300 ft. The vein is 1 to 2 ft. wide, and carries a relatively large amount of copper minerals.

The Ray Mine is situated 9 miles southeast of Charlotte, and is owned by the Baltimore & North Carolina Mining Co. There are five veins with an aggregate length of about four miles. The south vein has been worked to a depth of about 60 ft., and the Phifer Grove vein to a depth of 40 ft. The mine material from both was free-milling brown ore. The Ray Mine, which is the best known of them all, is entered by six shafts, the deepest being 250 ft. The ore seam is 6 to 8 ins. thick and is filled with nearly compact sulphurets. Most of the ore down to the 120-ft. level has been stoped out. Assays show gold ranging $20 to $30 per ton. There are 360 acres in this property.

The Surface Hill Mine, in Cedar Creek township, has long been known for its large yield of nuggets. It is quite certain that several thousand pennyweights must have come from the space of a few square feet.

A considerable amount of brown ore of good appearance, carrying copper sulphurets, has been mined in the process of hunting for nuggets, but as an ore it is of little value, despite its fine appearance. Assays show but $2 to $3 per ton.

Some Minor Mines.

The Stephen Wilson Mine is nine miles west of Charlotte. The property comprises 340 acres, and it is stated that ten well-defined veins have been located. Of these only two have been worked, namely, No. 2 and No. 3. No. 2 vein was entered by an underlay shaft to a depth (on the incline) of 400 ft., and four levels run. The ores carry iron and copper pyrites. Some very rich ores have been mined, showing assays of $25 to $345 per ton.

The Todd Mine is situated five miles northwest of Charlotte. It has been penetrated to a depth of 80 ft. Some exploratory work was done at this mine in 1886, and a 10-stamp mill erected.

The Black Mine, ten miles east of Charlotte, has a small, but very rich vein of brown ore, of which assays show values from $50 to $236.

The Copper Knob (or Gap Creek) Mine is situated in the southern part of Ashe county. A shaft was sunk to a depth of 60 ft. with satisfactory results, and subsequently deepened (as reported) to 140 ft. At this stage the mine became the prey of a company of speculators. The concurrent testimony of many persons cognizant of the last work is that the resources of the mine continued good as far as the explorations extended. Assays show $10 to $123 per ton of precious metals.

In the region west of the Blue Ridge are several gold mining localities, some of which have attracted attention, and have been the site of more or less productive work.

South Carolina Gold Mines.

There are quite a number of valuable and profitably worked gold mines in South Carolina, but this article will deal with only two of them, located in the two counties of Chesterfield and Lancaster.

The largest and probably the best known of these mines is the Haille, located three miles from Kershaw. This mine has been in profitable operation for a number of years. It is now owned by a company of which Mr. G. H. Seeley, of New York, is president; Mr. A. T. Cross, of New York, is secretary and treasurer, and Mr. A. Thies, general manager.

The chlorination process is used and the mine is equipped with modern machinery, costing over $50,000. The Haile is the largest gold mine in operation east of the Rocky Mountains.

About 150 miners are regularly employed, all negroes except the foremen. The exact figures are not obtainable, but the report is that the monthly product of this mine is from $7,000 to $20,000, the annual product therefore being somewhere between $100,000 and $200,000. The labor employed is cheap—much cheaper than that employed in western mines—and the profits of the company therefore relatively much greater than those working western mining property.

The Brewer Mine, in Chesterfield county, is operated now by the De Soto Mining Co. The chief owners are the widow of the late Senator Hearst, of California, and Mr. E. Motz, the latter being the superintendent and general manager of the company. The president of the company is also a New Yorker, Mr. Irwin C. Stump, as is also the secretary and treasurer, Mr. H. B. Parsons. C. A. Clark, of San Francisco, is vice-president. The Brewer Mine is equipped with modern machinery, which at present has a capacity of 200 tons of ore per 24 hours. The ore averages $3 of gold per ton. It is the intention to enlarge the capacity of the plant to 2,000 tons per day. The supply of gold-producing ore is said to be almost inexhaustible. The ore body now being worked is 2,500 ft. wide and 1½ miles long. The open shaft is 500 ft. in diameter and 200 ft. deep, and the tunnel leading into the mine is 475 ft. long. This mine also uses the chlorination process.

* * *

VALVE BOX AND CAPSTONE USED ON THE WATER-WORKS OF SYRACUSE, N. Y.

The valve boxes and capstones for the same, used on the Syracuse water-works in 1895, are shown in detail by the accompanying illustrations. Two classes of valve boxes were used, different only in the size of their lower portions, as shown.

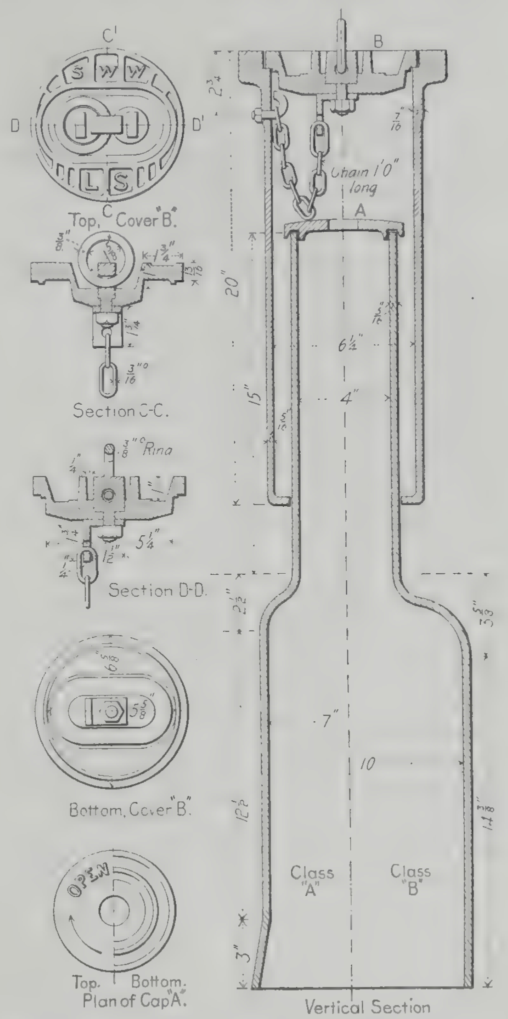

Fig. 1.—Details of Valve Boxes Used at Syracuse, N. Y.

The valve boxes were made by the Jackson & Woodin Mfg. Co., of Berwick, Pa., after the design furnished by the Syracuse Water Board, as shown herewith, and the contractor for the capstones was Mr. John Crabtree, of Syracuse. The caps are of limestone. We are indebted to Mr. W. R. Hill, M. Am. Soc. C. E., Chief Engineer of the Syracuse Water Board, for the information and illustrations given.

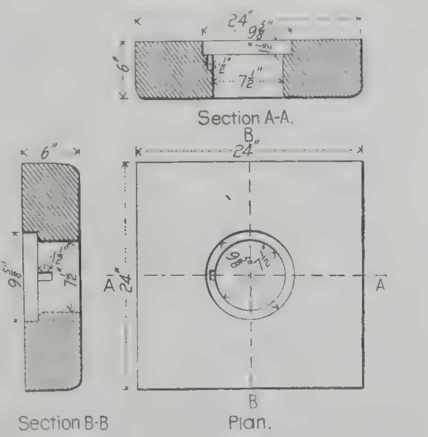

Fig. 2.—Capstones for Valve Boxes at Syracuse, N. Y.

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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

Irrigation enterprise in the west will receive a new impulse in view of the decision of the U. S. Supreme Court, outlined in our news columns, upholding the constitutionality of the Wright Irrigation District Law. Although this was a California statute similar ones had been passed by a number of other states, and doubtless other Western commonwealths will be encouraged by this decision to take the same step. Briefly, these acts give land-owners corporate powers under which money may be raised, and irrigation works built at the general public expense, instead of requiring the land-owners to buy water from irrigation companies, or to form themselves into such private corporations. A large number of irrigation districts have been formed in California, millions of dollars of bonds issued, millions more voted, and many irrigation works of magnitude have been carried out under the Wright law. The districts have been harried from the start by litigation, but the California State courts have invariably, if we are correctly informed, upheld the Wright law. Nevertheless, the legal opposition has had a depressing effect on the district bonds, and the depression has doubtless been increased by bringing to bear all possible means to discredit the securities in question. In addition to this, the districts were largely experimental at the start, and probably the best engineering and legal advice were not secured at the inception of some of the districts. The importance of the best possible legal and engineering advice has been more fully realized of late, at least by some of the organizations, and accordingly many of the districts have employed the most eminent engineers and lawyers of California to report on their districts. These reports have been handsomely printed, and doubtless have aided greatly in establishing confidence in the several enterprises among financial men and others.

Outside of California, irrigation districts have not made so great progress, or certainly have not come nearly so prominently to public notice. The other states have followed where California led, and many have been slow about doing so, in some cases with good reason, it may be assumed. Recently, all, or nearly all, enterprise of this sort has been at a halt, awaiting the decision which has just been made. Now that the U. S. Supreme Court has so firmly sustained what the California courts vigorously and continuously upheld for many years, irrigation enterprise may be expected to take new life; bonds will be sold readily and much irrigation work may be expected. While the legal questions have been in suspense, the practical questions of operating the districts and their works have doubtless been satisfactorily answered, in very many cases, the economical development, distribution and application of water to crops has been advanced and the people of many new sections have come to appreciate the advantages, and often the necessity of providing an artificial water supply. At the same time, the small farm idea, for many products, has developed. Altogether the future of irrigation seems to be much brightened by the decision. Some of the irrigation companies may not be pleased by it, but many will find increased markets for their water in bulk, districts buying their whole supply from a company, as is already practiced, thus relieving the companies from many petty details and conflicts seemingly inherent to the distribution of water by corporations. At the same time, not all sections will adopt the district system, even if they might, and the general stimulus given to irrigation will, in such sections, be wholly to the benefit of the companies.

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We print on another page of this issue an interesting account of the present status of gold mining in North Carolina. There is no doubt that gold exists in the Appalachian range in various parts of the Carolinas, Alabama and Georgia, and it is possible that these states may yet figure largely as producers of precious metals. In a recent issue of the "New York Financier," a correspondent calls attention to the fact that the mines of the Rand district in South Africa, the most profitable in the world, produce low-grade ores almost entirely, yielding only $2.50 to $20 per ton, and require treating by the cyanide process, or chlorination, and continues:

> In Georgia and Alabama there are miles and miles of veins carrying free gold from $2 to $20 per ton within 40 ft. of the surface and as many more miles carrying the quartz that contain sulphurets and by assay show $10 to $75 per ton within 75 ft. of the surface.
>
> There are also large bodies of low grade ores in disintegrated or decomposed veins that are 10 to 40 ft. wide and show by assay $1 to $5 per ton within a few feet of the surface.

It may seem that if the above showing were correct, the future gold bonanzas of the world would be in the mountain regions of the Southern States; but the remarkable characteristic of the South African deposits is the uniformity with which the gold is distributed through great masses of gold-bearing rock. Does this condition also exist in the gold mines and gold prospects of the South? If it does, and if an extensive system of sampling and assaying can establish this for any given mine, its value as a gold producer is beyond question. We have never seen, however, authentic testimony that this is the case. On the contrary, our information is that the gold bearing veins in the Southern rocks are usually of small width, or if of large size carry paying ore in only a small part of their width. However, if large bodies of low-grade ore with average contents high enough to be profitable exist in the South in connection with any of the various prospects, the fact ought not to be difficult to establish.

We may remark in this connection that the gold deposits of the Southern States have been most thoroughly discussed in various papers read before the American Institute of Mining Engineers. We would advise any of our readers interested in the subject and desiring more information concerning it to consult the "Transactions" of this society.

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A remarkably fast train service now being regularly made on the Great Western Ry., of England, is recorded in another column. The train runs from London to Exeter, 194 miles, without a stop, in a schedule time of 3 hours 45 mins., or at an average speed of 51.7 miles per hour for the entire run. Water is taken at the track tanks. The line has generally easy grades and curves, broken, however, at Bath and Bristol by sharp curves which have to be passed at reduced speed, while there are some grades of 1.23 to 1.10%, each a mile long, and longer grades of 0.8 to 0.67%. The weight of train, consisting of six corridor cars mounted on trucks, is about 413,600 lbs. In our issue of Sept. 19, 1895, we discussed at some length the high-speed train records of English and American railways, and gave the details of the make-up and schedules of some of these trains. The most noted American train is undoubtedly the Empire State Express of the New York Central R. R., which, with a load of about 377,000 lbs. behind the tender, makes its daily run of 440 miles at the average speed of 50.76 miles per hour, or 52.17 miles per hour if stops are deducted. This train makes three stops, and the first division of its run, 143 miles, is passed in 165 minutes, or at the rate of 52.31 miles per hour. The railways running from London northward are those which have hitherto done the most showy running in competitive racing and in regular schedules, while the western and southern railways have for years had a bad reputation in this respect. The present remarkable service on the Great Western Ry., however, seems to indicate that that line is returning to the old aggressive position and high standing of its early days.

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An interesting damage suit was decided in the Supreme Court in Brooklyn on Oct. 28, in which the widow of a workman obtained a verdict for $6,000 against Levering & Garrigues, contractors for the new New York station of the New York and Brooklyn Bridge. The workman was a painter, and the scaffold upon which he was working fell to the ground. The scaffold was supported by two hooks from the eaves of the building, and one of the hooks broke. It was proved on the trial that the foreman of the painters asked the foreman of the structural work for some iron to make a hook, that the latter selected two tie rods, each about 5 ft. long, which had been used to tie the floor beams of the old structure; the painter's foreman gave a sketch to the blacksmith who made the hooks as directed. Neither of the foremen nor the blacksmith tested the iron, but the blacksmith said he knew the iron was good because it stood the work he put on it while bending it at a red heat into the form of the hook. The completed hook also was not tested in any manner whatever, but the scaffold was hung with it one evening and the men went to work on the scaffold next morning, and within five minutes afterwards it fell, killing one man and seriously injuring another. It was proved that when the tie rods were put into the old structure, 12 or 14 years ago, they were obtained from reputable manufacturers under rigid specifications and inspection, but the fractures of the iron showed it to be extremely bad, so bad indeed that no testimony was offered to show that it was good; but only that it was presumably good on account of its source and on account of the blacksmith's judgment upon it while he was working it. The whole case was a good illustration of how builders, foremen, blacksmiths, painters, and in fact almost everyone have the universal habit of "taking things for granted" in regard to the strength of materials and of structures. Because the iron had been used in a building it was taken for granted that it was good iron originally and that it had not deteriorated during its 12 years of service; it was taken for granted that the shape and dimensions of the hook were sufficient, although the shape was somewhat unusual; it was taken for granted that the blacksmith knew his business and would not burn the iron while working it; the blacksmith seems to have known nothing about making a cold bending test of the iron to determine whether it was good or not, but assumed that if it stood bending hot it could not fail to be good. The boss painter took the completed hook as being all right, as a matter of course, and made no attempt to test it, although he had ample opportunity, and the workmen, as workmen always do, took the judgment of their foreman that the scaffold was all right. If either of the two foremen or the blacksmith had any suspicion as to the quality of the iron, their doubts could have been resolved by a cold bending test which they could have made in five minutes; but not one of them seems to have had any suspicion whatever.

The lesson of the accident is, do not "take things for granted," but it will be heeded by but the few who happen to hear of such accidents. The great majority of foremen, blacksmiths and the public at large will continue to take things for granted as long as human nature is what it is.

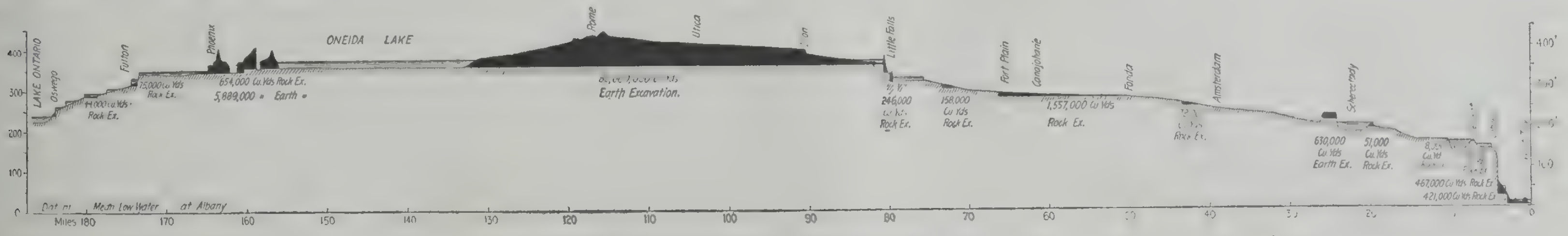
The incident is also an illustration of the risk which every large employer of labor runs of seeing a good slice or the whole of his profits from a piece of work absorbed by damage suits on account of accidents to employees. The law is clear that the employer of labor is charged with a responsibility for the safety of his workmen; and motives of self-interest as well as motives of humanity impel toward the most careful provisions for their safety. In addition to this it is the practise of most contractors and many manufacturers nowadays to carry insurance against losses of this class in some of the various casualty companies. Even the most painstaking vigilance cannot prevent occasional serious accidents, and it is as wise to make provision against exceptional losses of this sort as it is to make a similar provision against losses by fire.

We commend this incident also to the few engineers who still hold to iron as a safer metal than steel for structural purposes. A hook which breaks off short under a static load is certainly pretty poor metal and will well match all the stories that are told of unaccountable failures of steel from "crystallization," etc. Engineers are well agreed that structural steel of the present day is a safer material than the product now turned out from the puddling furnaces; but this occurrence illustrates the fact that more than a dozen years ago iron of very bad quality was also made and found its way into structures of such importance even as the Brooklyn Bridge terminal station.

Louis Baldwin Howell, M. E., died in Chicago, Ill., Nov. 12. He graduated from the Sibley School of Cornell University in the class of 1895, and during his senior year was the managing editor of the "Sibley Journal of Mechanical Engineering." A short time after his graduation he became a member of the staff of Engineering News, but was obliged to resign his position in December, 1895, on account of an affliction of the lungs. The remainder of the winter he spent at Eddy, New Mexico, but the climate there did not effect the cure that was hoped, and the last months of his life were spent at his home in Chicago.

Mr. Howell was a young man of remarkable abilities, and although a member of the staff of this journal for a few months only, he proved himself possessed of talents that justified hopes of the highest success in his profession. During his stay in New Mexico he prepared articles for this journal, of which one on "The Thompson-Ryan Dynamo" was published in our issue of March 12, and another describing the extensive works of the Pecos Irrigation & Improvement Co., at Eddy, was published Sept. 17.

By his attractive personal qualities and his excellent character he won the friendship and esteem of all those with whom he was associated, and the news of his untimely death brings to all his many friends the sense of a personal loss.

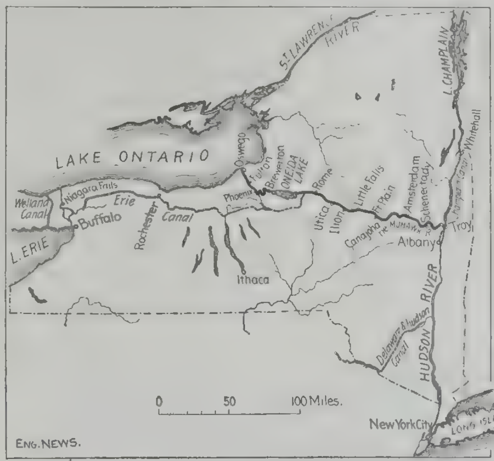


PROFILE OF PROPOSED OSWEGO SHIP CANAL.

A SURVEY OF A GREAT LAKES AND HUDSON RIVER SHIP CANAL.

The position of this journal on the proposal to construct a ship-canal from the Great Lakes to the Atlantic Ocean is well known to our readers. We believe that the current estimates of the great profits and public benefits of such an enterprise are absolutely unreliable because the information is nowhere available from which accurate estimates can be made, either of the cost of the work or of the traffic which would use it. Further, none of the various advocates of the enterprise have seemed to us to take a really broad and comprehensive view of all the conditions of the problem. The steady reduction in the cost of carrying bulk freight by rail, for example, seems to be persistently overlooked.

Nevertheless, we appreciate the fact that a great number of people, including many prominent members of the engineering profession, are enthusiastic over the possibilities, or probabilities, as they consider them, of "a deep waterway from the Great Lakes to the Atlantic;" and because the information available is so limited, it is as difficult to prove that their expectations cannot be realized as it is for them to show that they are well grounded. Vague guesses are not engineering estimates; and before the ship-canal enterprise will deserve to receive the support of either private or public capital on the one hand, or to be definitely laid on the shelf on the other, the actual facts concerning the enterprise ought to be ascertained and made public.



Map of the Canals of New York State, Showing Proposed Ship Canal on the Oswego Route.

The most important part of any such investigation, it appears to us, is the ascertaining of the traffic which a ship-canal over any of the various routes could secure. It ought to be first known with some accuracy what benefits will result from a proposed work before the actual planning and estimating of its cost should proceed very far. In this ship-canal scheme, however, there is a noticeable tendency on the part of its promoters to gloss over with glittering generalities this part of the investigation, and devote attention solely to the engineering questions respecting the most available route and the cost of the work.

Information in this field also, however, is exceedingly meager. No survey that is worthy of the name has ever been made of any of the proposed deep waterway routes, and the estimates of cost, therefore, have been more or less of the character of guesses. In the last annual report of the State Engineer of New York, however, we find a report by Mr. Albert J. Himes, Assoc. M. Am. Soc. C. E., Resident Engineer on the Eastern Division of the New York State Canals, of a "hasty reconnoisance" made by him for a 20-ft. deep waterway from Lake Ontario to the Hudson River. As no special fund was available for the work, it was done "in such odd moments as could be snatched from the routine work of the division." The data was obtained largely from papers in the Am. Soc. C. E. Transactions, the files of State Engineer reports, the maps of the Geological Survey, and other published matter, supplemented by cross-sections taken with the stadia. It is manifest that data secured in such hasty manner are hardly a safe reliance on which to base final opinions concerning an $80,000,000 enterprise. Nevertheless Mr. Himes' survey does offer something tangible in the place of the previous lack of knowledge, and we have, therefore, thought it worth while to present his principal facts and discuss his results in this place.

It is fair to say at the outset that Mr. Himes disclaims any great accuracy for his estimates, and states that they must be considered as preliminary, and as only valuable as a means of determining the advisability of making a complete instrumental survey, when the necessities of canal improvement require such a radical change in the present canal system as is here contemplated.

The proposed location is between Troy, on the River Hudson, and Oswego, on Lake Ontario, a distance of 182½ miles. The plan contemplates slack-water navigation of the Mohawk River by dams and locks to Rome, and the utilization of Oneida Lake and the Oswego River, on the general route suggested by the late State Engineer Elnathan Sweet, in his paper presented to the American Society of Civil Engineers in 1884. The estimates cover a canal 100 ft. wide on the bottom and 20 ft. deep, with locks 450 ft. by 60 ft. The proposed maximum lift of a common lock is 27 ft.; a lift seemingly warranted by the locks at Sault Ste. Marie and other points.

Concerning the important question of water supply to the summit-level, the estimates are based upon the emptying of each lock every 30 minutes, with evaporation and leakage duly considered. The required maximum amount, on this basis, would be 36,000 cu. ft. per minute; and of this the present 33,000 cu. ft. per minute on the summit-level of the Erie canal would be available for the new canal. As this is mostly stored water, it would be independent of the rainfall during the navigation season. To supplement the available supply, there is a drainage area above the proposed summit-level of 1,972 sq. miles, which Mr. Himes believes can be depended upon for a flow of 27,240 cu. ft. per minute, which, added to the present supply would be equivalent to 60,240 cu. ft. per minute. Oneida Lake would also be used as a storage reservoir to a 10-ft. depth; and as this lake has an area of 81 sq. miles, and allowing 1 ft. for evaporation, the remaining 9 ft. would furnish a flow of about 67,000 cu. ft. per minute continuously for seven months. Mr. Himes thus deems the sufficiency of a summit-level water supply as absolutely unquestionable.

In the matter of excavation the ultimate cost will depend largely upon the character of the material encountered, and in this connection Mr. Himes notes that by the conditions imposed he was compelled to depend upon surface indications alone. The most serious cutting is in the summit between Little Falls, on the Mohawk, and Oneida Lake, a distance of about 45 miles. The contents of this cut is estimated at 80,000,000 cu. yds. of earth at 25 cts. per cu. yd.; but Mr. Himes says that while this price on the Chicago drainage canal covered the handling of some very hard material, if the material actually found here were rock, the cost of its removal would be prohibitory. After discussing the dams required on the Mohawk and Oswego Rivers, the nature of the locks and the question of land damages, the following estimate is submitted for the total cost of an enlarged canal between Troy and Oswego:

86,519,000 cu. yds. earth excavation, at 25 cts.	$21,629,750
3,873,000 " " rock excavation, at $1.00	3,873,000
18 dams, average cost $376,278	6,773,000
518 vertical ft. locks at $40,000 per vertical ft.	20,720,000
65 bridges	1,750,000
Slope protection	5,188,757
Land damages	3,218,263
	$63,152,770
Engineering and contingencies, 30%	18,945,831
Total	$82,098,601

Mr. Himes sums up the merits of the proposed scheme as follows: By using slack-water navigation, there is deeper water at the lower end of each level, owing to the slope of the river bed, and out of 182½ miles of canal, 33.4 miles, or 18% of the whole, and including Oneida Lake, will have a depth of at least 25 ft., making navigation that much easier and safer. The width of the waterway is also greater than the typical canal sections for 73% of the entire distance, and the easier displacement of water will permit greater speed than in a narrow canal. New water powers of great value would be created; the removal of the present Erie canal from cities and towns would result in great gain in property values, and the land abandoned by the old canal would be worth much money to the State, though this is not used to offset land damages in the estimate. The engineering problems, while great, are capable of solution; and the chief difficulties in the way are the great cut through Rome, the control of the floods on the Mohawk and the operation of the proposed elevator locks. Mr. Himes deems his estimates rather above than below the actual cost of the work, and he believes that the result of his investigations are favorable to the route and warrant a more exhaustive study.

The most striking feature in the plan is the great summit-level cut, some 45 miles long, and averaging about 50 ft. in depth. Mr. Himes confesses that if this material were rock, its cost of excavation would be prohibitory. The possibility is suggested, however, that by using a higher summit-level and more locks it would be possible to greatly reduce this excavation. It is true that doubts then arise concerning the sufficiency of the water supply for the summit-level, but Mr. Himes points out that inclines or elevators might be designed for transferring boats to the summit-level which would use much less water than an ordinary canal lock.

But a more important question respecting the Oswego route than that of mere quantities and cost is the fact that a 20-ft. waterway over this route would only furnish a part of the proposed connection between the Atlantic seaboard and the Great Lakes. To the estimated cost of this link in the line would have to be added the deepening of the Hudson River for at least 30 miles, to secure a depth of 20 ft. of water, and also that of a 20-ft. canal between Lakes Ontario and Erie overcoming a difference in level of 326 ft. Mr. L. E. Cooley, at the late Deep Waterways Convention, estimated the cost of a new ship-canal, on the American side of the Niagara River, at $23,000,000. What the improvement of the Hudson River would cost for the 30 miles in question can not be definitely stated; but as a harbor has to be formed also at Oswego, the cost of which is not included in Mr. Hime's estimate, it is safe to say that the 20-ft. waterway from Lake Erie to deep water in the Hudson River by way of Oswego would cost not less than $125,000,000.

This is $75,000,000 less than the sum which has been commonly named as the cost of a 20-ft. channel over the present line of the Erie canal; but it is to be remembered that this is a pure guess, so that the comparison must be taken only for what it is worth.

We said at the outset that the economic advantage of the canal was a far more important question than the matter of its cost. Mr. Hime's report devotes one paragraph to this and we copy it verbatim as follows:

> In discussing the economy of building such a waterway, it would be well to consider the history of the Suez Canal. That canal cost in round numbers £20,000,000. To-day the profits of the canal have been so enormous that its stock is worth £80,000,000. But the traffic passing through the Detroit River to-day is not only greater than any traffic that ever passed through the Suez Canal, but greater than the traffic passing through any other single channel in the whole world. This traffic is mainly domestic and is carried on almost wholly between Chicago, Duluth and the upper lake ports on the one hand, and Cleveland, Buffalo and the lower lake ports on the other. Such being the present condition of traffic, what might we expect if the same waterway were extended to connect Albany, New York, Brooklyn, Jersey City and Philadelphia with Buffalo, Cleveland, Detroit, Milwaukee, Chicago and Duluth? We need not consider the possibility of trans-Atlantic shipments from Duluth, but only the extension of our domestic commerce.
>
> Turning now to the military aspect, it is idle to say that no war will ever come between this country and Canada, for the history of the world for all time is a succession of peace and war of varying duration. We hope it may not come; but if it does come, and the vast commerce and the wealth of the lake cities is unprotected, then may Heaven save us, our own hasty efforts cannot.

It appears to us that Mr. Himes is attempting a comparison between two things which are very dissimilar. The alternative to the use of the Suez canal is an ocean voyage around the continent of Africa. The alternative to the use of any Great Lakes and Hudson ship-canal would be the use of some other one of several different routes almost and perhaps quite as economical as the proposed ship-canal.

The railway lines to tide water are carrying freight cheaper every year. They have proved their ability to compete with the present Erie canal, and what is there to show that economies and improvements in railway engineering have come to an end? The Canadian waterway to the sea, by way of the St. Lawrence and Montreal, is being rapidly improved and is to be still further developed by the expenditure of large sums of money. Again, the class or type of vessel has yet to be devised which is adapted to a combined lake, canal and ocean service, if the voyage is to be made without breaking bulk. Barge transportation, in tows on the present waterways, is also in the development stage, and there is good reason to believe that it may prove more economical than transportation by vessels of deeper draft.

As for the "military" uses of a ship-canal across New York State, on which Mr. Himes lays such stress, it reminds us of a story of a peaceable and law-abiding wolf, who barricaded his den when he went to sleep for fear a lamb who lived next door would come in during the night and eat him up.

Seriously, in the highly improbable event of hostilities between Great Britain and the United States, land forces would occupy Canada and would permanently wreck the locks on the Canadian canals with a few well-placed charges of dynamite, long before any of the lighter craft of the British Navy, which alone could ascend the canals, could reach this side of the ocean.

It is fair to say, of course, that this aspect of the scheme was not properly within the scope of Mr. Himes' work. His task was to examine the feasibility and cost of a ship-canal on the Oswego route, and it appears that with the means at his disposal he accomplished wonders. His work should be given careful consideration in weighing the merits of different deep-waterway routes to the seaboard, when it is settled that such a waterway is "worth while."

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LETTERS TO THE EDITOR.

Thenard Movable Dam.

Sir: In Executive Document No. 78, House of Representatives, 42d Congress, 2d Session, will be seen about the fullest presentation of movable dams to be found in print. The Thenard system is there illustrated and described.

Yours truly, J. S. Walker.

Engineer Office, U. S. A., Nashville, Tenn., Nov. 9, 1896.

(We do not know whether this document is on sale; but enquiry made of Mr. F. A. Crandall, Superintendent of Documents, Washington, D. C., will settle that point.—Ed.)

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Patents on Hydraulic Dredges.

Sir: In your issue of Oct. 29, I notice a letter from the New York Dredging Co., by H. S. Wood, concerning a dredge that company is building for the Mississippi River Commission, in which there occurs the following:

> One special feature of the design is that it is so far different from all usual arrangements of suction dredges with mechanical excavators, as to be entirely outside of the principles claimed by A. B. Bowers as his invention.

I thank Mr. Wood for this admission that "all usual arrangements of suction dredgers with mechanical excavators" are WITHIN "the principles claimed by A. B. Bowers as his invention," or in other words, within the claims of the Bowers Letters-Patent.

As I have twelve U. S. Letters-Patent containing in the aggregate 389 claims, it is perhaps not surprising that he should have failed to notice many of these as, for instance, among others bearing directly on the design referred to, the 14th claim of Letters-Patent No. 411,183, which is as follows:

> 14. In combination, a suction pipe and a rotary excavator secured to the mouth thereof, said excavator being provided with cutting edges or blades, and having its axis outide of and transverse to said pipe.

Until the courts have thus limited this and other claims, it is a bold assertion that the design of the dredge referred to "is outside of the principles claimed by A. B. Bowers, as his invention."

Conceding that he may have inadvertently overlooked the claim cited and many others, is it not strange, in view of his connection with the pending litigation, that he should also have overlooked the fact that Col. Von Schmidt, Williams and Bixler, the McNee Bros., the Golden State & Miners' Iron Works, and others, have been for several years under perpetual injunction not to use claim 25 of my Letters-Patent No. 318,859, which reads as follows:

> 25. A discharge pipe consisting of a series of sections flexibly joined together and supported by floats, in combination with a dredger having a rotary excavator.

Perhaps it may be of interest to note in this connection that in settlement of various suits against infringers of my patents I have acquired the entire right to the Angell, Lynch, Brown, Hobart (Atlas and Hercules), Letters-Patent; and to the Von Schmidt Letters-Patent also, except as to a one-half interest on the Pacific Coast and the right to, I think, four other states—eighteen Letters-Patent besides my own; and that the Bowers Pacific Dredging Co., of San Francisco, the Bowers Dredging Co., and the Bowers Gulf Dredging Co., of Chicago, the Bowers Hydraulic Dredging Co., of Camden, N. J., and myself, also, are protected by all 30 of the Letters-Patent owned by me with their 450-odd claims.

Respectfully yours,
A. B. Bowers.

Great Northern Hotel, Chicago, Nov. 13, 1896.

P. S.—Since writing the above, Judge Hanford has granted a preliminary injunction against the New York Dredging Co., restraining it from infringement of my patents in the suit of Bowers and the Bowers Dredging Co. vs. The New York Dredging Co., in the U. S. Circuit Court for the Western District of Washington. —A. B. B.

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Specifications for Water-Tube Boilers for the St. Louis Water-Works.

Sir: In answer to your editorial reply to my letter of the 7th inst., permit me to say that I adhere to my position "that—within reasonable limits, of course—it is absolutely immaterial whether the bidder furnishes 1 or 50 sq. ft. of heating or grate surface to do a given amount of work." It is assumed, of course, that proper precautions will be taken to insure that the contractor must comply with the requirements of the specifications as to efficiency, capacity, dryness of steam, and smokelessness.

You ask what my advice to a client would be in a case where two bidders, offering boilers "of identical construction," ask practically the same price, the one, however, giving nearly 50% more heating surface than the other.

In a public letting by a municipality, the decision must be in favor of the lowest bidder, who complies with the specifications, the additional heating surface not being entitled to consideration. In the case of a private corporation, however, my recommendation would unquestionably be in favor of the bidder furnishing the most heating surface, other considerations being equal.

Your question, however, does not cover the point at issue. As a matter of fact no two water-tube boilers in the market are "indentical in construction." Most of them differ widely, both in general design and in detail. It is no more proper, therefore, to compare them solely on the basis of heating surface, than it would be to make a similar comparison between the old type of cylindrical boiler and the modern return tubular. Differences in design and detail unquestionably affect the amount of work which can be done by a square foot of heating surface.

Without entering into this controversy further, it would seem to a disinterested outsider that in the matter of proportioning heating surface to capacity, the different boiler-makers—at least those of long standing and experience—should be credited with using ordinary good business judgment. It does not seem reasonable that one manufacturer could continue to sell his type of boiler year after year at a low rating of heating surface per horse-power without being sure of his ground; nor that another would continue to give a different type of boiler a greater allowance of heating surface unless he deemed it necessary to do so. The builders of boilers themselves should be, and I think usually are, very good judges of what can be done with their boilers. So many trials of capacity have been made, and they are so readily made now, that there can be no excuse for either ignorance or deception in this matter.

If your question were asked me on the basis of boilers not "identical in construction"—as would always be the case—I should study the differences, and endeavor to form a conclusion as to the value of a square foot of heating surface in each case. This would reduce the problem to one of relative ability to evaporate water, and on this I would base my recommendations.

Very respectfully,
William H. Bryan,
M. Am. Soc. M. E.

St. Louis, Mo., Nov. 14, 1896.

(Our question was intended to "cover the point at issue," for we understood that the two boilers referred to were of identical design, viz.: the Heine and the O'Brien, but that they differed in the amount of grate surface and heating surface offered by each as the equivalent of a horsepower. It would be unprofitable to continue the discussion further, for we see no probability that the differences of opinion between ourselves and Mr. Bryan can be reconciled. There are some new questions raised in Mr. Bryan's present letter, however, on which we may comment. That boiler makers of long standing and experience use "ordinary good business judgment" may be conceded. They sell boilers on the merits of their reputation, give good material and liberal proportions, and generally good satisfaction; and it is good "business judgment" to keep on selling boilers in just that way, with as little bother as possible concerning tests. But these same boiler makers are apt to be anything but good judges of what can be done with their boilers with different kinds of fuel and under different conditions, or of how to burn different kinds of fuel under their boilers to obtain the best results. Examples of the prevailing ignorance among boiler makers of what they can do with their boilers must have frequently come under Mr. Bryan's observation. In the case now under discussion, one maker offered 25% more grate surface and 48% more heating surface than the other; one or other of the bidders must have underrated or overrated the capacity of his boiler. In a former competition for supplying boilers to the St. Louis water-works the successful bidder failed to make good his guarantee, showing ignorance on his part as to what he could do with his boiler. If Mr. Bryan is able to form a conclusion as to the relative value of a square foot of heating surface in two different boilers by studying the differences of construction, we hope he will before long give the public his method of forming such a conclusion in the shape of a paper read before one of the engineering societies. We have no doubt such a paper would lead to a lively discussion, and bring out a variety of different opinions on the subject.—Ed.)

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THE APPLICATION OF PHOTOGRAPHY TO SURVEYING.

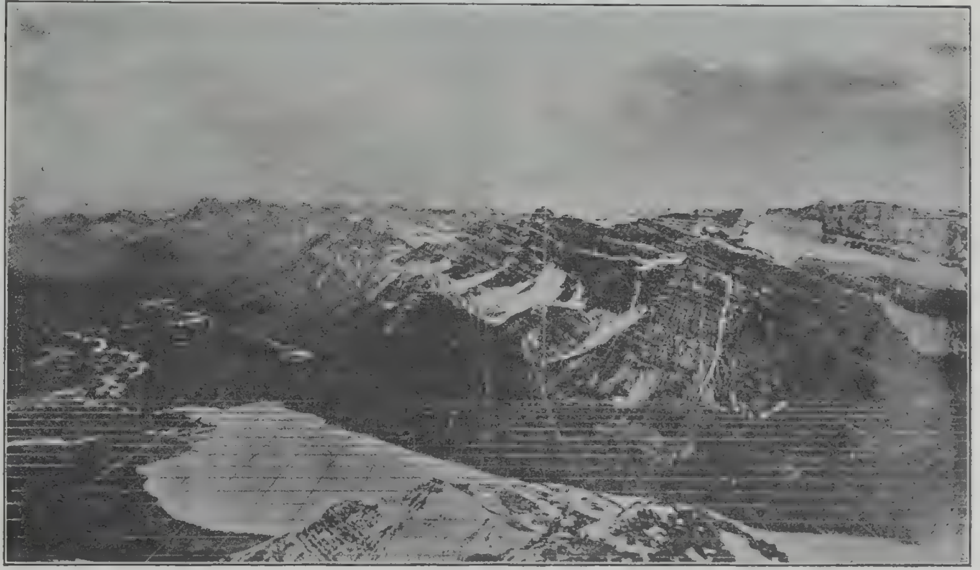
The first practical application of photography, on this continent, to the continuous survey of large areas, is due to the experiments and patient and intelligent work of Mr. E. Deville, Surveyor General of Canada. This method of obtaining topographical data was first suggested in 1850, by Col. Laussedat, of the French army; and later, German and Italian engineers continued his investigations and elaborated upon his methods. But the system seems to have been entirely abandoned in France, and in Germany it is mainly used for making plans of buildings; but the Italians have instituted the Ordnance Photographic Survey, and under the able engineer M. Porro, they have vastly developed the system and have done some remarkable work. In America, Lieut. Henry A. Reid, U. S. A., has published an excellent work upon "Photography Applied to Surveying," in which he gives the detailed history of the process and describes the instruments and methods employed. But the Canadians, alone on this continent, have made a practical application of the system upon any extensive scale.

Until a few years ago the land surveys of the Dominion Government were chiefly confined to the prairies of Manitoba and the Northwest Territories, where the operations were simple and topographical features were scarce. But when these surveys reached the Rocky Mountains the conditions changed; topography became well marked, and the old system of section lines became useless, if not impossible in application. Government administrations demanded a fairly accurate map and some means had to be devised for making this map rapidly and at a moderate cost. As the ordinary methods of topographical surveying were too slow and expensive, and as rapid surveys, based upon triangulation and sketches had been tried and proved ineffectual, photography was resorted to.

The principle of the method employed and a summary of work actually performed in the Dominion is given by Mr. John S. Dennis, of Ottawa, Canada, in a paper read before the Denver meeting of the American Society of Irrigation Engineers. From this paper we make the following abstract:

"The method used is based upon the fact that a photograph taken with a suitable lens is a true perspective, in which the focal length is the distance line. By drawing the horizon and principal lines all measurements usually taken on the ground can be obtained from the photograph. But there is this difference, that while the ordinary surveying instruments and methods restrict the surveyor to a few constructions, photography affords a great variety of processes by applying the inverse laws of perspective. Mr. Dennis does not enter into the detail of the methods used, and refers those interested to the work of Lieut. Reid; but he gives the results of the surveys thus made. Regular photographic surveys were commenced in 1888, in the main range of the Rocky Mountains, near the Canadian Pacific Ry., and 250 square miles were covered in that year. From that time from 375 to 500 sq. miles were thus surveyed each year until the aggregate area covered, at the end of 1892, was 2,025 sq. miles.

These surveys were all made by a party consisting of the topographer, one assistant, a packer and a laborer. It has now been established that 500 sq. miles is about the limit of area which a party, travelling rapidly, can cover in one season; though this area is, of course, affected by the general character of the ground; being largest in an open district with wide undulations. The topographer does not need more than a few minutes at each station, to observe angles and expose his plates. As showing the general advantages and the rapidity of the work, the season of 1892 is taken as follows: The start was made on June 29, the snow being too deep for work before that date, and the survey was stopped on Oct. 17, when the snow again became too deep for travelling. Of the 111 intervening days 48 were lost through smoke, rain and snow storms; in the 63 actual working days thus left, the equivalent of 500 sq. miles of territory was surveyed, an average of 8 sq. miles per working day.



PHOTOGRAPH USED IN THE CANADIAN TOPOGRAPHIC SURVEY, SHOWING METHOD OF PLOTTING.

The results of the survey are plotted on a scale of 1—20,000, and reduced for publication to 1—40,000. The published "Anthracite" sheet, with an area of 63 sq. miles, may be taken as an illustration of practice. This plot was made from 6 stations inside the sheet and 11 stations outside, and 1,075 points were fixed by intersections, or by constructions equivalent in accuracy, taken from 35 photographic views. This corresponds to 17 points per sq. mile; though more points could be fixed without difficulty as the limit is the time which can be devoted to plotting. The office rule is that the topographer must plot his season's work before going into the field again; though more detailed maps of any particular locality can be made at any time from the same photographs. The expenses of the season of 1892 were:

Packer, $2.00 per day; laborer, $1.50 per day...	$429.00
Transportation	578.50
Living expenses	394.71
Miscellaneous	76.98
Total	$1,479.19

To this add $1,500 per annum for the salary of the topographer and $730 for that of his assistant, and the total is $3,709.19, as the cost of surveying 500 sq. miles in one year. This is equivalent to $7.42 per sq. mile, or 1.15 cts. per acre. This extremely low cost is due to the fact that the party is very small, and very little time is consumed in taking angles and photographs, and no time is required in taking measurements on the ground. The time spent in the field is chiefly devoted to travelling from one point to another, and the actual work of deducing results from the data thus collected is done in the office by two men.

Mr. Dennis believes that this method could be successfully and economically applied to surveys made in connection with irrigation enterprises. On the Canadian maps the contour intervals are 100 ft.; but a detailed plan of the area covered by any one sheet could be made to a larger scale from the same photographs, and contours shown at any intervals required. The strongest point in its favor, however, would be the rapidity with which the work could be done; though economy in first cost of the survey is also often a vital consideration. It should be stated that the application of the method requires experience and a combination of the faculties which make an accomplished topographer. He has nothing before his eyes to show the progress of the work, or the gaps that may exist in it; so that he must ever be on the watch, and depend upon his judgment and experience for the data actually transmitted to the home office for record. Another peculiarity of photographic surveying, which applies directly to irrigation engineering, is that the same photographs can be used for a small scale general map, or a large scale detailed map, and a return to the ground for additional data is unnecessary.

The photograph here reproduced is one of several used by Mr. Dennis in his paper, and illustrates some of the intersections made for defining the boundaries of Bow Lake, and for obtaining other topographical data at that place.

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THE EXCLUSION OF TRUCKS from Fifth Ave., New York city, between 25th and 59th Sts., has been reported upon by the Street Committee of the Board of Aldermen, and favored only in a minority report. The majority reported that few people came before the committee desiring the restriction, while many protested against it. The minority denied that there was any purpose of turning the street over to a privileged class; and argued that the restriction would simply convert this avenue into a pleasure thoroughfare for the whole community. When this street is paved with asphalt, as proposed, some restriction will become a necessity to preserve the street from the almost exclusive use of heavy vehicles which will seek it because of easier traction. Other parallel avenues exist which could be used by heavy teams, and it seems that all interests should be united in thus preserving the only handsome approach to Central Park. Both reports have been laid over and ordered printed.

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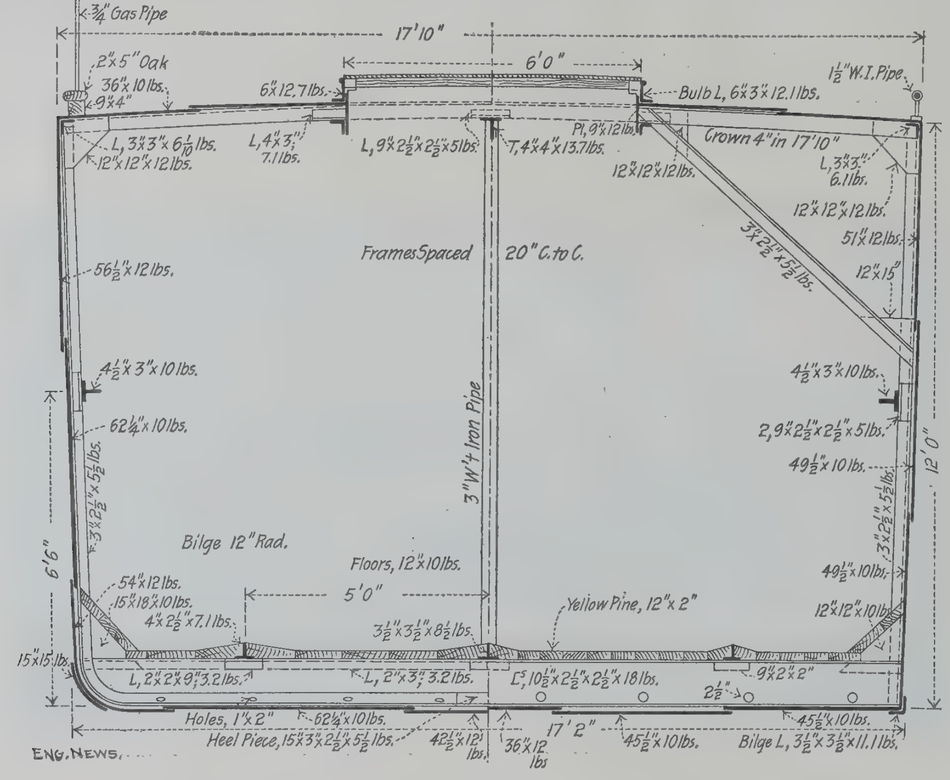
A MUNICIPAL ELECTRIC LIGHTING PLANT FOR Philadelphia is to be reported on by Mr. Jos. J. de Kinder, M. Am. Soc. M. E., Mr. M. Richards Muckle, Jr., and a third person to be selected by these two. The city owns a large gas plant.

STEEL CANAL BOATS.[*]

By Lewis Nixon, M. Soc. N. A. & M. E.

The appearance of the first fleet of steel canal boats on the Erie Canal was due to an investigation by the Cleveland Chamber of Commerce, which revealed the fact that the poor showing by the manufacturers of that city in the East was due to their inability to compete in Eastern markets on account of the heavy freight charges. It was found that the reason Buffalo had better freight rates was due to the competition of the Erie Canal from that city to New York. Mr. Charles E. Wheeler, the Secretary of the Chamber of Commerce, suggested the building of a fleet of steel boats to take freight through without transfer, from Cleveland to New York. Great prejudice was found along the canal against such a project, as it was claimed that the rocky bottom would seriously injure the steel vessels, and that no canal boat could weather the storms of Lake Erie. The first fleet, constructed in 1895, set at rest all doubts as to the fitness of steel boats for the service. This fleet consisted of a steamer and five consorts, all being 98 ft. long, 17 ft. 10 ins. wide, and 10 ft. deep. The steamer is driven by a fore and aft compound engine of 120 HP., and carries 125 tons of freight, while the consorts carry 230 tons each. The first trip was made in August, 1895, with a cargo of rails for the New York street railways. A rock was struck shortly after leaving Buffalo, by which the vessels were lifted from 6 ins. to a foot out of water; but it was found, after careful inspection in dock, that no injury whatever was done the vessels, the greatest dent being about ¼-in. deep. On the first return trip a cargo of sugar was carried, consigned to houses in Cleveland and other cities, one railway leaving Cleveland being given a solid train of 36 cars of sugar. During this trip a very severe storm was encountered on Lake Erie, and, although the vessels were tossed about like corks and were often lost sight of from the steamer in the hollow of the waves, less than $100 worth of damage resulted to the cargo of $75,000 worth of sugar; and this was caused by improper loading.



Half Section of Steamer. Half Section of Barge.

MIDSHIP SECTION OF STEEL CANAL BOAT, 100 FT. LONG.

In January, 1896, a further addition to this steel fleet was contracted for, consisting of three steamers and ten consorts. They were the same breadth and length as the first ones, but were made 2 ft. deeper with a view to utilizing the increased depth of 2 ft. of water in the canal. The steamers were given engines with cylinders 12 and 24 ins., by 16 ins. stroke, and Roberts tubular boilers. These engines develop about 275 HP. The consorts were built with square bilges, as shown on the midship sections. Open-hearth steel was used in the construction, of a tensile strength of 60,000 lbs., and an elongation in 8 ins. of 20%.

The consorts have frames 3 ins. by 2½ ins., of 5½ lbs. per ft., spaced 20 ins. apart. Forward, the frames, floors, and beams are canted, and alternate frames for 18 ft. on each side of the stern are built as web frames. A heavy breast hook is worked across the stem. The floors are made of channels 10½ ins. deep, weighing 18 lbs. per ft. Keelsons and longitudinals are formed by heavy "T" bars. The main hatch is 30 ft. long. This hatch is framed with a 6-in. bulb angle, forming a girder in connection with a 9-in. plate, and this girder is braced to the frames by 3½ × 2½-in. × 5½-lb. angle struts. Wooden hatch covers are fitted and a tarpaulin cover is secured over this by means of iron clamps, wedges and battens worked on the coaming.

The steamers are built with rounded bilges, but with about the same general construction as the barges.

The vessels are now run in fleets of one steamer and three consorts, carrying in all about 1,000 tons. Four fleets are to be kept constantly en route, with three consorts in New York loading for the return trip, thus keeping the steamers always on the go. A reduction of expense of about 40% is effected by the use of steam as compared with horse towing. The greatly increased fleet ordered after the first season's experience is an evidence of the commercial success of the venture. It is safe to say that this system of water transportation will reduce freight rates at least 25% over rail rates. A fleet makes about five miles an hour in Lake Erie, and from 3½ to 4 miles on the canal. The trip is made from Cleveland to New York in about ten days.

The importance of this growing fleet of steel canal boats arises not so much from the use of metal in their construction as from the attention which their success as freight carriers has directed towards the possibilities of the Erie Canal, and the results in the way of water transportation throughout the United States which are sure to follow.

While the debt which the interior of our country owes to the railways is beyond calculation, the cost of carrying products by rail over such distances eliminates all chances of profit at the farm. The expensive equipment and great first cost of railways means that the freight charges must be regulated by the necessity for paying the interest on the bonds issued for such constructions. Expansion of capitalization, and, worst of all, excessive competition, followed by consequent combination, bring about a rate destructive of profit to the producer. Piled upon this are the transfer tribute demanded at Buffalo, and the excessive lighterage charges in New York. Of the $20 paid for bringing a car-load from Buffalo to New York, as much as $18 of it has been paid for lighterage by the railroad. Canal traffic does away with lighterage; the freight arrives already lightered. The railroads discriminate against package freight, so that the millers of the Northwest pay about three times as much per mile for transporting flour as is charged for sending wheat to the mills of England, Holland and France, where it is ground to compete on the spot with American-made flour, with the result that our millers must fail in their effort to make flour for export profitable.

An all-water route with no fixed charges, and using the cheapest form of equipment against five lines whose aggregate interest-bearing cost is not less than half a million of dollars a mile, possesses advantages not necessary to explain.

The movement of food products from Buffalo to New York by rail, and the subsequent shipment to New England and Europe, is one that if followed on the same lines much longer will prove disastrous to New York city, and reduce this great city to a second-class port. New York, unlike Philadelphia, Boston, Baltimore, Norfolk and Newport News, cannot hold out the inducements of free storage, immediate access to ship's side, and minimum port charges. The present conditions of freight handling are the worst that could be devised, even if plotted by an enemy. Nine-tenths of the freight is received on the New Jersey shore, where there are no accommodations for storage or shipment; for, as a terminal point, it is so overtaxed that vexatious delays, blockades of rolling-stock, and congestion of traffic, that flour cars that would form a train thirty miles long remained outside Jersey City last winter for months, awaiting a chance to unload. Brooklyn, where the greater part of this vast bulk of freight must be stored, because storage cannot be afforded in New York, cannot be used as a shipping point by railroads; so that the final shipment must be made from New York. The three great elements of a perfect port, viz:—provisions for receipt, storage, and shipment, are, for the railroads, provided respectively on the Jersey shore, in Brooklyn, and in New York, all separated by water. In each case the transfer must be made by lighters, with consequent inconvenience, delay and cost; and when sent to New England, we have the cars carried on floats eleven miles around the Battery and up the Harlem. In times of great cold, fogs, and winds, such service is brought to a standstill, and even at its best it is costly, slow and dangerous.

What is needed at present is a pier on North River for export; for storage, for accumulation; for New England, space must be given on the Harlem River; and for local distribution, wharves are needed on the East River, near the Battery. The export trade can be taken care of in the most excellent basin extending from 52d St. to 54th St.

During the open season of the canal, there will be a direct connection with New England by means of the New Haven system, from canal boats landing at Fishkill Landing, so effecting an enormous saving over the present cost of delivering food products to that section. As the economic possibilities of New York as a shipping port are developed, there are sure to be great warehouses built along the shores of Staten Island, fed by canals in summer and railroads during the winter.

For storing the great quantities of flour for New England's winter consumption, there is a canal basin just below Spuyten Duyvil, near the entrance to the new Harlem canal, where food products may be stored, and shipped via the Sound or by rail from the freight terminal of the New Haven R. R. at Mott Haven, close to the basin.

The local traffic of New York and Brooklyn is at present cared for at piers 2, 3 and 4, in the East River near the Battery. It is to be hoped that the charter for the Greater New York will be drawn to provide, not only for present needs, but for a proper development of the facilities that will, if properly utilized, check the decline of commerce, cheapen the food supply of the people of New York, and make it the gateway through which must pass the food products of New England and Europe. Without some such aid, the New England factories, located on a non-productive soil, cannot hope to continue in competition with western manufacturing towns situated in the midst of food-producing regions.

Already events are shaping themselves in the direction of a more perfect use of water transportation. The people of New York by a direct vote have decided to expend $9,000,000 during the next two years in deepening the entire channel to a depth of 9 ft., and enlarging the locks, thus increasing the freight carrying capacity by at least 25%, with no increase in the cost of transportation. It is confidently expected that when this is done, freight can be carried at the rate of one mill per ton per mile. Railroads paralleling this canal cannot carry freight for an average cost of less than five times this sum,[*] for, even more striking than the contrast between the vast capital needed to compass a great freight movement by rail, where roadbed and equipment are most expensive, and the small amount needed by canal, where roadbed is free and equipment cheap, is the difference in cost of carriage between the two systems.

Taking a fleet on the deepened canal, of five consorts and one steamer, carrying 68,000 bushels of wheat, we find that to carry this wheat by rail will require two trains of 68 cars and two locomotives. When the freight arrives at the harbor of New York on the cars it must be lifted into a costly railroad elevator, then put into a lighter, towed alongside of a ship, and again elevated; or if it is to be stored it must be taken to Brooklyn, all the other transfers being required subsequently. The canal-boat freight can be carried direct to the vessel's side and elevated.

The use of barges of great proportionate freight-carrying capacity, drawn by powerful tugs or by vessels similar to the barges (but with freight capacity reduced enough to carry machinery), has been shown to be a commercial success, not only on the canal, but by large handlers of coal and oil at sea; and while such a change in the handling of freight by affording safe, sure, and regular de-

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[*] Condensed from a paper read before the Fourth General Meeting of the Society of Naval Architects and Marine Engineers.

[*] Railways are now handling such bulk freights as are carried on canals at a cost of only two or three mills per ton per mile, where the volume of traffic is large and full train loads can be hauled long distances.—Ed. Eng. News.

..veries will strike a blow at our coasting schooner fleet, it cannot help but materially reduce the cost of transfer by water; while all forms of water carriage will assist in regulating freight rates on land.

The last report of the State Engineer of New York, Mr. Campbell W. Adams, gives a description of the Cleveland steel canal boats, in which we find the following information in addition to that given by Mr. Nixon:

> The cost of this fleet will approximate $15,000 for the propeller and $6,000 for each consort. The best time made by the boats was 13 days from New York to Cleveland, they being loaded to 6 ft. draft. The best time from Cleveland to Buffalo was 30 hours in good weather, a loss of 4 hours of this time was due to a jam of boats at Tonawanda. * * * Their entire ability to weather any storm on the lakes has been proved to the entire satisfaction of the company.

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NOVEL ARRANGEMENT OF A TRAVELING CABLEWAY

The accompanying cuts represent a cableway with a novel design of tower, which has been built by the Lidgerwood Mfg. Co., of New York city for the use of James Flanagan & Co., contractors, in unloading earth from scows at the foot of West 79th St., New York city. The earth had to be taken to a distance of about 500 ft. from the scows, up steep banks and over a railway, the general location being shown in Fig. 1. Teams were used at first, but were abandoned on account of the difficulty of hauling up the heavy grades. The cableway was finally adopted, and it is admirably adapted for the work, being located overhead and out of the way of the railway traffic, which is very considerable at this point.

The overhanging tower at the river terminus, which is shown in Fig. 2, enables the carrying bucket to be dropped directly into the scow and loaded, making the operation rapid and direct. The empty buckets are filled while the loaded one is in transit. The plant handles daily a scow load of about 400 cu. yds. The buckets used are of 1 cu. yd. capacity. The main cable is 1½ ins. diameter, for a load of 1½ tons. The hoisting engine is of the Lidgerwood design, with cylinders 9 × 10 ins,. and double drums of large diameter. The engineman controls the entire operation of hoisting and delivering.

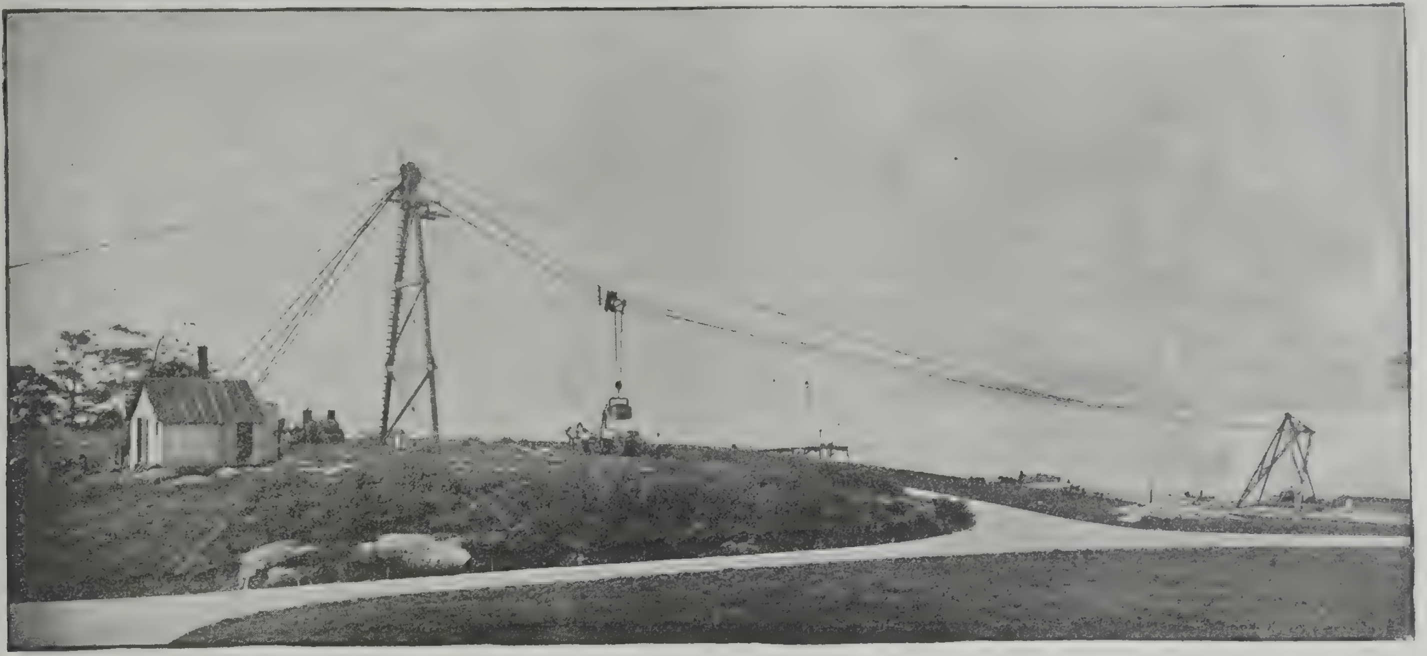

FIG. 1.—CABLEWAY FOR CARRYING EARTH AT WEST SEVENTY-NINTH ST., NEW YORK CITY.

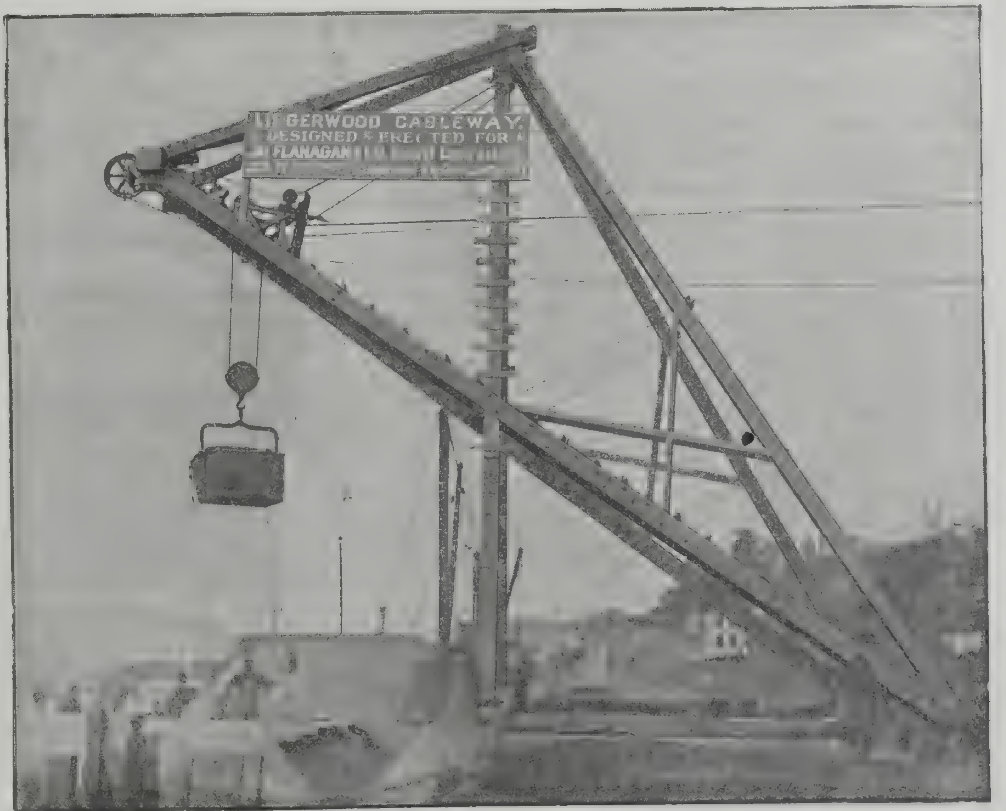

FIG. 2.—OVERHANGING TOWER OF CABLEWAY AT SEVENTY-NINTH ST., NEW YORK CITY.

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THE LONGEST CONTINUOUS RAILWAY RUN IN THE WORLD.*

Ever since the middle of July the Great Western Ry. has daily made the longest run without stop ever yet regularly performed day by day by any railway in the world. The 10.25 a. m. train from Paddington station (London), which is the westbound Cornwall express, has run every week-day without a stop to Exeter, a distance of 194 miles. I do not assert that this run is the longest ever made, for I have not forgotten either the experimental run of 299¼ miles made by the London & Northwestern Ry. last year, or the occasional trips of the "American special" on the same line between London (Euston) and Liverpool (Riverside station) without a halt. But no such run as this of the Great Western Ry. has ever been made in ordinary daily practice, the nearest approach to it being that of the London & Northwestern from London to Crewe (158 miles), which is 36 miles shorter. In railway working, however, as in other mundane affairs, promise and performance are not always identical things, and it becomes interesting to see how the remarkable promise of the Great Western Ry. special time-table is fulfilled in actual working. The timing of this 10.25 a. m. Great Western down express is as follows:

Miles	............Paddington	depart 10.25
194	............Exeter	arrive 2.10

This represents an average speed from start to stop of 51.7 miles an hour. That, although a good rate of speed, may at first sight seem mild after the averages of some of the Northern lines; but several qualifying circumstances have to be taken into account, and when allowance is made for these drawbacks, it will be seen that the work demanded from Mr. Dean's fine engines is of a very high class.** That the down road for the first 117 miles or so is one of the easiest in the world may be readily admitted. But the passing of Bristol without entering the station has its serious disadvantage in point of road. It involves a diversion by way of the loop line, several chains longer, with a series of sharp curves which cannot properly be passed over (and, as a matter of fact, are not passed over) at a higher velocity than ten miles an hour; and the mile of the loop line by which the Bristol station is avoided occupies over three minutes in passage. Thus, nothing is gained by the train through passing by Bristol, except the escape from imminent risk of detentions through "blockings" by signal. The Bristol & Exeter Division is, as a rule, constructed on easy gradients, but the Wellington grade would be deemed severe even on the mountainous lines of the North, culminating—after several miles of 1 in 163, 1 in 132, and 1 in 103, started at slow speed, slackening through Taunton—in a mile and a quarter at 1 in 91, a mile at 1 in 81, and a mile at 1 in 126. So that to haul a train of heavy corridor coaches is by no means an easy task.

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*Extract from an article by Mr. Charles Rous-Marten in the "Engineer," London, England.

**Mr. Wm. Dean is Locomotive Superintendent of the Great Western Ry., and a large number of the engines have been designed by him and built at the company's shops.—Ed. Eng. News.

Every facility of investigation having been most readily and courteously afforded to me by the Great Western Ry. authorities, I traveled by the 10.25 a. m. train from Paddington to Exeter on Sept. 7. The weather was favorable throughout, without side wind, and the rails were in good order. The train consisted of six bogie clerestoried corridor coaches (i. e., monitor roof cars, mounted on trucks—Ed.) weighing in all approximately 140 tons behind the tender. The engine was No. 3001, "Amazon," one of Mr. Dean's splendid express engines with a single pair of driving wheels 7 ft. 8 ins. diameter, rebuilt with a leading four-wheeled bogie, and with cylinders 19 × 24 ins. in lieu of 20 × 24 ins.; steam pressure, 160 lbs.; heating surface, 1,561 sq. ft.

Starting from Paddington station (London) within a few seconds of schedule time, the running, while slightly faster than usual, was singularly even and steady. The driver managed his engine admirably, keeping a minute or two always in hand, and quickly making up each loss by signal check without attaining any speed which the most timid passenger or ignorant alarmist could have deemed "excessive." We passed Chippenham (94 miles) in 98 min. 50 sec.

This manifestly was excellent and particularly even running. A signal check at Bathampton, due to a slow train having been allowed to get in the way of the express, caused a loss of a couple of minutes, but milepost 105¼ was passed in 112 min. 53 sec. from London, without allowing for the 2 mins. lost by the check. I mention this distance, as comparison with the work done on two runs of identical length on other lines may be of interest. Bath station was passed at the reduced speed of barely ten miles an hour, the slackening being protracted for a considerable distance before full speed was resumed. The actual time from London to Bath was 115 min. 47 sec., equivalent to 113¾ mins. net. At Salford another vexatious signal check was encountered, and for the third time our speed was lowered to ten miles an hour, or less, involving a further loss of at least 2 mins. We were abreast of Bristol station in 2 h. 10 min. from London, equal to a run of 126 mins. net, allowing for the time lost by signal checks, but not allowing anything for the "service" slack through Bath. It will show how very cautiously the curves of the diversion loop were negotiated when I mention that the distance of 1,980 ft. from Pylle Hill Junction to Bedminster station occupied 1¾ mins.

With the resumption of our main line running, speed was rapidly regained, and rose to a high point down the short descent of 1 in 200 approaching Yatton; maintaining a rapid pace, the 161¼ mile-post was passed in exactly three hours from Paddington. Here, however, a permanent way relaying slack brought down our average, but Taunton was passed in 3 h. 2 min. 41 sec. from the start. Then began the ascent of the Wellington bank—that terror of the broad-gage engine in former days. Mr. Dean's fine single-wheeler made very little of the incline. Skilfully handled by her driver, the "Amazon" mounted bravely, and her speed did not fall below 34.6 miles an hour up to the top of the ascent of 1 in 81, with a load of over 140 tons behind her tender. This was undeniably good work. Once through the Whiteball tunnel and over the summit, the speed quickly rose, and the distance of just 20 miles from the tunnel to the stop at Exeter was run in exactly 19 minutes, notwithstanding another signal check near Stoke Canon.

The train came to a standstill under the roof of St. David's Station, Exeter, at 2.2 precisely, according to London time, 2.4 according to the local station time, which on comparison with my watches both going and returning I found to be two minutes ahead of the Paddington clock. Thus the great run of 194 miles had been made without a stop (in spite of three bad signal checks, a permanent-way slack, and the protracted slowings round Bristol and through Bath station) in 3 h. 36 min. 43 sec., that is to say, in 216 min. 43 sec. (53.76 miles per hour). The engine arrived in perfect trim after being in constant motion for over 3½ hours, with all bearings cool, and everything quite fit for another long run had this been required. Water was picked up twice while running.

As for the traveling throughout, nothing could possibly have been steadier, smoother, or easier than the running of the splendid bogie coaches which formed the train. At the highest velocities or round the sharpest curves their steadiness was all that could have been desired by the most exacting traveller. In all respects it fully equalled the running of the newest twelve-wheelers employed in the Scottish traffic, and assuredly no higher praise than this could be awarded.

My return journey was made by the second part of the up Cornish express. It had been detained at wayside stations for luggage, notably 20 mins. at Truro, where room had to be found for no fewer than 27 bicycles, when the vans were already crammed. Consequently we started from Exeter 34 mins. late. The load consisted of nine corridor bogie cars and a six-wheel car, representing a total weight behind tender of about 515,200 lbs. Two of Mr. Dean's large 7 ft. 8 in. singles, Nos. 3047 ("Lorna Doone") and 3050 ("Royal Sovereign") took the train to Bristol—75½ miles—without a stop in 85 mins., or 3 mins. under time; the 44¾ miles from Taunton, after passing that station at reduced speed, being done in 48 mins. to the stop at Bristol. A very even rate of speed was generally maintained, and the traveling was as smooth and easy as on the down journey. At Bristol the six-wheel car and two bogie cars were taken off, bringing down the load to approximately 369,600 lbs., taken by another 7 ft. 8 in. single-wheeler, No. 3007 ("Dragon"). In spite of two extra stops (at Swindon and Westbourne Park), occupying in all 4¼ mins., a very bad signal check at Box, and a slack for bridge repairs near Reading, the run from Bristol to Paddington was made in 2 h. 13¾ min. traveling time. The loss by signal delays amounted to fully 9 mins. It is noteworthy that the speed never fell below 56 miles an hour up the Wootton Bassett bank of 1%.

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SPEED TRIALS OF A SCREW-PROPELLED FERRYBOAT.*

By Mr. F. L. Du Bosque, M. Am. Soc. M. E.†

The performance of the screw-propelled ferryboats now in service has been so satisfactory that, in providing the equipment for a new ferry from its terminal at Jersey City to 23d St., New York, the Pennsylvania R. R. Co. decided, from the experience they had gained with the screw boats it now operates, to adopt the same method of propulsion for the new ones. The service will require more speedy boats—in fact, as fast as can be consistently operated in a harbor as crowded as the lower North River—and a speed equal to 15 statute miles per hour was decided upon as satisfactory, considering all conditions. To determine the power required to propel such a type of ferryboat at this speed, progressive speed trials were made with the screw-propelled ferryboat "Cincinnati"; incidentally, data were taken to determine the efficiency of this system of propulsion.

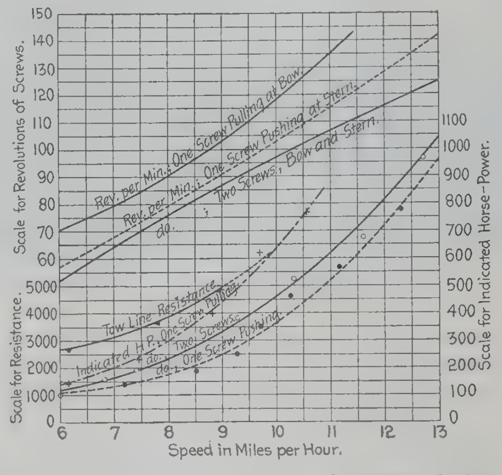

Fig. 1.—Diagram Showing Tow-Line Resistance, Indicated Horse-Power, and Revolutions of Screws at Different Speeds of the Ferryboat "Cincinnati," Pennsylvania R.R.

The trials were made as follows:

A distance of 5,600 ft. was laid off on the New York shore of the North River, extending from 94th St. to 115th St., and range poles were erected at the terminals, perpendicular to the direction of the course. At this particular part of the river there is a depth of seven fathoms, and the course is so located that projecting points of land beyond the course act as range marks, so that a boat can be steered back and forth, at uniformly the same distance from the shore, through the same strength of current, and in a straight line.

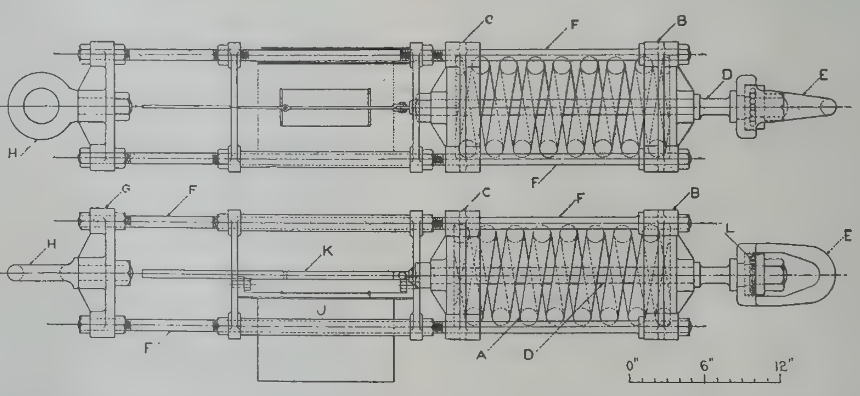

FIG. 2.—DYNAMOMETER USED IN SPEED TRIALS OF P. R. R. FERRYBOAT "CINCINNATI."

Runs were made on this course, with and against the tide, at speeds varying from 6 to 13 statute miles per hour; one series with the two screws in operation, one at the bow and one at the stern; one series with the bow screw removed and stern screw "pushing," and one series with the stern screw removed and the bow screw "pulling."

The speed of the boat was held uniform by governing the speed of the screws—in other words, by running the engines at a constant rate of revolutions per minute—and four runs, two with and two against the tide, were made at each predetermined speed of screw; the time of entering and leaving the course was noted with a stop-watch, and the final mean of the four observations taken as the mean speed; two sets of indicator diagrams were taken from the engine cylinders while on the course, the indicated horse-power calculated, and the mean of the several runs accepted as the indicated horse-power for the observed mean speed. The results of the observations have been plotted on the accompanying diagram, and curves drawn to pass as nearly as possible through the observed speed and power. This curve shows facts which are summarized in Table I.

TABLE I.—Efficiency of Various Arrangements of Screw Propulsion at Various Speeds.

Speed. Statute miles per hour.	1 Screw Pushing. I. HP.	Revs. per min.	Slip. %.	2 Screws. I. HP.	Revs. per min.	Slip. %.	1 Screw Pulling. I. HP.	Revs. per min.	Slip. %.
9	250	91	19.5	332	87	20	443	103	35.5
10	364	103	24.5	464	97	20.5	638	118	36
11	520	115	27.5	624	107	19	880	135	35
12	720	128	28	816	116	18.5			

The I. HP. given is that developed by the main engines only, and does not include the air, circulating or feed pumps.

To determine the efficiency of the system, the screws were removed and the boat towed over the measured course, twice with and twice against the tide at three different speeds, and the tow-line strain measured by a dynamometer.

The resistance observed is plotted on the accompanying diagram, Plate I, and the curve produced shows results which are given in Table II.

TABLE II.—Resistance and Work of Screws at Various Speeds.

Speed in miles per hour.	Resistance, both screws removed. Pounds.	Indicated Thrust. One screw pushing. Pounds.	Two screws. Pounds.	One screw pulling. Pounds.
8	3,880	6,700	9,050	9,380
9	4,950	8,200	11,350	12,100
10	6,400	10,250	14,120	15,440

It will be noticed that the proportion of the power put into the engine which is utilized in overcoming the actual resistance of the boat at 9 miles per hour is 43%, when two screws are in use; 60% when one screw is pushing, and 40% when one screw is pulling.

The usual speed of this boat in ferry service is 11 miles per hour, and at this speed it requires 20% more power to propel the boat with two screws than with one screw pushing, and 69% more power to propel the boat with the screw at the bow than at the stern. If the same power could be put into one screw at the stern as is used by the two screws, the speed would be increased from 11 miles to 11.53 miles per hour. It is clear, therefore, that the bow screw is inefficient. When under way, it thrusts a column of water against the bow of the boat at a velocity equal to the slip ratio of the screw, and considerable power is absorbed through friction of the blade surface; but a ferryboat's bow becomes its stern at each succeeding trip, and it is therefore impossible to dispense with the forward screw.

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*A paper read at the fourth general meeting of the Society of Naval Architects and Marine Engineers, New York, Nov. 12, 1896. An illustrated description of the ferryboat "Cincinnati," on which the trials described in this paper were made, was published in Engineering News of Nov. 7, 1891.

†Engineer of Floating Equipment, Pennsylvania R. R. Co., Jersey City, N. J.

The screw at the bow, however, is useful, for one of the most desirable features in a ferryboat is the ability to start and stop promptly. Of the seven minutes required to go from landing to landing, two minutes are consumed in getting under way and stopping. Superiority in this respect is one of the reasons why a screw boat is preferable to a side wheeler. A half minute is more easily gained in maneuvering by using screws than by increasing the speed of the boat when under way, and it is in stopping and backing that the forward screw shows its usefulness; it is able to thrust a column of water directly ahead that will not impinge against the boat. Several means have been suggested to overcome the loss due to the use of this forward screw when underway, the most fascinating of which seems to be to so design the screw that it will have very little backing power. If this could be done, the propelling effect of the forward screw would be small, and the power required to turn it would probably be only that due to the surface friction of the blades.

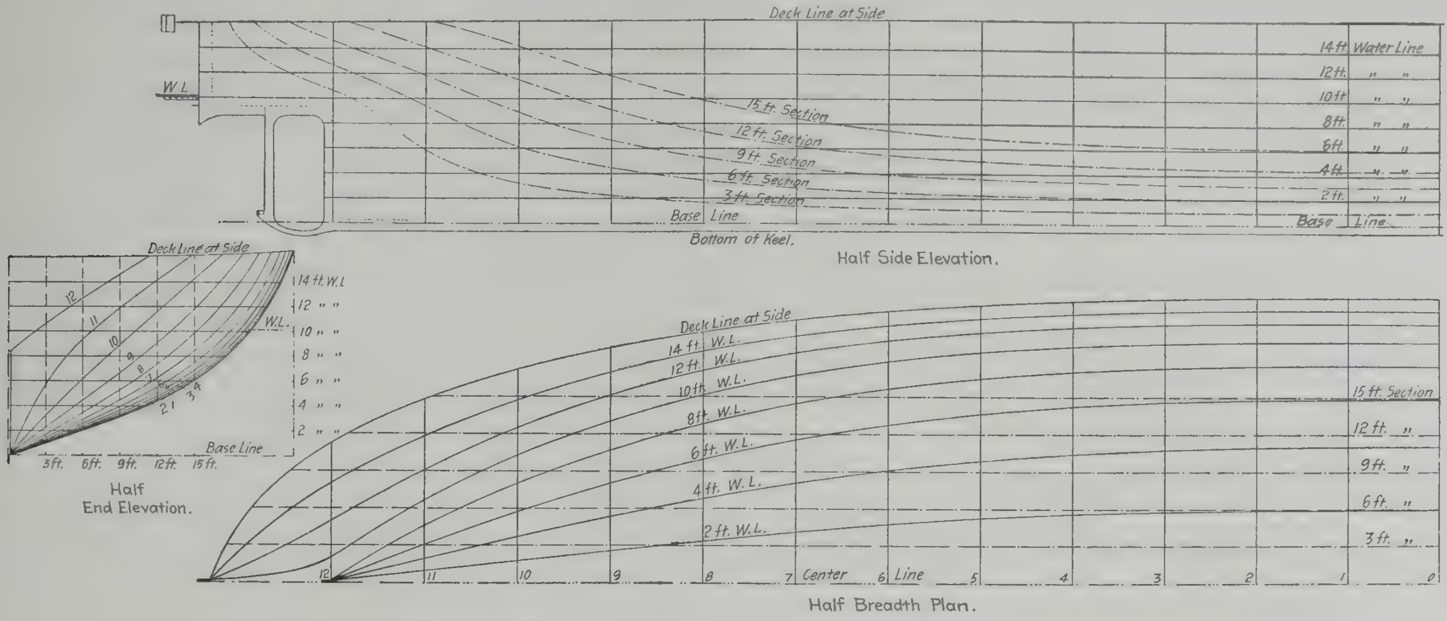

FIG. 3.—LINES OF HULL OF P. R. R. FERRYBOAT "CINCINNATI."

DIMENSIONS.

	ft.		ins.
Length on keel	180	0	
" " water line	200	0	
" over all	206	0	
Breadth at water line	39	2½	
" " deck	46	0	
" " over all	65	0	
Depth deck amidship at side to base line	18	6	
" water line to base line	10	1½	
" of keel		5	
Draft, extreme	11	2½	

Displacement	953 tons
Coefficient of fineness block	46.66
" " water lines	75.50
" " immersed midship section	61.54
Area immersed midship section	244.14 sq. ft.
Wetted surface	7469.40 "

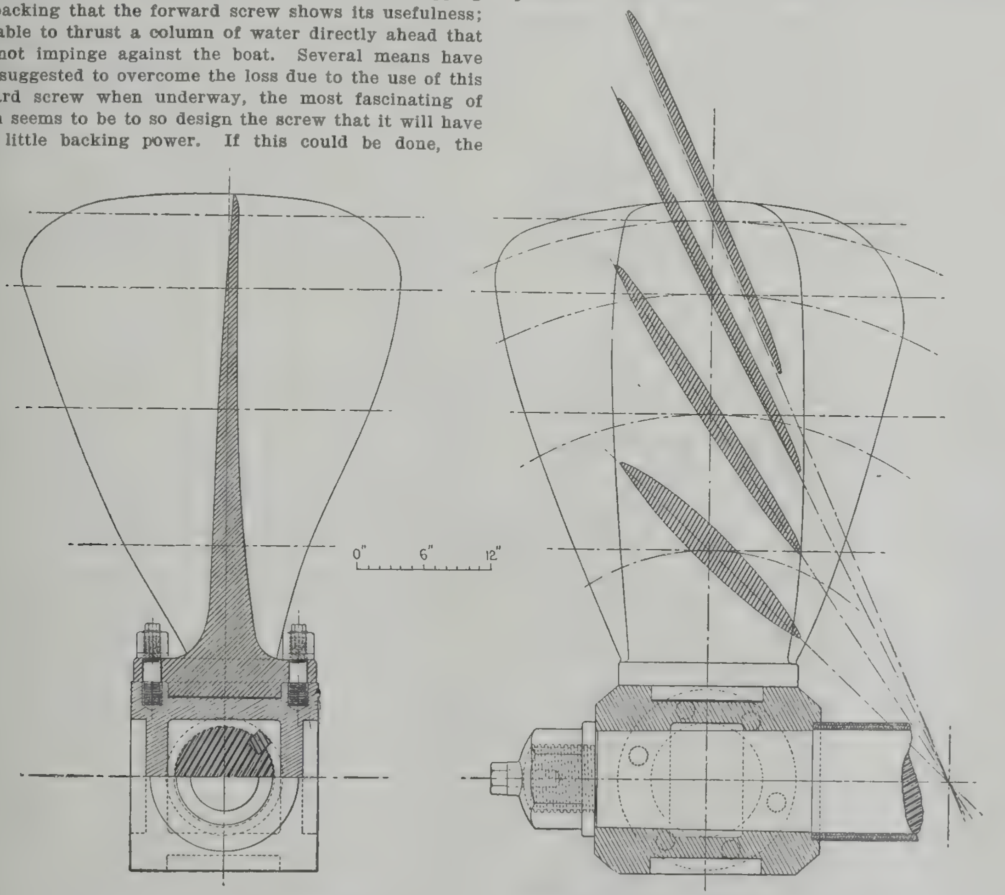

FIG. 4.—PROPELLER OF P. R. R. FERRYBOAT "CINCINNATI."

(Material, Cast-Steel; Diameter, 8 ft. 6 ins., Pitch, 11.3883 ft.; Disk Area, 113.49 sq. ft.; Developed Area, 32.26 sq. ft.; Projected Area, 26.57 sq. ft.)

The screw-propelled ferryboat is a type now so well known that it seems unnecessary to describe it, and to the few interested in the subject sufficient information is given in the accompanying plates to analyze the distribution of the power required. The service required from a ferryboat is so peculiar that the form of the hull, and the means of propelling it, are necessarily different from the usual type of boat. The propeller shaft is continuous from end to end, and to sufficiently submerge the screws the engines must be low; this requires a greater draft than a side-wheel propelled boat. On account of the height and weight of the superstructure for the accommodation of passengers and teams, the breadth on the water-line must be great, not to prevent capsizing, but because the greater number of the passengers carried are unused to the sea and become alarmed at a slight angle of heel, which is exaggerated by the great breadth of the decks. The metacentric height of the "Cincinnati" is 9 ft., and is not thought to be too great. The breadth of the water-lines is carried well to the ends to give longitudinal stability, so that the ends will not be depressed by the weight which gathers there in loading and unloading the boat. These conditions, it will be seen, impose extreme proportions; the amidship section is "V" shaped and the volume of the hull is but 46% of a circumscribed parallelepiped; though admitting of very fine water-lines and section-lines the ratio of wetted surface to displacement is much larger than usual.

The forms of hull and propeller of the ferryboat experimented upon are shown in Figs. 3 and 4, respectively.

The screw-propelled boat will eventually supplant the side-wheeled boat for ferry service, where certainty in the operation of the ferry is necessary, and where the comfort of the passengers is considered. As before stated, the boats are more quickly maneuvered at the landings, and in the winter they proceed through the ice without interruption, when the side-wheeled boats are very much delayed. A comparison of the power required to propel either type of boat shows results in favor of the side wheel. The "Cincinnati" and "Chicago" are operated on the same ferry, and their speeds are about the same.

	Propellers.	I. HP.	Displacement.	Speed.
"Cincinnati"	Screws.	624	952 tons.	11 miles.
"Chicago"	Side wheels.	530	775 "	11 "

If the power required to drive these boats varies as $\sqrt[3]{\text{displacement}^2}$, and the boats were brought to the same displacement, this would be the result:

	I. HP.	Displacement.	Speed.
"Cincinnati"	624	952 tons.	11 miles.
"Chicago"	608	952 "	11

The I. HP. of the "Chicago" includes the jet condenser.

It can, no doubt, be safely said, therefore, that the side wheel is a more economical propeller for a ferryboat than the two-screw arrangement, but it must not be forgotten that the advantages gained by the use of the screw are more valuable for the successful operation of a ferry than the amount saved in power.

Dynamometer.

So much depends upon the accuracy of the dynamometer in making resistance trials, and such good results were had from the one used in these trials, that a plan of it is shown on Fig. 2. A steel spring, A, is fitted between two caps, B and C, and a rod D, rigidly connected with the cap C, passes through the spring and the cap B, and is fastened to the tow line by the eye E.

The cap B is rigidly connected with the four rods at F, F, which passes freely through the cap C, and are rigidly connected with the casting G. This casting is fastened to the boat by means of the eye H. At J is a drum revolved by clock mechanism, and K is a guided rod, carrying a pencil, and connected with the main rod D.

The device was mounted on the boat in such a way that it was entirely clear of the deck, and was free to swing in any direction, and to follow the "lead" of the tow line, but it was not permitted to rotate; therefore, to overcome any twisting strains that would cause friction in the device, a roller bearing was fitted at L, so that the eye E could revolve freely and allow for the twisting of the tow line.

When the spring is compressed by a strain applied by the tow line through the eye E, the amount of the compression is recorded, by a pencil carried in the bar K, on a sheet of paper carried on the drum J; and as this drum revolves, the amount of the compression at any period of the run is recorded.

To determine the strain corresponding to various compressions, the complete device was calibrated by suspending weights from it and noting the amount of the compression. To determine the amount of friction, if any, the spring was taken from the device and tested between clamps in a reliable testing machine. No appreciable difference was found in the calibration by the two methods, so that is is safe to assume that the dynamometer measured the actual tow-line strains. The tow line was 360 ft. long, and it is hardly possible that the propellers of the towing boat affected the boat towed.

A WATER-WORKS PLANT FOR A VILLAGE OF 300 INHABITANTS.

A novel scheme for raising money for a water-works has been successfully carried out at Deansboro, N. Y. The population of the village was only 300, and no fire protection was available. A committee was appointed to appraise all buildings and their contents, after which fire protection was offered on all dwellings and out buildings in return for stock subscription to the amount of 2% of their appraised value; the rates for other buildings were as follows: Churches, schools and other public buildings, 2½%; stores and all buildings not included in the above classification, 3%. The owners of nearly all the buildings took stock and the works are expected to be in operation by Dec. 1.

The supply is developed from water-bearing gravel, water being collected by tile drains and brought into a central basin. From this basin the water is conveyed to the village, the main passing around the reservoir, and only the surplus above consumption going into the reservoir. This plan was adopted in order to prevent the possibility of the stored water being drawn off by excessive domestic consumption and leaving the village without fire protection.

The reservoir is excavated in red clay, and riprapped on its inner slopes. Its dimensions are 44 × 95 ft. at the top and 22 × 72 ft. at the bottom, the slope being 1 to 1. The water line is 8½ to 9 ft. above the bottom.

About 1¾ miles of mains have been laid, 13 hydrants set, and some 40 domestic services have been put in, or are expected. The pressure on the mains is given as 60 lbs. The company has an authorized capital stock of $4,000, but the cost of construction is not stated. We are indebted to Mr. Geo. I. Honey, secretary of the water company, for the above information.

Fire protection, as stated above, is furnished free to all stockholders. The rates to stockholders for a domestic supply are as follows: Family use, $5 per year; lawn sprinkling, $3; barns, $2.50. The rates to outsiders have not been fixed.

A MOTOR CARRIAGE RACE from London to Brighton, 52 miles, took place on Nov. 14, about 50 carriages starting. An American carriage, built by the Duryea Motor Carriage Co., won the race, making the run in about four hours.

VOTING MACHINES were used in several districts in the State of New York during the recent election. In most cases they gave complete satisfaction, but in some places they were found defective. In one district in Rochester the machine failed to register the votes of about 200 men, and the city council by a vote of 13 to 6 decided that the machines were not satisfactory and refused to pay for them.

A MONOLITHIC CONCRETE BRIDGE has been built at Detroit, Mich., to carry the Michigan Central R. R. across the new Boulevard. The arch is 50 ft. span and 13 ft. 6 ins. high at the center, and carries eight railway tracks. the bridge is of concrete and iron construction, having curved iron beams imbedded in the arch concrete, and the structure is faced with Berea sandstone. The bridge was designed by Mr. W. H. Ashwell, engineer of the Park and Boulevard Commission, and the contractor was Mr. T. J. Kennedy. The cost was about $30,000.

AN UNDERGROUND RAILWAY on Atlantic Ave., Brooklyn, N. Y., has been proposed by Mr. F. E. Storm, civil engineer, of that city, and the plans have been submitted to the Atlantic Avenue Commission. The work is to be all constructed in open cut, but the part from South Ferry to Fort Greene Place would be roofed over. From Fort Greene Place to the city line an open depressed track is provided for, bridged at each cross street and fenced in along the openings. The construction is to be of ironwork and concrete filling. The cost would be $2,433,525, divided as follows: From South Ferry to Fort Greene Place, 7,400 ft., at $65.30 per ft., $483,220; from Fort Greene Place to the city line, 31,100 ft., at $53.41 per ft., $1,652,654; 20 depressed stations, at $11,676.40 each, $233,528; 54 bridges, at $1,187.28 each, $64,113.12. These figures do not provide for the readjustment of water and sewer pipes, which would have to be done by the city, and which, according to the estimates of the engineers of the City Works Department, would cost from $500,000 to $1,000,000.

THE MILWAUKEE WATER INTAKE TUNNEL SUIT brought against the city by the contractors, Shailer & Schniglau, has been decided in favor of the city. A contract was signed in the summer of 1890 for this work, the price to be $250,000. In October, 1893, the city took the work into its hands and subsequently completed it. The city had paid about $80,000 on the contract and the suit just closed was for damages amounting to $170,000 to make up the difference between this and the contract price. Full details of the suit are not at hand, but such information as we have received indicates that the chief claim of the contractors was that the character of the material to be encountered was misrepresented. The city filed a counter claim for a large sum, partly as damages for delay in the completion of the work but principally for the excess of the expense incurred by the city to complete the work over the contract price. Neither claim was allowed.

THE EAST RIVER TUNNEL PROJECT, of the New York & Brooklyn R. R. Co., has been "turned down" by the Brooklyn Board of Aldermen by declining to take up the matter at this time and indefinitely postponing discussion. But Mr. Frederick B. Esler, representing the tunnel company, says that the company will now resort to its original plan providing for a Brooklyn terminus at the foot of Fulton St. This would be on private property over which the Brooklyn Board of Aldermen has no jurisdiction. The tunnel company has all the necessary authority from the New York Board of Aldermen, and the authority of New York extends to low-water mark on the Brooklyn side of the East River. The purpose of the tunnel is to connect the passenger railway systems of the two cities.

SWITCHING BY ELECTRICITY is now in use at the Brooklyn terminal of the Brooklyn Bridge cable railway. One of the new motor cars is being used instead of the steam switching engine, and all these cars will be tested in this way before being put into train service. They do the work quicker than the steam locomotives.

ELECTRIC POWER FROM NIAGARA FALLS was first utilized in Buffalo, N. Y., on Nov. 15, and the electric railways of that city are now operated partly by the current from the power plant at the Falls, this being, for the present at any rate, supplementary to the 4,000 HP. of the existing power plants of the railways. It is said that only about 1,000 HP. of the Niagara current is thus being utilized.

COMPRESSED AIR MOTORS form the subject of a late letter from Paris to the New York "Evening Post." The Mekarski system, introduced at Nantes, in 1879, includes the storage of air compressed to 25 atmospheres in reservoirs under the motor-car. This air passing through a regulator is reduced to a pressure of 5 atmospheres in the working cylinders, and the loss of energy in this reduction, estimated at 38%, is met by a reheating of the air before it enters the cylinders. The Mekarski system of motors is now used on the line from Nogent to Bry, on the Marne, from the Louvre to St. Cloud and to Versailles; and from St. Augustin to Vincennes. The objections to the system is the dead weight of the motor-car and its reservoirs, amounting to from 4 to 10 tons, and the necessity of going to a central station for re-charging. Otherwise, the system works well and grades of more than 6% are readily overcome. Mr. Popp, of the Compagnie Parisienne d'Air Comprime, now proposes to establish lines of piping carrying compressed air and so arranged as to charge the car reservoirs at short intervals along the route, and he has already laid down 2½ miles of such a line, furnishing air at 10 atmospheres, in Saint-Quentin. He would thus do away with the heavy reservoirs on the motor-car and claims a loss of only 1% in transmitting the compressed air 2½ miles, with a plant costing about the same as for electric traction; both for compressors as offsetting dynamos, and pipes as offsetting overhead wires and their supports. The extreme cost price of the Mekarski system, as originally used, is set down by this correspondent at 7 cts. per kilometer per motor car, or 11.3 cts. per mile, including the compression of the air, repairs, maintenance, interest, sinking fund and profit to factory. This is compared with 17.7 cts. per mile for horse-tramways in Paris. When the motor hauls another 50-passenger car, the supplementary expense is 3.2 cts. per mile. In Belgium, where labor and coal costs half as much as in Paris, the cost goes down to 6.4 cts. per mile for the motor-car.

THE REGULATION OF STREET TRAFFIC, by ordinance, has been attempted in New York city. The ordinance adopted applies to the Boulevard and provides that

> except when going or coming directly from or to their place of departure or destination on said Boulevard, and except when actually passing another vehicle or an obstacle, all trucks, express wagons, vans and business vehicles of all sorts shall keep in single line upon the extreme right of the Western Boulevard at all points between 59th St. and Manhattan St.

It further specifies that all bicycles and passenger vehicles shall use the part of the street not set apart for the above classes of vehicles. The enforcement of this law is already causing grumbling and trouble; but it is a wise and reasonable ordinance and should be applied on many other avenues of heavy traffic.

A PIER ROOF-GARDEN, upon the pier at the foot of East Third Street, New York city, has been ordered by the Board of Dock Commissioners, to meet the request of the Board of Aldermen for the establishment of such gardens for the purpose of providing places of healthful recreation for the people living near these piers. Plans for such a roof-garden have been prepared by Edward H. Kendall, Past President of the Institute of American Architects and consulting engineer to the Dock Board; these plans have been approved, and the preparation of the contract and specifications ordered at the earliest possible date.

THE PRODUCTION OF TIN PLATE in the United States for the fiscal year ending June 30 is reported by the Treasury Department to have been 307,228,621 lbs. The total imports were 385,070,372 lbs. and the exports 137,659,779 lbs., making net imports 247,410,593 lbs. The annual capacity of the mills completed and in process of construction on June 30 is 585,000,000 lbs., or more than the total of domestic production and net imports. Of the production, 98½% was made from sheets rolled in the United States. The report embraces the production of 53 firms making tin plates, and of 36 rolling mills producing black plates.

A HUGE GRANITE BLOCK has been quarried at Barre, Vt., for the Moriarty monument in New Orleans, but there is trouble in finding a railway that can take it, as its size is too great for the smallest bridges on some roads. The stone is 15 ft. square and 3 ft. thick.

THE HANKOW-PEKIN RAILWAY may be built with Chinese capital, says a Pekin dispatch. There is a hitch in the negotiations with the American syndicate which was lately reported as being ready to advance 30,000,000 taels for this purpose, and the Chinese government is now attempting to borrow 20,000,000 taels among native capitalists. This attempt will probably also result in failure.

THE PHILADELPHIA & READING R. R. and its leased lines, mining properties, etc., will probably be operated under the control of the Reading Co., whose capital stock has been increased to $40,000,000. Mr. Joseph S. Harris is president and Mr. Wm. R. Taylor is secretary of the company.

ACETYLENE GAS GENERATORS are now used to furnish light for magic lantern purposes. Calcium carbide is placed in the generator, and water admitted at the bottom through a stop-cock. As the water rises and comes in contact with the carbide, the acetylene is generated and escapes into a receiver and thence to the burners. When more gas is generated than is used the increasing pressure depresses the water level, and almost stops the generation of gas. The gas is burned in the lantern in four 1-ft. burners, each giving a perfectly white light of 125 c. p. It is claimed that the convenience of the apparatus will cause acetylene to entirely supplant the oxy-hydrogen light commonly used for magic lanterns.

THE VALIDITY OF THE BERLINER TELEPHONE patent is now being tried in the Supreme Court of the United States, argument having been begun on Nov. 9. Upon its decision will depend whether the Bell Telephone Co. shall retain its monopoly of the existing system of telephone transmission for 17 years from November, 1891, the date of the patent for the Berliner transmitter, or whether the system shall become free to the public. Berliner's original application was filed June 4, 1877, and came under the control of the Bell Co. in 1878, but it was not issued till 1891. Suit was begun by the government on Nov. 17, 1891, for the cancellation of the patent on the ground of the extraordinary delay, which it was claimed was in effect a fraud upon the public; and also on the grounds that a patent issued to Berliner in 1880 covered the same invention as that covered by the patent in suit; that the patent was not for the invention described in the application as filed. The first trial of the case before the U. S. Circuit Court for the District of Massachusetts, on Jan. 3, 1895, resulted in favor of the government; this decision was reversed on June 14, 1895, by the Court of Appeals for the First Circuit, and the government has now taken the case into the Supreme Court.

ENGINEERING NEWS
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FAST RAILWAY RUNS are being made by the Baltimore & Ohio R. R. express trains, between Philadelphia and Washington, 136 miles. The schedule time is 53 miles per hour, and the maximum obtained is 75 miles per hour, the latter speed being only maintained for short distances, and in most cases when enginemen are attempting to make up lost time. On Nov. 4, train 510, with engine 1310, hauling 4 cars, covered 96.7 miles in 124 minutes and made 4 stops. This train covered 61 miles in 65 minutes, including 5 minutes crossing the Susquehanna River bridge. On Nov. 6, train 511, engine 849, with 4 cars, covered 25.6 miles from Aberdeen to Bay View in 24 minutes. On Nov. 10, train 501, engine 1309, with 6 cars, covered 96.7 miles in 123 minutes, including 4 stops; 25.6 miles of this distance, Aberdeen to Bay View, was covered in 25 minutes. On Nov. 13, train 504, engine 1308, with 6 cars, covered 96.7 miles in 121 minutes, including one stop. Probably the best performance was on Nov. 15. Train 507 (the Chicago limited), with engine 1308, hauling 11 cars, the entire train, with the exception of 3 cars, being vestibuled, left Camden Station, Baltimore, at 7.04 p. m. and arrived in Washington at 7.52 p. m., being a run of 40 miles in 48 minutes. This train covered the distance between Muirkirk and Alexandria Junction, on the Washington Branch, 8.1 miles in 7 minutes. This was an exceptionally good run, when it is taken into consideration that the speed had to be slow through the cities of Baltimore and Washington, and there was one slow order on account of sewer construction.

A PARALLEL RAILWAY SCHEME at Catskill, N. Y., was recently nipped in the bud by the New York Railroad Commission. The proposed road was projected by the Catskill, Cairo & Windham Street Ry. Co., and ran parallel with the line of the Catskill Mountain Ry. Co. for its entire length. In its decision refusing the application the Commission said:

> After a personal inspection of the proposed route and the existing line, and upon the evidence submitted, it seems to the Board that there is not business or traffic enough to authorize the construction of an additional railroad. The existing line is not self-sustaining and has not been at any time since its construction. It has ample facilities to transact all the business that is offered or which is likely to be offered for several years to come. From the applicant's own evidence it is apparent that the travel along the proposed route is not such as would make the construction of this road a public convenience and necessity as contemplated by the statute.

ELECTRIC TRACTION on the suburban and Coney Island lines of the Long Island R. R. is being considered by the company, in order to introduce a frequent service of cars instead of the less frequent service of trains now in use.

ELECTRIC TRACTION may be introduced on a part of the line of the Cincinnati, Hamilton & Dayton R. R. The company has acquired the street railways of Middletown, O., and will connect them with its own line, running cars through between Middletown and Hamilton by electricity. The system may also be extended to some of its suburban lines at Cincinnati.

A STEAM CARRIAGE OR OMNIBUS, built by Mr. M. Scotte, of Epernay, France, is now in service between Picauville and the nearest railway station. The motor car consists of a front compartment for the engine and a back compartment for 14 passengers. The trail car will seat 24 passengers. The 16-HP. engine is of the vertical compound type. The boiler is vertical, and carries a pressure of 50 lbs. per sq. in. The power is transmitted to the rear wheels, and the forward wheels are employed for steering, being pivoted around a vertical axis by means of a wheel directed by the engineman. The coal or coke for fuel is carried forward, and the bunkers will admit of about 450 lbs., or sufficient fuel to serve for four hours of travel; 150 gallons of water are carried in the tanks situated under the seats and under the floor. The dimensions of the motor car are 17 ft. in length and 6 ft. wide. Its weight is 7,700 lbs., without passengers. It will turn in a circle of 12 ft. diameter.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a derailment on the Bald Eagle Branch of the Pennsylvania R. R., at Unionville, Pa., Nov. 18. A broken car axle was the cause of the accident, and 20 coal cars were smashed in the wreck. One trainman was killed and another injured.——A runaway westbound freight train on the Denver, Leadville & Gunnison R. R. jumped the track at a curve at the foot of a steep grade east of Webster, Mo., Nov. 14. One man was killed and three were injured, while the engine and 14 cars were smashed.

A LASSOED LOCOMOTIVE caused considerable damage at East Liverpool, O., Nov. 18. While hoisting the steel floor beams of the new bridge over the Ohio River, which spans the Cleveland & Pittsburg R. R., a wire cable was allowed to slacken so that it almost touched the rails. A heavy freight train was approaching, and the bridge workmen tried to raise the cable out of the way, but the smokestack of the locomotive struck it, carrying it nearly 600 ft. Telegraph poles, signal towers, and telegraph wires were snapped off and the traveling crane cars on the new bridge were upset. The rope was pulled out of the Ohio end of the bridge reel, and this prevented injury to property and loss of life of bridge employees, and persons in stores, residences, and on the streets. One end was thus finally freed before the train was stopped, and fell from the locomotive on the side of the track next to the bridge. The engine was considerably damaged, and part of the smokestack was torn away.

A LOCOMOTIVE BOILER EXPLOSION occurred Nov. 17 on the Atlantic Coast Line R. R., near Richmond, Va., and two men were badly scalded. The engine was hauling a freight train when the crown sheet collapsed.

A BROKEN STEAM PIPE on the tugboat "Hudson," while the boat was at Kinderhook, N. Y., Nov. 18, resulted in severe injuries to the engineman and fireman, and the latter died soon after the accident.

A HIGHWAY BRIDGE OR TRESTLE over Village Creek, near Ensley City, Ala., gave way under a wagon Nov. 22; one person was killed and 12 were hurt. It is said that the stringers were too short and had slipped off the end sills.

BIDS FOR A STEEL POCKET DUMP at the foot of East 17th St., East River, New York city, are wanted by the Commissioner of Street Cleaning until Dec. 3. About 150,000 lbs. of structural steel will be required, together with wrought and cast iron in small quantities, and some 30,000 ft. B. M. of timber and boards. Col. Geo. E. Waring, Jr., M. Inst. C. E., is Commissioner of Street Cleaning.

THE BROOKLYN DRY-DOCK ACCIDENT, of last August, has at last been passed upon by the Secretary of the Navy. The court of inquiry convened held Mr. A. G. Menocal, C. E., U. S. N., and Mr. U. S. G. White, C. E., U. S. N., responsible for the accident to the caisson, stating in effect that these officers should have transferred the ballast from the hold of the caisson to the upper deck, instead of entirely removing it, before replacing it with concrete; that notwithstanding their calculations, the entire removal of the ballast was unprecedented and they should have taken no risks, even to save some trouble and expense. The court recommended a court martial; but Secretary Herbert, while upholding the finding of the court of inquiry, "in view of the long service of these officers," will not order a court martial, but "reprobates their conduct," and charges the damage done to "a want of knowledge of which you ought to have possessed yourselves before acting."

THE PNEUMATIC MOTOR SYSTEM of the U. S. Monitor "Terror," was fully tested at sea, on Nov. 19, in steering the ship, turning the turrets and loading and pointing the 10-in. guns. The two air-compressors employed compress the air directly into an 8-in. pipe running through the ship, no other reservoir being used. In this pipe a pressure of 125 lbs. to the sq. in. can be developed in 45 seconds. From this main, small pipes lead to the steering gear, turrets, shell hoists, etc. In the trial the rudder was turned from hard a-port to hard a-starboard in 6 seconds. In 3 seconds a turret weighing over 250 tons was set moving, and in 52 seconds both turrets were turned completely around by compressed air. The first 10-in. gun was loaded in 1 min. 37 sec.; including the lifting of the 500-lb. shell and the powder from the magazines, and the loading of the gun and ramming home of the charge, all by pneumatic appliances. Some trouble occurred during the test from the lack of any previous drill, but the working of the pneumatic system was pronounced successful. At the same trial the four 10-in. guns were fired simultaneously by electricity, with full service charges and shells. This is a thing said to have been never before tried on an American war-ship, and the "Terror" stood the test well.

THE NEW BATTLE-SHIP "IOWA" had a trial trip, in charge of her builders, the Cramp & Sons Shipbuilding Co., on Nov. 13. The course was 10 knots in length, located 20 miles east of the Delaware capes. Four trips were made over the course, the average speed being 16.27 knots with 112 revolutions of the screw per minute. The speed guaranteed by the builders was 16 knots. The horsepower developed by the engines was approximately 11,000. The official trial is expected to be made in February.

EXTENSIVE INDUSTRIAL DEVELOPMENTS AT NIAGARA Falls and vicinity are expected soon to result from the successful transmission of electric power from the Falls to Buffalo and the increased power equipment of the two power companies, the Niagara Power Co., which owns the great tunnel, and the Niagara Falls Hydraulic Power & Manufacturing Co., whose plant on the side of the cliff below the falls was described in our issue of Mar. 26. The former company intends to place in position as soon as possible five more 5,000-HP. dynamos. The extension of the wheel pit to receive the turbines is now being made. Among the new developments in the vicinity is the plant of the Matthiesen Alkali Co., which is expected to be ready to operate Jan. 15, 1897. The Niagara Development Co. will build 25 new houses at Echota in the spring. The Pittsburg Reduction Co. has started its new aluminum plant, taking power from the new electric plant of the Niagara Falls Hydraulic Power & Manufacturing Co. The production of aluminum by electric power from Niagara Falls is now so great a success that the Pittsburg Reduction Co. has found it advantageous to abandon its plant at Patricroft, England, and make all its product in this country.

ALUMINUM IS USED TO CONDUCT ELECTRICITY in the new aluminum works of the Pittsburg Reduction Co. at Niagara Falls, transmitting current from the generators in the power house to the electric furnaces in the melting house. The electric conductivity of aluminum, according to M. Lazare Weiler's table, is 54.2, pure copper being 100. The specific gravity of aluminum is 2.67, and that of copper 8.85, or 3.32 times as much. To carry the same current as could be carried by a rod of copper of 1 sq. in. section would require $1 \div 0.542 = 1.845$ sq. in. of aluminum, and this would weigh only $1.845 \div 3.32 = 0.556$ of the weight of the copper. If the cost per pound of aluminum were only 1.8 times as much as the cost per pound of copper, then the cost of a conductor of each of the metals would be the same.

THE NAIL TRUST has collapsed. It began in June, 1895, and it in one year had advanced the price of wire nails from 95 cts. to $2.70 per keg. In one year it made 6,000,000 kegs of nails. It taxed the dealers 15 cts. a keg, which tax was refunded to them at the end of six months on proof that they had not cut the selling prices. It paid competing manufacturers to close their works, or bought them outright. It got control of the nail machine makers so that no one outside of the trust could buy a nail machine, and ran things with a high hand generally. The yearly average prices of nails at Chicago for the five years previous to the formation of the trust were: 1890, $2.51; 1891, $2.04; 1892, $1.70; 1893, $1.49; 1894, $1.11. In April, 1895, the average price was 95 cts., and on May 1, 1896, the price was fixed by the trust at $2.70, after repeated advances during the year, and this price has since been maintained. The collapse came about through the starting of several small nail factories which bought a new nail machine recently put on the market and which the trust failed to capture. Nails at Chicago have already dropped to $1.70 per keg, and the price is expected to go to $1.25.

AMERICAN CITIZENS ONLY can be employed by the contractors for the improvement of the New York State canals. This is in accordance with the law passed May 10, 1894 (Chapter 622, Laws of 1894), relating to the employment of mechanics and laborers upon public works. This law forbids the hiring of any but American citizens for labor performed for the state of New York or for any municipal corporation in that state, and the same law requires the contractors for such work to pay the men not less than the prevailing rate of wages for similar services.

NICARAGUA CANAL LEGISLATION, says Mr. J. R. Bartlett, of the Nicaragua Canal Company, is not to be "forced" upon Congress at its next session. "A moderate attempt" will be made to secure favorable action; but meanwhile private negotiations for foreign capital will be resumed where they were broken off by the Venezuela proclamation of President Cleveland. Mr. Bartlett says that at that time English capitalists had agreed to advance $60,000,000 towards the construction of the canal.

NOTES OF A TRANSCONTINENTAL TRIP.

V.

San Francisco.

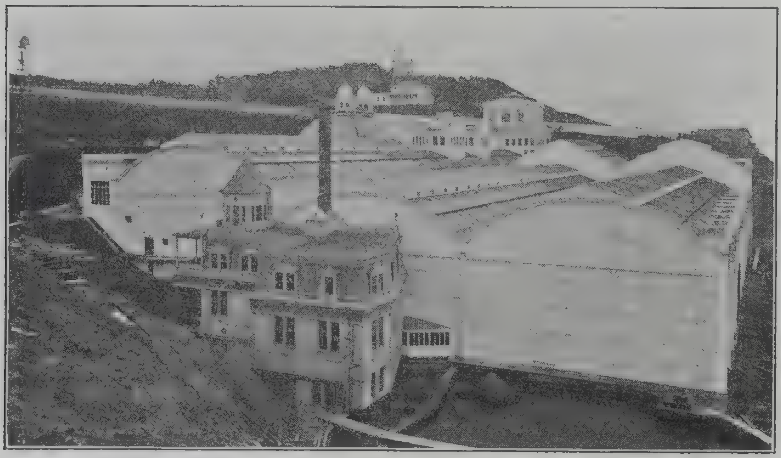


FIG. 1.—VIEW OF THE SUTRO BATHS AND SUTRO HOUSE.

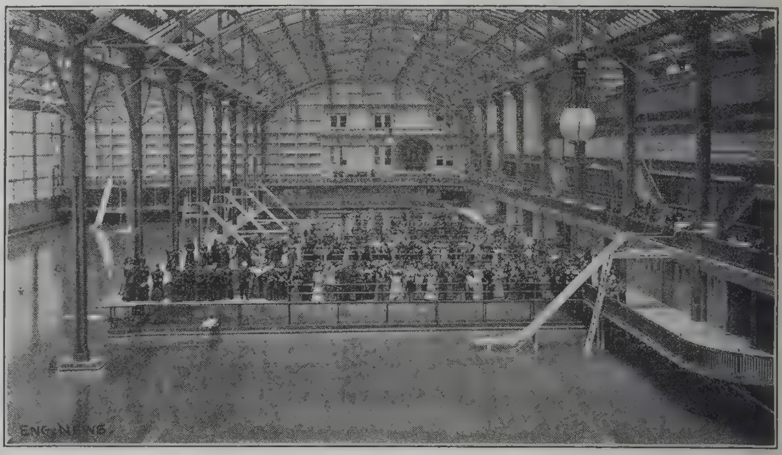


FIG. 2.—INTERIOR VIEW OF THE SUTRO BATHS; SAN FRANCISCO.

This is a large and attractive city, having a population of about 400,000. It is situated on the north point of a peninsula, 30 miles long, which separates San Francisco Bay from the Pacific Ocean, the northern side of the city fronting on the Golden Gate, and its eastern side on the bay. The far-famed Golden Gate is the narrow strait connecting the bay with the ocean, so that the great bay, with an area of about 600 sq. miles, is almost entirely land-locked. This strait forms the only break for some hundreds of miles in the low coast range of hills which rise directly from the shore. A peculiar meteorological result of this break in the range is that San Francisco is practically never hot, for in the afternoon of a warm day the wind from the sea will begin to pour through the strait as through a funnel, until by the evening there will be a chilly gale blowing. The climate is remarkably mild and equable, being free from extremes of heat and cold. I had expected to find this an exceedingly hot place after the great heat on the Sierras, but while other towns in the state were experiencing temperatures of 80 to 96°, the temperature in San Francisco rarely got as high as 75°, and then only for a short time, while every night was cool and fresh. There is a great deal of fog on the coast, and looking up Market St., during a sunny day, there is often to be seen a grey darkness over the hills between the city and the coast, which to a stranger appears to presage a heavy thunderstorm, but the clouds do not approach and the sunshine remains unobscured. Taking a car for the shore, which is about 7 miles distant, one finds the air growing colder and damper, while along the crest of the coast range can be seen a mass of white vapor rolling down on the east or landward slopes, but not getting very far. This is found to be a wet sea fog, which settles close down on the water, and it is this fog, coupled with the many dangerous points of the coast, which has led to the loss of so many steamers in this vicinity. On returning to the city, the fog is gradually left behind and the sunshine is again reached.

The city government is far from being satisfactory, as it is run mainly on a political basis and with personal and party ends in view. There is a city surveyor, but no city engineer, and the street commission has no engineer. The sewerage system is very imperfect and many of the sewers are in a dilapidated condition, caving in quite frequently. In 1892, a sewer commission was appointed to investigate the condition of the system and to report upon the means of improving it. For political reasons, however, it was legislated out of office in 1893, before it had done anything beyond making a preliminary report which conclusively showed the faulty condition of the work as existing. This commission was composed of Mr. Irving M. Scott, Col. G. H. Mendell, U.S. Engrs., Mr. Geo. Davidson, Mr. Marsden Manson, and Mr. C. E. Grunski. The street paving is not very good as a whole, but the sidewalks are in much better condition. Concrete or artificial stone is largely used for the sidewalks, and it is specially noticeable that it has a rougher and coarser surface and is consequently much less slippery, than the cement paving commonly used in the East.

An engineer notices the great extent to which concrete is used for garden walls, retaining walls, sidewalks, steps, gate posts, sidewalks, etc., and even for the basement walls of buildings, the exposed surface in these latter cases being finished to imitate rock-faced stone. The reason for this extensive use of concrete is the cheapness of Portland cement, which is brought here by ships as ballast, and costs very little, while the equable climate is very favorable to the durability of the concrete. A number of contracting firms devote themselves to this class of work as a specialty.

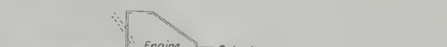


Fig. 3.—Plan of the Sutro Baths.

The topography of the city is irregular, there being several isolated hills, besides the range on the coast; the Mission Peaks are 925 ft. high, Reservoir Hill (in Golden Gate Park), 920 ft., while Russian Hill and Telegraph Hill are also points of interest. This makes the streets (which are laid out on a rectangular plan) very steep in places, so steep in fact that several blocks on the south slope of the ridge parallel with the Golden Gate are impassable for teams, and can only be used with much exertion by pedestrians. It was on locations like these that the cable railways were first established, and it is here that the cable railways are found to be of special interest. San Francisco is in fact the home of the cable railway, which was first introduced there by Mr. Andrew S. Hallidie, in 1873. The first line was the Clay Street Hill Ry., with 5,197 ft. of double-track and a maximum grade of 16.26%. A ride on any one of the lines built along the ridge, where grades of 18 to 23% occur, such as the Powell St., California St. or Sutter St. lines, is really more thrilling to a stranger than is the ascent of Pike's Peak. In the latter case the train ascends slowly and this gives the impression of great care and caution being taken, while the cable cars climb rapidly up a series of short steep grades (broken by the level stretches at street intersections) and then as rapidly run down similar grades from the summit level. Curves are also traversed quite rapidly and on some of the lines the up and down motion almost conduces to seasickness. Various styles of grips are used, some having the jaws moving vertically and some horizontally, and both wheels and levers are used to operate the grips. On some lines short open grip cars are used, hauling short four-wheel, closed trail cars, but the more important lines have very long cars on two four-wheel trucks, half of the car being open (with seats back to back and the grip levers between) and half closed. The car bodies are set low on the trucks, so that it is an easy step to the platform. Ordinary wheel brakes are used, but there is also a track brake fitted to one of the trucks, this brake having a wooden bar or shoe which is forced vertically down upon the rail. At many of the terminals turntables are used, smaller tables having one track engaging with one or other of the converging double tracks, while larger turntables have two tracks in line with the main tracks. The turntables are of iron construction with a wooden platform at the street level, and some of them are operated by power derived from the cable. There is a most extensive system of transfers between the various connecting and intersecting lines, while since the opening of the Sutro electric line to the Cliff House, the trip of about 7 miles from the city to the shore can be made for 5 cts. Electric traction is employed on many of the more level lines, the cars being large combination cars, as on the cable lines, and it was noticeable that here (as in other western cities) the conductors did not have as much to do in looking after and replacing the trolleys as they do in many eastern cities. There are two steam lines to the shore, operated by double-end saddle tank engines; one of these has open-sided excursion cars, while the other (following the shore of the Golden Gate and opening up some wonderful scenery) has a curious style of car with an open section at the middle and a closed section at each end.

There are many fine offices and store buildings, but the craze for "sky-scrapers" has not yet broken out to any extent, though the proprietors of the San Francisco "Call" are now erecting a 15-story building of steel skeleton construction. The new Parrott Building is a large steel building with many interesting features, including a great dome over the center of the first floor (in the central light court).

One of the notable buildings of San Francisco is the Palace Hotel, which was of almost unprecedented size and magnificence when built some years ago, and is still a very striking building. It occupies an entire block, 275 × 350 ft., and is in tho form of a hollow square, with light courts allowing for four rows of rooms on each side. It has seven floors above the ground floor and can accommodate 1,200 guests. The central court is carried up to the roof, which is of glass, and around it, on each floor, is a broad corridor or gallery. Carriages drive into this court and leave guests right at the door of the hotel office. The whole effect is enhanced by the handsome finish of the fronts of the galleries, with white balustrades and pillars, and the liberal use of palms and tropical plants. All the water for the use of the hotel is filtered in a large filter plant erected on the roof of the building.

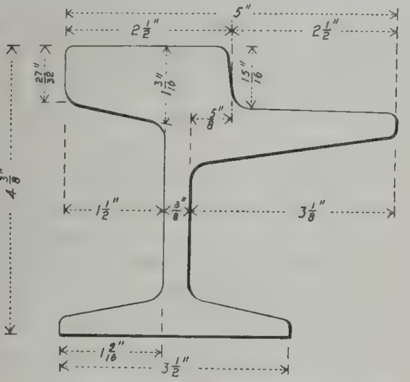


Fig. 4.—70-lb Rail for Street Railways; San Francisco, Cal.

The street cleaning of the city is done under the management of the Merchants' Association, and the men are dressed in a uniform consisting of a brown canvas jacket or jumper, overalls of coarse brown duck, and a blue cap with the name of the association in gilt letters. At the foot of Market St. is a large railway office and waiting room for the ferries to the railway station at Oakland and to the various towns situated across the bay. Work is now in progress upon a large new steel structure, which is being built under the supervision of Mr. Horace E. Brown, Engineer to the Harbor Commission. The Risdon Iron Works, of San Francisco, have the contract for this work. At Oakland some land reclamation work is going on to form a site for coal bunkers. Mr. Grunsky is the engineer, and Mr. Otto von Geldern is in charge of the work for him.

The sea coast is reached by either one of two steam railways, or the Sutro electric railway, all starting from the suburbs of the city and converging near the celebrated Cliff House in front of the Seal Rocks. The old Cliff House was burned on Dec. 24, 1895, but a larger structure was at once built, and is a great resort for tourists and people from the city. North of the Cliff House are the new and extensive Sutro baths. On top of the hill (shown in the eastern view of the Sutro baths, Fig. 1) and overlooking the ocean is Sutro Heights, the residence of Mr. Adolph Sutro, Mayor of San Francisco, but who is most widely known from his connection with the famous Sutro tunnel on the Comstock lode in Nevada. The grounds of his establishment are open to the public.

The Sutro Baths.

On the shore, and close to the Cliff House, are the new Sutro baths, established and built by Mr. Sutro, and which were opened in March, 1896. The buildings are handsome and spacious, and form a pleasure resort for visitors as well as bathers, there being a museum and other attractions, and cheerful promenades lined with palms and growing plants. The entire building is 499.5 × 254.1 ft., and contains about 600 tons of ironwork in the columns and roof trusses, 270,000 cu. ft. of concrete, 3,500,000 ft. of lumber and 100,000 sq. ft. of glass. Provision is made for spectators at aquatic sports and swimming matches, there being seating capacity for 3,500 persons in the amphitheatre, and 3,500 on the promenade, while the total capacity of the building, including the aisles, etc., is 25,000 persons. There are seven swimming tanks, as follows: One large tank, 1,409,062 gallons capacity; 4 small tanks, 70, 283, 400 and 875 gallons; 1 medium size tank, 112,500 gallons; 1 fresh water tank for plunges. There are 9 spring boards, and 7 toboggan slides lined with sheet brass and having a continuous stream of water running down them. These are shown in the general interior view, Fig. 2. There are 517 private dressing rooms and 9 club rooms, the total capacity being 1,110; 29 dressing rooms and all the club rooms are fitted with shower baths, and there are 66 shower baths in all. The laundry equipment can handle 20,000 bathing suits and 40,000 towels per day. The restaurant is on these floors, with an area of 30 × 75 ft. on each floor.

The water for the baths is taken from the waves or rollers which break on the reef on which the baths are built. A catchwater basin 75 × 150 ft. was blasted out of the rock, and this receives the water from the waves, which then flows to the receiving pond, and through a tunnel to the settling tanks, whence it goes to the various bathing tanks. With a high sea rolling in, the tanks can all be filled in an hour. A centrifugal pump with a capacity of 6,000 gallons per minute keeps up a constant circulation, and can fill the baths in from 5 to 6 hours. The tanks can all be emptied in an hour, at high or low water, through an outlet of 24 inches diameter, the waste water being led away to a point where it is discharged into a tidal current, so that there is no chance of its being at once taken in again. The water is heated by a system devised by Mr. Sutro, using direct steam driven through small tunnels. The temperature is graduated in the different tanks, and in the smaller tanks it can be raised 10 or 20° in a few minutes. The bath buildings are protected on the west by a breakwater lying north and south, 400 ft. long, 20 ft. deep, 25 ft. wide at the top and 75 ft. at the base, containing 450,000 cu. ft. of rock; another breakwater runs east and west, this latter being 300 ft. long and of the same cross section, containing 300,000 cu. ft. of rock. A general plan of the establishment is shown in Fig. 3.

The power house contains three compound vertical, direct connected engines of the marine type. Two of these operate the Sutro Electric Ry.; the larger has cylinders 16 × 24 ins. and 32 × 24 ins., and is rated at 600-HP. at 150 revolutions per minute; the other has cylinders 11 × 18 ins. and 22½ × 18 ins., and is rated at 300 HP. at 200 revolutions per minute. Each engine has its own surface condenser, through which the water from the ocean flows on its way to the baths. The engines drive dynamos of 400 K-W. and 200 K-W., respectively, the smaller being sufficient during week days, when only about 8 cars are running, and the larger being used when the traffic is heavy, while both engines are run together on Sundays, the traffic then being exceptionally heavy.

The third engine drives two 75-K-W. generators for the electric lighting of the baths. All the engines have steam jackets on the cylinder walls and heads. Each cylinder has two separate steam valves and two separate exhaust valves, the former (on both cylinders) being controlled by the engine governor. The engines were built by the Fulton Iron Works, of San Francisco, and the dynamos by the General Electric Co., of Schenectady, N. Y. Steam is supplied by three Babcock & Wilcox water-tube boilers, carrying 140 lbs. pressure, and the fuel is Welsh anthracite coal, costing $7 per ton. Records of coal consumption, currents, etc., are taken daily, and account is taken of the amount of the total power consumed by the railway, the pumps, and the Frith wheel and other attractions. The baths were designed and built under the personal direction of Mr. Sutro, and they, as well as the electric railway, are among the many works built by Mr. Sutro for the benefit of the people of San Francisco.

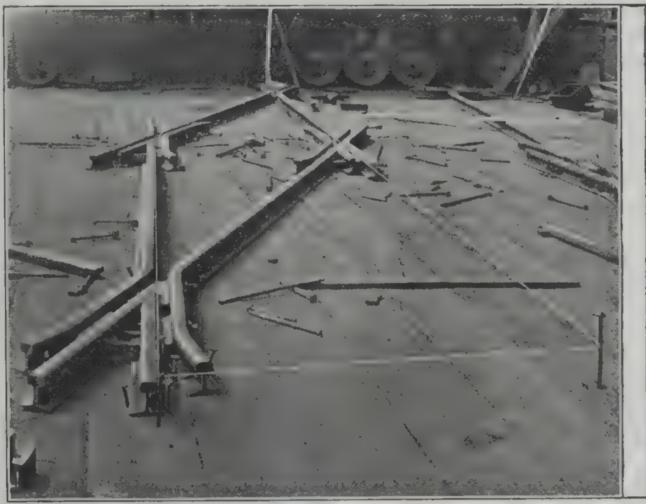


Fig. 6.—Track Crossing; Built by the Pacific Rolling Mills.

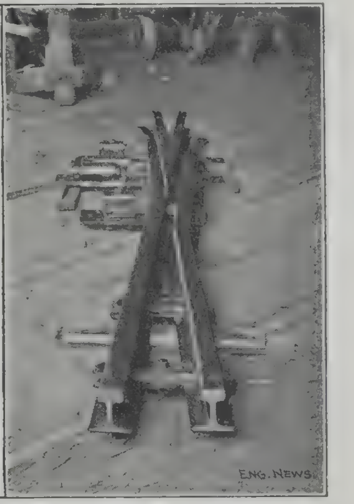


Fig. 5.—Spring Rail Frog for the S. F. & S. J. V. Ry.; Made by the Pacific Rolling Mills, San Francisco.

Business and Industries of San Francisco.

Union Iron Works.—These works have a very extensive plant for machinery and shipbuilding. The company is naturally proud of its work on the warships "Oregon" and "San Francisco" for the U. S. Navy, while since my visit it has obtained the contract for one of the new battleships, and very recently for a battleship for Japan. Besides the ordinary machine shops, foundry, etc., it has a galvanizing plant, extensive ship-yards, a large floating dry-dock and a storage space piled up with spare propellers, shafts, engine fittings, etc., for the various steamers built. A large new boiler shop is being built, and a new three-story office building, the lower story of this latter being of rock-faced monolithic concrete, while the upper part is of pressed brick with stone trimmings. The concrete work is being done by Keatings & Leonard, licensees for the well-known Ransome system of concrete and twisted iron construction, who have done a considerable amount of work of this kind. All kinds of iron and machine work are done here, and at present a good deal of mining machinery is being turned out, the works being quite busy and employing some 2,000 men. In the shops are some exceptionally large machine tools which were designed and built at the works. The great compound hoisting engines built for the Anaconda copper mines were illustrated and described in Engineering News, Sept. 3, and at the time of my visit the following work was in progress: Two sets of double-acting hoisting engines, with two cylinders, 30 × 72 ins., on each side; one similar engine, with cylinders 20 × 60 ins.; a 20-stamp silver mill for Mexico; three sets of 1,200 HP. triple-expansion engines of marine type, with direct-connected dynamos, for the Market St. Ry.; nine elephant boilers, 160 lbs. pressure, fitted with Rooney stokers, for the Market Street Ry.; triple expansion engine of 2,800 HP. for the Pacific Coast Steamship Co.; two gunboats; a steamer of 600 tons for the Sandwich Islands. The repairing and overhauling of steamers is an important feature of the firm's business.

Pacific Rolling Mills.—The works were first started for the manufacture of bar iron, and then, when the Central Pacific Railway was being built, they made great quantities of ironwork for cars, since which time the plant has grown very extensively. The principal orders now on hand are for structural work, but include also some small highway bridges (80, 120 and 140-ft. span), and there is a considerable amount of minor work in hand, such as spikes, bolts, nuts, and the rod bands for wooden stave pipe. The ironwork for the Parrott building, with its great dome, and the dome on the City Hall, were turned out from these works. Z-bars are among the sections rolled; in fact, it is claimed that this was the first mill to roll such a section in this country, it having been made originally for one of the warships, the plans for which were purchased abroad, and it was desired to substitute one section for a double-angle section shown on the plans. Short pieces of Z-bars, used in pairs, are used on some of the street railways as chairs for the side-bearing girder rails. The works have 8, 10, 12 and 15-in. mills, and also roll light T-rails, up to 40 lbs. per yd., and street rails up to the 70-lb. side-bearing section now generally used for the city's street railways, and this is shown in Fig. 4. A somewhat new line of business for the Pacific Coast which has recently been taken up by these works is the manufacture of switches, frogs and crossings for railway and street railway work, and a considerable amount of work of this kind has been done for the new San Francisco & San Joaquin Valley Ry. Fig. 5 shows a spring rail frog for this railway, and Fig. 6 shows a crossing under construction. Some large steel-framed turntables for street cars have also been built, including one in front of the Chronicle Building, which is operated by gearing, the cogs of the turntable rack being formed by bolts through two concentric rings. There is a steel plant for the manufacture of steel castings, large and small, the work including pistons for locomotives, 7 ft. pistons for some of the new cruisers, Fig. 7, and the large stern frame castings for these vessels. The rolling mills are driven by a large engine of the Corliss type with a form of valve gear specially designed to cause the engine to follow up the load on the mill quickly and then release it quickly. Oil fuel is used for the boilers, being brought up from southern California in tank steamers and pumped from the vessels to the storage tanks. Gas heating furnaces are used, having valves underneath for the purpose of economizing space, and there is a very interesting hydraulic charging machine, revolving on a turntable. The furnaces, charging machine, and many other interesting parts of the plant were designed by Mr. Patrick Noble, general manager, who has been associated with the works for 28 years, and who may be seen in Fig. 7, standing at the side of the casting.

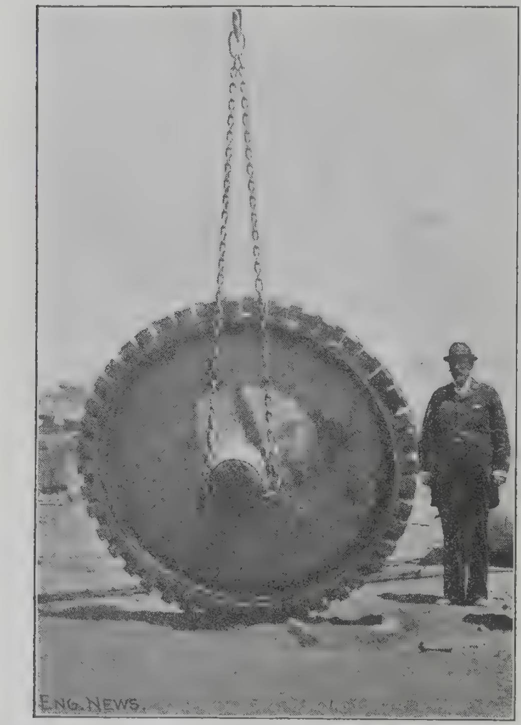


Fig. 7.—Cast Steel Piston; Made by Pacific Rolling Mills.

Pelton Water Wheel Co.—This firm is one of the few whose business does not seem to have suffered from the prevailing depression, this fact being due mainly to the present great activity in water power projects. The lowest head under which any Pelton wheel is now working is 14 ft., while the maximum is 2,100 ft., this latter being at Fresno, Cal., as described in Engineering News, July 2. Cast-iron buckets are used for the ordinary heads and phosphor bronze buckets for wheels working under high heads.

Alcatraz Asphalt Co. — This company has recently carried out some successful work of asphalt paving on a gravel foundation or base, and has lined several reservoirs for the Oakland Water Co., of Oakland, Cal. (the new rival of the old Contra Costa Water Co.), using a 4-in. layer of asphalt painted with an asphalt paint.

A. Lietz Co.—This company, manufacturing engineering instruments, makes a specialty of the cyclotomic transit, recently described in Engineering News. This instrument costs less than an ordinary transit, but is claimed to be more accurate and more durable. It is true that angles cannot be repeated with it, but it does not seem that many engineers do this, or consider it necessary, as already a large number of the new instruments have been sold. Mr. Lietz has a special aluminum alloy, containing 70% aluminum, which he uses for standards and other parts of instruments and which is sufficiently hard to require no bushing for screws and bearings. The standards are designed to give great stiffness, and the instruments are found to be very rigid, even in high winds. The aluminum is also used for the telescope tubes. An 18-in. Y level, with aluminum fittings and weighing only 6 lbs. has been successfully used in windy weather by the engineer of the Harbor Commission.

Excelsior Wooden Pipe Co.—The use of wooden stave pipe is becoming very general in the western states, to convey water over long distances for irrigation or domestic supply, and this pipe has been frequently described and illustrated in Engineering News. In the larger sizes of pipe the staves are built up to shape on a collapsible form or centering, and in pipes of less than 18 ins. diameter a "rounding-out" machine or mandrel is used to bring up sunken staves to the proper contour, as the other staves cannot be driven down. This was designed for use on the water-works system of Hollister, Cal., which were the first works on which wooden stave pipe of 10 and 12 ins. diameter was used. In adobe soil, which is corrosive to steel, the wooden pipe has many advantages. The sides of the staves are carefully trimmed by planing knives to the radius and curve of any given diameter of pipe, and then a test section is set up to test the accuracy of the fit of the staves, as any slight error, multiplied by the number of staves forming the circumference of the pipe will make a badly-shaped pipe. At each end of each stave is a saw cut, and in one of these is inserted a steel strip of such length as to leave a 1-12 in. open joint between the staves, the staves being then driven up with a 16-lb. sledge, thus forcing the steel slightly into the wood and making a tight joint. The steel strip is also slightly wider than the stave, so as to cut into the sides of the adjacent staves. It is evident that special care and attention are required for the successful building of this kind of pipe. A firm of sewer contractors which received a contract for a wooden pipe line at Los Angeles, made a failure of the work from lack of experience, and caused very considerable expense to get it in working order. The encircling bands are round steel rods, with Sternbergh's upset ends and cold rolled threads, while the clips are malleable castings. Considerable changes have been made in the form of the clips to get a continuation of maximum strength with minimum weight. Rods of oval section have been tried, but Mr. D. C. Henney, the manager and engineer, considers the circular section preferable.

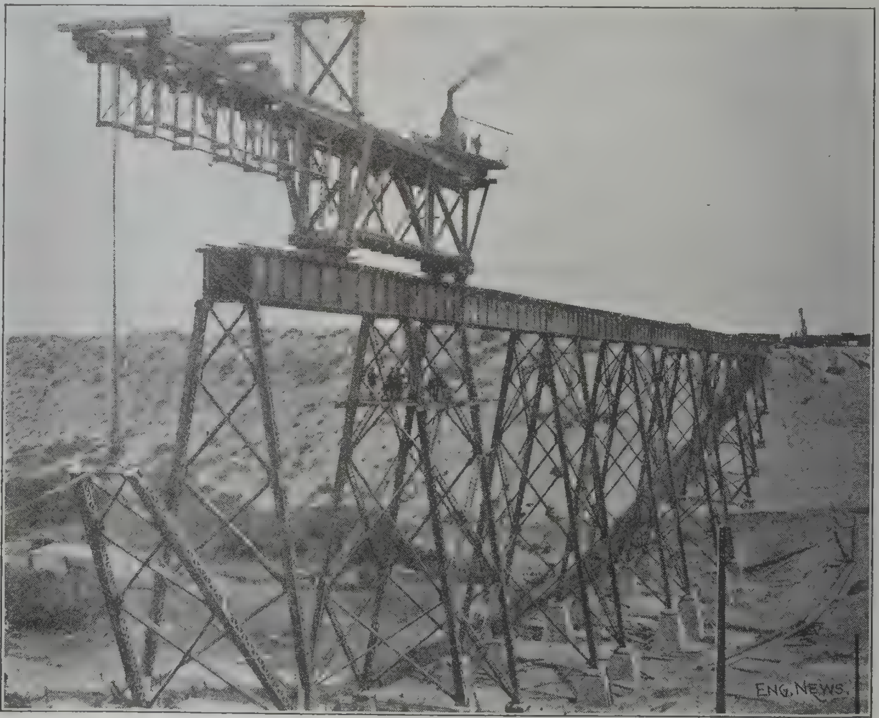
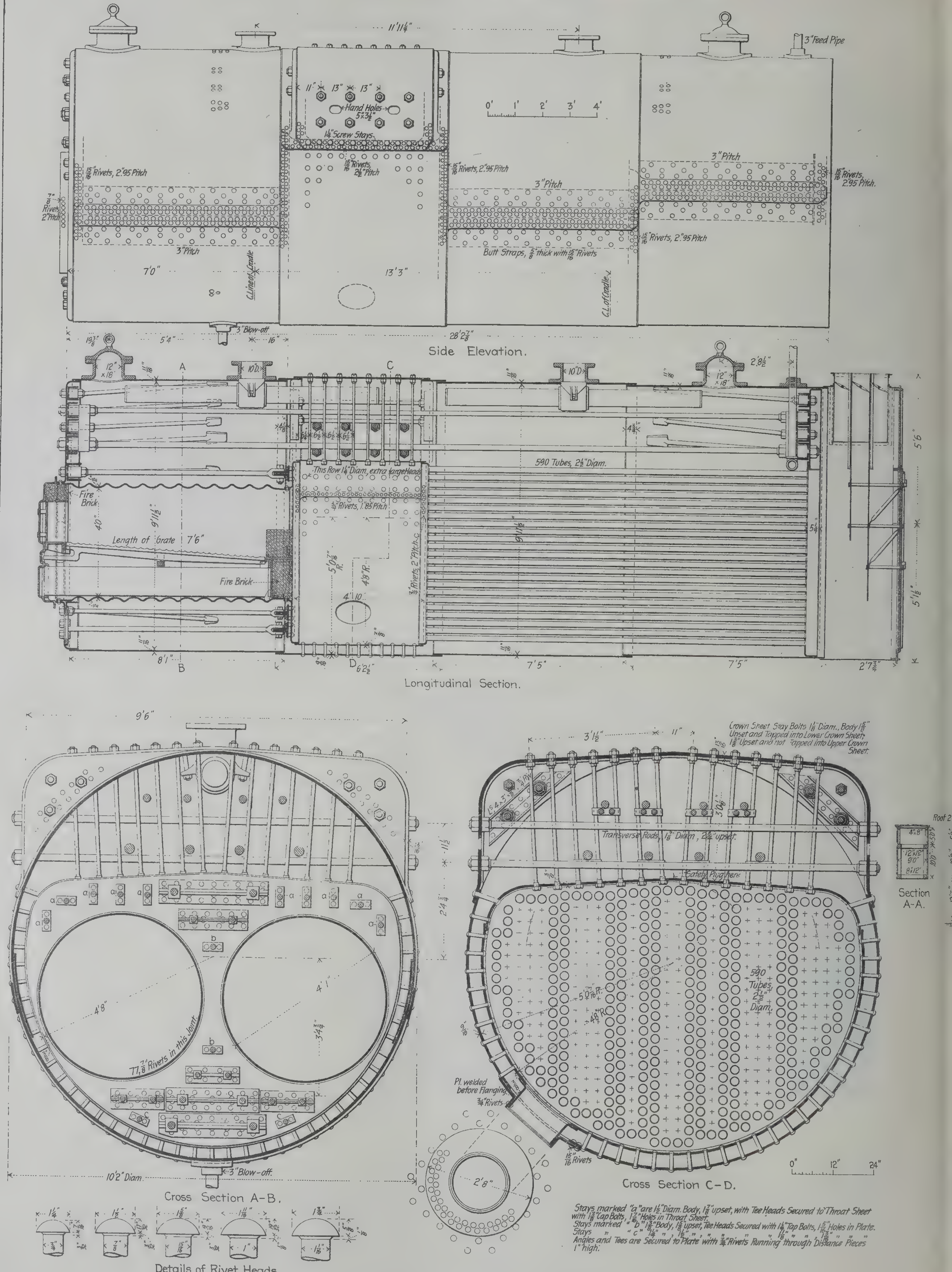


FIG. 8.—LOS ALAMOS VIADUCT; COAST LINE DIVISION, SOUTHERN PACIFIC RY.
Erected by the Thompson Bridge Co.; San Francisco, Cal.

Steel and Iron Pipe.—Iron and steel pipe are supplied by three principal firms. Dunham, Kerrigan & Hayden, hardware merchants, make this one of their specialties, and have an engineer, Mr. Thomas Brooks, in charge of this department. He reports a number of cases where this pipe has been used under very high heads. The collapse of riveted steel pipe by external atmospheric pressure, when the water in the pipe has been suddenly drawn off by an accident (causing a vacuum in the pipe) led Mr. Brooks to devise a special form of air valve to give ample area of opening from the exterior in case of such an emergency. This firm supplied the pipe line for the power plant at Fresno, Cal., the total length of which was 4,020 ft., with a head of 1,400 ft., including 20-in. lap-welded pipe and 24-in. riveted steel pipe. Two forms of joints were used, the Converse lock joint, and a bolted flange joint, the cast-iron flanges being shrunk on and headed to the pipe and reinforced by ¾-in. rivets. One flange of each joint has a recessed face and the other a projecting face, a 3-16-in. rubber gasket being placed between the flanges, which are then drawn up by 16 bolts 1 in. diameter, 10¼ ins. long. The 31,500 ft. of steel pipe for the Hollister water-works, above noted, was supplied by W. W. Montague & Co., of San Francisco.

Bridge Companies.—Bridge work is at a very low



Side Elevation.

Longitudinal Section.

Cross Section A–B.

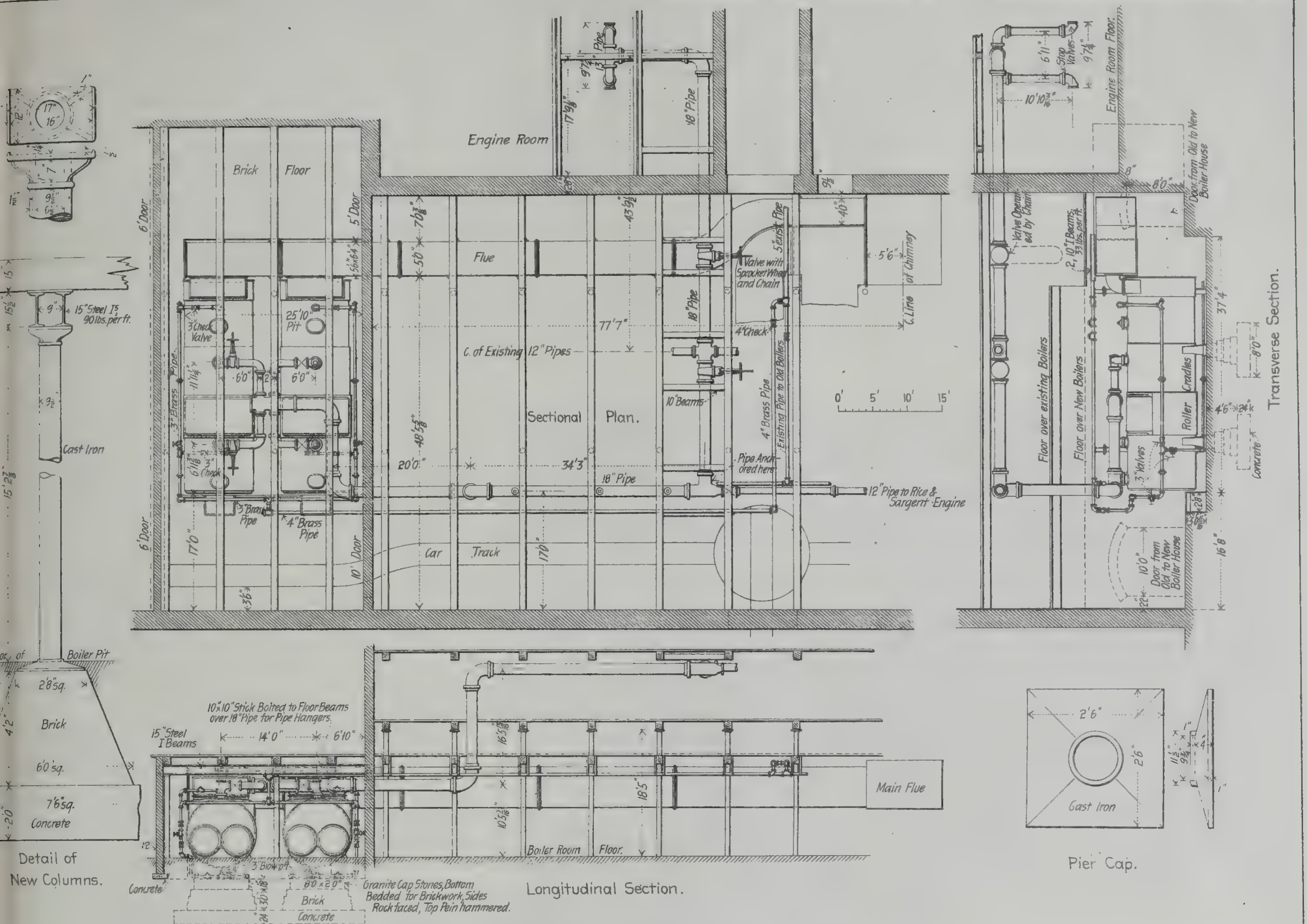
Cross Section C–D.

Section A-A.

Details of Rivet Heads.

Stays marked "a" are 1½" Diam. Body, 1⅞" upset, with Tee Heads Secured to Throat Sheet with 1⅜" Cap Bolts, 1 7/16" Holes in Throat Sheet.
Stays marked "b" 1⅜" Body, 1⅝" upset, Tee Heads Secured with 1¼" Tap Bolts, 1 5/16" Holes in Plate.
Stays " "c" 1¼" " , 1½" " , " " " 1⅛" " " , 1 3/16" " " "
Angles and Tees are Secured to Plate with ¾" Rivets Running through Distance Pieces 1" high.

TWO-FURNACE BOILER, LOCOMOTIVE TYPE.


Detail of New Columns.

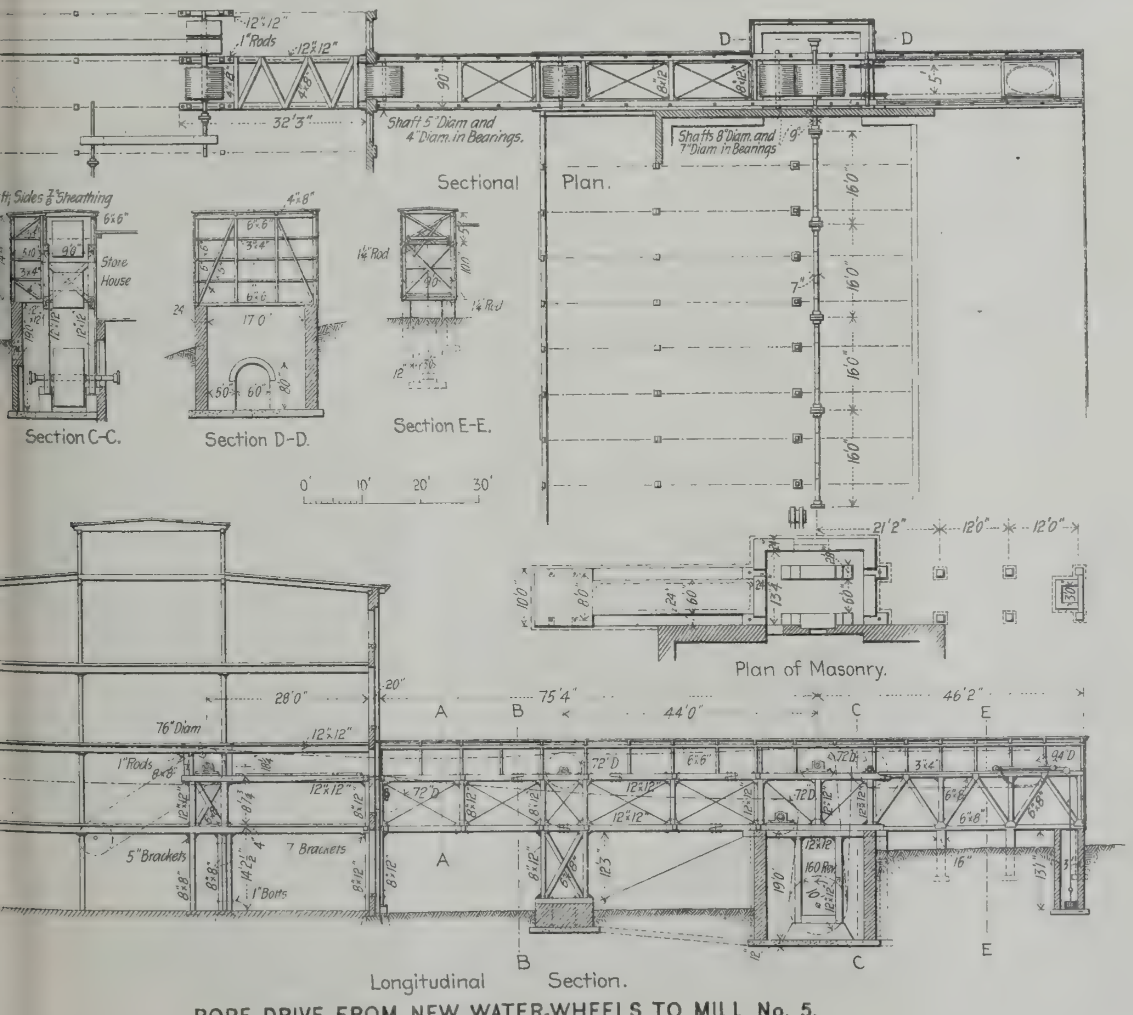
Sectional Plan.

Transverse Section.

Longitudinal Section.

Pier Cap.

GENERAL ARRANGEMENT OF NEW BOILERS AND STEAM PIPING.


Sectional Plan.

Section C-C.

Section D-D.

Section E-E.

Plan of Masonry.

Longitudinal Section.

ROPE DRIVE FROM NEW WATER-WHEELS TO MILL No. 5.

NEW
BOILER PLANT
AND
ROPE TRANSMISSION
FOR THE
WASHINGTON MILLS,
LAWRENCE, MASS.

Dean & Main,
Boston, Mass.,
Engineers.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

ebb and the companies making this work a specialty are practically idle. The San Francisco Bridge Co. has built some wooden bridges with pile abutments for the new San Francisco & San Joaquin Valley Ry. The Thomson Bridge Co. has erected some of the bridges and trestles on the new Coast Division of the Southern Pacific Ry., including the Santa Maria River Bridge with seven spans of 183 ft., and the Los Alamos viaduct, 734 ft. long, with plate girder spans on metal bents. A view showing the erection of this viaduct is given in Fig. 8. The bents are raised by the derrick on the traveler, and the plate girders were run out onto the structure on flat cars, and then run out through the traveler trusses by means of trolleys and slings, and set in place on the bents. Mr. Thomson says that the piles along the harbor front at San Francisco are supported entirely by skin friction, not reaching any firm bottom; these piles are ordinarily 80 to 90 ft. long, but he has driven Oregon pine piles 135 ft. long, 16 ins. diameter at one end and 6 to 8 ins. at the other.

Railways.

The most important railway work now in progress in California is that of the San Francisco & San Joaquin Valley Ry., which starts from Stockton (whence steamers run to San Francisco) and runs down a rich fruit and wheat-growing country, its objective points being Fresno and Bakersfield. The railway parallels two lines of the Southern Pacific Ry. but will develop a large local traffic. All switches and frogs, and many of the cars have been built by firms on the coast, mainly to designs prepared by the engineer, as this was a new character of manufacture in that district. Particulars of this road and its structures were published in our issue of Oct. 29. The Southern Pacific Ry. is building a new coast line to Los Angeles, having maximum grades of 1% as against 2½% by the present line over the Tehachapi Pass, on which summit grades two twelve-wheel engines are used for freight trains and two ten-wheel engines for passenger trains. One of the viaducts on this line is shown in Fig. 8. The new line is laid with 75-lb. rails and has an excellent track, being intended for fast traffic. This road is also building some small branches near Pomona, for which Grant Bros., of San Francisco and Los Angeles, are the contractors.

THE NEW POWER PLANT OF THE WASHINGTON MILLS CO., LAWRENCE, MASS.

(With inset.)

The Washington Mills, of Lawrence, Mass., since their reorganization some ten years ago, have been enlarged by extending the area covered by buildings, adding stories to existing buildings, and by replacing old buildings by new ones until they are now claimed to be the largest woolen mills in the world. Originally, like all the Lawrence mills, water power was the sole reliance, but for some years a pair of 30-in. × 60-in. horizontal non-condensing engines have also been in use. They were designed by Mr. E. D. Leavitt, and were built by the Dickson Mfg. Co., of Scranton, Pa. They are worked from 2,000 to 2,400 I-HP. constantly. The exhaust steam from these engines is used in the dye-house.

Recently Messrs. Dean & Main, mechanical and mill engineers, 53 State St., Boston, Mass., have put in for the mills 1,100-HP. of Hercules water-wheels, making the total water power of the mill at ordinary stages of the river 3,500 HP., and they have designed a rope drive for transmitting the power from these wheels, and two steam boilers and an engine containing some other unusual features, the whole forming a unique power plant well worthy of description.

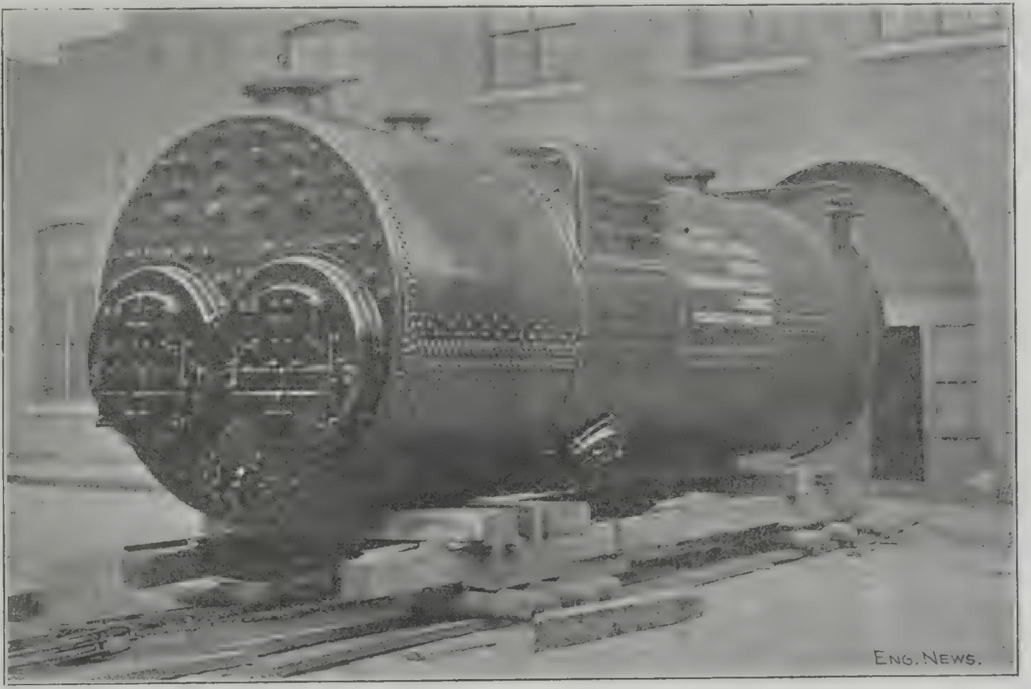
The extension of the mill have been so considerable that the total of steam and water power above noted, amounting to early 6,000 HP., has been insufficient during times of even small amounts of back water in the river, and especially during lighting up time, when 750 HP. is required to drive the electric lighting dynamos. This will soon be increased to 1,000 HP.

The Rope Drive.

The 1,100 HP. water wheels above referred to had to be so placed as to utilize an old waterway from the canal to the river; but this position was at some distance from the mill where the power was needed. It was necessary to transfer the power by a shaft westward some 80 ft., then southerly 103 ft., and vertically about 25 ft. After some scheming, it was decided to use for this purpose the "American" or continuous rope drive.

This drive is interesting, if not unique, because of its length and the great power transmitted. The rope wheels have 24 grooves for 1¾-in. rope, and 7,000 ft. of rope are used. The speed of the rope is 5,026 ft. per minute, and Kenyon cotton rope is used.

As shown in the drawing, the main rope wheel on the water-wheel shaft is 10 ft. in diameter. From it the rope passes upward, and thence over two 72-in. sheaves horizontally to the receiving wheel 76 ins. in diameter. The horizontal ropes are supported by two 72-in. carrying sheaves, and there is one 72-in. sheave used to direct one strand of the rope to the inclined take-up sheave which travels on a carriage. The movement of the take-up is very slight and maintains the tension of the rope satisfactorily.



INTERNALLY FIRED BOILER FOR THE WASHINGTON MILLS, LAWRENCE, MASS.
Designed by Dean & Main, Engineers, Boston, Mass. Built by The Atlantic Works, East Boston, Mass.

To make this rope drive a success, it was thought to be only necessary to support it on a very rigid structure from one end to the other, in order to maintain alinement and prevent vibration. A heavy timber truss was built from one end to the other, with chords and posts of Southern pine, and diagonal straining rods in vertical and horizontal planes, provided with right and left hand nuts, the whole being firmly anchored to foundations.

The drive is successful, and it is impossible to say from its behavior, when running, whether it is carrying a load or not.

The Boilers.

About the time the rope drive was undertaken, it became necessary to provide additional boilers. The existing boiler house was full, containing eleven horizontal return tubular boilers, 78 ins. in diameter, with 2,190 sq. ft. of heating surface (fire sides of tubes) each, or 24,000 sq. ft. in all, and carrying 135 lbs. of steam. Although the grates were large, being 8 ft. by 7 ft., 25 lbs. of coal were being burnt per sq. ft. per hour.

There was no place about the mill where a new boiler house could be built. There was, however, a space of little value on the other side of the end wall of the boiler house, and otherwise forming its continuation, except that the overhead floor was much lower than that in the boiler house, which had been made high to accommodate horizontal return tubular boilers. To raise this floor was a very expensive job, and besides this it would ruin the room above for manufacturing purposes.

It was seen, however, that a special design of boiler could be made that could amply be accommodated in the space at hand. The design shown on the inset sheet was prepared by Dean & Main, and two boilers were built by the Atlantic Works, East Boston, Mass. Each boiler has two 48-in. Morrison corrugated furnaces, entering a combustion chamber, from which 590 2½-in. tubes pass to the smoke box. The grates are 7 ft. 6 ins. long, the bridge wall 12 ins. long, the combustion chamber 5 ft. long and 6 ft. 8 ins. high, and the tubes are 14 ft. long between the heads. The length of the boiler over all is about 31 ft. The heating surface of each boiler is 5,300 sq. ft., the grate surface 62.20 sq. ft., and the ratio of heating to grate surface 85.2 to 1.

The unusually large ratio of 85 to 1 was adopted because it is probable that these boilers will be rushed, as the old boilers have been, and it is desirable to have enough surface to take up the heat evolved. The relation considered in designing the boiler has been that between coal burnt and heating surface, rather than the usual one between grate surface and heating surface.

The minimum inside diameter of the boilers is 9 ft. 10⅛ ins., and the maximum outside diameter 10 ft. 2 ins. The weight empty of each boiler is 90,000 lbs., and the weight of water held by it is 60,000 lbs., so that the working weight of each boiler is 75 tons in addition to the weight of the steam pipes, etc., resting upon it. Each boiler rests upon two cast-iron cradles, one of which is stationary, and the other rests on rollers of cold rolled shafting to permit free expansion and contraction.

Each boiler has two 6-in. pop safety valves which are set to blow at 135 lbs. gage pressure.

Each plate of the boiler was tested by the Pittsburg Testing Laboratory. All rivet, stay-bolt, and tube holes were drilled in place, and the rivets were driven by a hydraulic machine.

It is intended to have one fireman to each boiler and to burn one ton of coal an hour under each.

We would call attention especially to the means provided at the rear of the boilers for equalizing the flow of the gases of combustion through the upper and lower rows of tubes. In all horizontal fire tube-boilers there is a tendency for the gases to pass through the upper tubes rather than the lower, and in consequence a waste of heat results, the gases escaping from the upper tubes at too high a temperature. To counteract this tendency in these boilers three dampers have been placed in the stack, each controlling one of three portions into which the smoke chamber in the rear of the boiler is divided. These portions are made by hanging curtains or partitions in front of the tubes, so designed that they offer greater resistance to the flow of the gases through the upper rows of tubes than through the lower, which resistance may be varied at will by operation of the dampers. To secure the best effect the velocity of the gases should be the same through all the tubes and the temperature of the gas discharged by each tube should be uniform. The latter may be determined approximately by very simple means, such as placing an iron bar in a tube for a sufficient time, suddenly cooling it by plunging in a weighed quantity of water, and determining the rise in temperature of the water by a thermometer.

A number of bars may thus be used at a time, to take the relative temperatures of several tubes in a vertical row, and the three dampers adjusted until the greatest uniformity in temperatures is obtained.

The Engine.

In view of the great amount of power required to drive the lighting dynamos, and of the importance of being as independent of low and back water as possible, it was decided to put in a new engine designed to develop some 1,000 or 1,200 HP. at its point of maximum economy, but capable of working at much greater power.

The proper location of the engine was quite a problem, but it was finally decided to have it connected to the new water wheel shaft. Accordingly this shaft was extended westerly beyond the rope drive described above into No. 3 Mill basement, and arranged to drive No. 1 Mill, which adjoins No. 3.

On account of scarcity of room, it was finally decided to take the rather bold step of placing this engine in the line of the above-mentioned shaft which runs at 100 revolutions per minute. It was decided also to have a vertical engine in order to save room, do away with cylinder cutting and reduce friction, to say nothing of saving cylinder oil. There are a sufficient number of precedents for fast running large power engines at present to make this a safe project if the engine is properly designed.

Specifications were drawn up by Dean & Main for an engine having the following leading characteristics: Vertical inverted, four-valve, cross compound, surface condensing, thoroughly steam jacketed and provided with a large reheater. Diameter cylinders, 25 and 50 ins.; stroke, 36 ins.; revolutions per minute, 160; piston speed per minute, 960 ft. Shaft to be of hollow oil tempered steel, and all of the main forgings to be of the same quality of steel, made very light.

The engine was made condensing because the old engines furnish about all the exhaust steam that can be utilized, and it was made surface-condensing in order to keep the condensing water clean for the purpose of using it in the dye-house, instead of the cold river water, as at present, which is heated by exhaust steam. Thus all of the heat rejected by the engine is used in the dye-house quite as effectively as if it had entered the water at that point instead of at the engine, with the advantage that much less steam is required for the power than would be required by a non-condensing engine. There is, moreover, less condensation in the engine, and less loss of heat between the engine and dye-house, than with the non-condensing engine. All heat that enters the engine goes to the dye-house, except the equivalent of the work done, that lost in the engine by radiation, jacket and reheater condensation, and of course that contained in the air-pump discharge. By removing the oil from it, the heat in the latter can be saved. The cost of coal for running this engine is, therefore, next to nothing.

The circulating pump not only sends the water through the condenser, but continues its course to the dye-house. The surface condenser has a combined circulating and air pump, the whole was made by the firm of H. R. Worthington. There is also an automatic receiver pump for returning the separator, jackets and re-heater condensations to the boilers, and the exhaust of these auxiliary pumps goes into the exhaust system of the old engines.

The contract for the engine was awarded to the Rice & Sargent Engine Co., of Providence, R. I. It will have Corliss valves, but the specifications required the low pressure valves to be worked by positive connections with the eccentrics, and to have a fixed cut-off at ¼ stroke, capable, by adjustment when the engine is not running, of being extended any amount to ⅜ stroke. The valves will be wide open at 1-10 stroke, and the port opening is 12% of the piston area. The high pressure valves only are to be connected with the governor, and dash pots are to be used on this cylinder and closed by steam.

The speed of the surface of the shaft journals being great, the bearings were made sufficiently long to reduce the pressure per unit of surface considerably below that occurring in common practice, and ring oiling is to be employed. The product of journal speed by pressure per unit of surface, however, is far within that common in locomotive driving axle practice.

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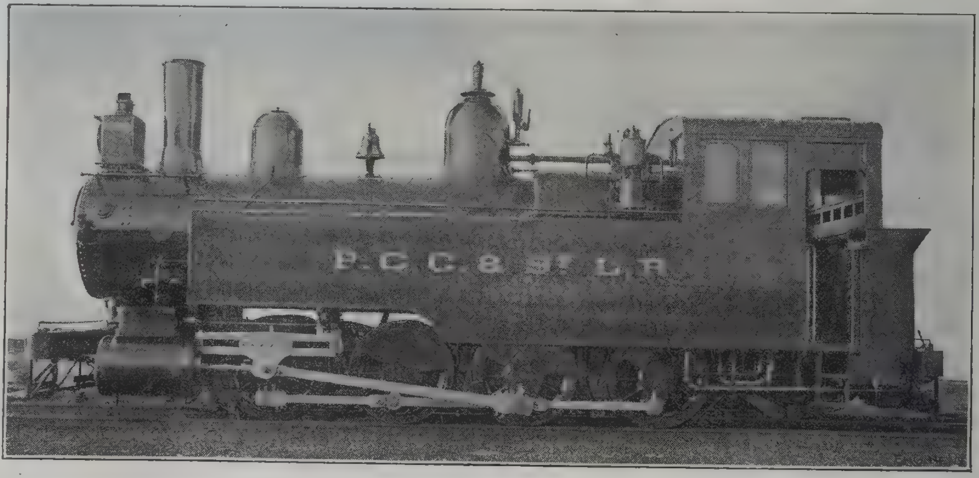
HEAVY TANK LOCOMOTIVE FOR THE MADISON INCLINE, PENNSYLVANIA LINES.

The operation on a grade of nearly 6%, more than a mile long, of the regular traffic of an important trunk line of railway is a problem not often met with, but such a grade exists near Madison, Ind., on the Louisville Division of the Pittsburg, Cincinnati, Chicago & St. Louis Ry. (the Southwest System of the Pennsylvania Lines West of Pittsburg). It is 7,012 ft. long, with a total elevation of 413 ft., making a rise of 311 ft. per mile, or approximately 5.9%. It is undoubtedly one of the steepest long grades in the world upon which a regular passenger and freight service is maintained with the use of adhesive power only. We illustrate herewith a locomotive designed specially for service on this very heavy grade.

When ascending this grade, the cars (as a precaution in case of broken couplings) are pushed before the engine; and when descending, the engine backs down at the front of the train. It is to be understood that the regular road engines are disconnected from their trains at the top of the grade, and left there waiting for the next train brought up by the hill engine. The peculiar conditions of the service at this place necessitated many departures from customary locomotive construction, and the proportions of the engine are consequently somewhat different from ordinary practice and do not entirely conform to the rules recommended by the Master Mechanics' Association. One of the most notable features is the adoption of a tank engine, thus increasing the weight available for adhesion, a matter to which we have briefly referred on our editorial page.



HEAVY TANK LOCOMOTIVE FOR THE MADISON INCLINE; PITTSBURG, CINCINNATI, CHICAGO & ST. LOUIS RY.
S. P. Bush, Superintendent of Motive Power.

The locomotive, as will be seen by the accompanying cut, is carried on eight wheels, all of which are coupled, and has a large tank on each side of the boiler and a small coal bunker behind the cab. The fuel used is bituminous coal. The general dimensions and particulars are as follows:

Tank Engine for Madison Incline; P., C., C. & St. L. Ry.

Running Gear:	
Driving wheels, diameter	4 ft. 2 ins.
Journals, driving axles	8 × 8½ "
Wheel Base.—Driving	15 ft. 3 "
Wheels having blind tires	Second pair.
Weight in Working Order; (all on drvg wh'ls)	140,000 lbs.
Cylinders	22 × 28 ins.
Distance center to center	7 ft. 4 "
Form of crosshead and guides, Laird (cast-st'l cross-h'd)	
Connecting rod, length between centers	9 ft. 10⅜ ins.
Valve Gear:	
Type	Stephenson link.
Steam ports	1¼ × 18 ins.
Exhaust ports	2¾ × 18 "
Slide valves	Richardson balanced.
Lap, outside	1-in.
Lap, inside	3-16-in.
Travel	5 ins.
Lead	1-16-in.
Boiler:	
Diameter of barrel inside	5 ft.
Thickness of barrel plates	7-16-in.
Height from rail to center line	7 ft. 6 ins.
Working steam pressure	150 lbs.
Firebox:	
Type	Belpaire.
Length inside	7 ft. 9½ ins.
Width inside, at top	3 " 11½ "
Width inside, at bottom	3 " 6 "
Depth	4 " 9½ "
Thickness of side plates	5-16-in.
Crown sheet	⅜-in.
Tube sheet	⅜-in.
Grate area	27 sq. ft.
Tubes:	
Number	219
Pitch	2 13-16 ins.
Diameter, outside	2 "
Length between tube plates	13-ft. 4⅝ "
Total fire area of tube openings	3.65 sq. ft.
Heating Surface:	
Ratio to grate area	61.91 to 1
Tubes, exterior	1,528.89 sq ft.
Firebox	142.86 " "
Total, with exterior tube area	1,671.75 " "
Miscellaneous:	
Exhaust nozzle, single; diameter	5 ins.
Smokestack, smallest diameter	18 "
Smokestack, height from rail to top	15 ft.
Capacity of tanks	2,000 gallons.
Capacity of coal space	3,000 lbs.
Tractive force per lb. effective press. on piston	271 lbs.
Total tractive force with effective pressure equal to 30% of boiler pressure	32 520 "
Total adhesive tractive power, at 25% of weight on drivers	35,000 "

In order to prevent the trains from gaining too much headway during the descent the engine is equipped with an interesting arrangement for regulating the speed. This is based on the principal of the Le Chatelier brake, and is in some respects similar to that used on several of the western mountain railways. It consists in connecting the valve chests with a 1½-in. pipe, from which a 2-in. connection runs back to a point below the cab floor at the engineman's side, where it terminates in a muffler. When descending the hill the link motion of the engine is reversed, so that the cylinders during a portion of the stroke will force air up into the valve chests and thence through this pipe to the muffler, where it escapes into the atmosphere. By means of a regulating valve below the cab floor the escape of the air can be checked so as to obtain the most desirable speed for the pistons, and consequently for the engine. By closing the valve entirely the engine can be stopped during the descent. In order to prevent the pistons from sucking in air from the smoke box, with accompanying cinders and grit, a steam jet is directed upwards through the exhaust column from an opening in the hollow wall dividing the two exhaust passages. Fresh, clean air is instead admitted into the cylinders from a connection at the base of the exhaust column; this leads to the outside of the smoke box and is shown over the valve chest in the illustration. This connection can be opened or closed by means of a valve operated from the cab, and it is, of course, apparent that it must be opened only when descending the grade. In order to lubricate the cylinders a small jet of hot water is let into each exhaust passage. Besides this regulating device the engine is equipped with the American driving-wheel brake, and there is also a powerful screw hand-brake which alone will hold the engine and train on the grade.

As before stated, the service for which the engine was designed necessitated a departure from the customary proportions of locomotives. A little reflection will show how different the work of this engine is from that of ordinary engines. A road engine has to exercise its entire hauling capacity only when starting a train and getting up speed, but during the majority of the time it is in service only a fraction of the total power is needed. The total adhesive weight on the drivers is never utilized when the train is running at its regular speed with the lever hooked up towards the middle, and it is then that the economy of expansion comes in. If a road engine could be so situated as to have to make a continuous start lasting during its whole run, it would be under the same conditions as when going up a steep grade. The exertion of the full adhesive power is consequently not the exception but the normal condition of work on the Madison hill.

To use steam expansively under these conditions would be impossible, unless the cylinders were of much greater proportions with regard to the adhesive weight, than on the ordinary road engine. The total weight of the new engine is 140,000 lbs., all adhesive weight, but the mean weight during the ascent is about 130,000 lbs., this being based on the consumption of two-thirds of the water in the side tanks. According to ordinary practice this weight would require a cylinder proportion of about 22 × 24¾ ins. The additional 3¼ ins. of the stroke which this engine has, is a clear gain in the expansion of the steam, over and above that which may be produced when the engine does not exert its full adhesive power up to the slipping point. In other words, the cylinders were made as large as it was practical to make them, and the economy of this is shown by the fact that ordinarily the engine is able to make three round trips up and down the hill without refilling its coal bunker, which holds only 1½ tons of coal.

The engine was placed in service on Jan. 1, 1896, and has been giving entire satisfaction ever since. No official test of its hauling capacity has yet been made, although it is the intention to make such a test in the near future, in order to obtain reliable details of performance for comparison and future use. We are officially informed, however, that the engine has fully met the expectations of the officials, and that its performance during the ascent as well as the descent is entirely satisfactory.

Quite a number of interesting details had to be considered in the design of the engine. In order to keep the front ends of the top row of flues under water on the grade without filling the boiler so full as to cause the engine to get wet steam and throw water from the smokestack, the back end of the boiler is set considerably higher than the front end. The throttle valve is of the ordinary balanced type, but it has no play on its stem, the object being to avoid the clattering of the valve upon its seat in case the compression in the steam chest should exceed the boiler pressure during the descent. To protect the steam chests, a relief valve has been placed on each, which is set just beyond boiler pressure. In arranging the driving springs for the engine it was calculated that the front springs would receive the greatest load and they were designed accordingly. When the engine is on the grade, however, its center of gravity is shifted backwards, and in consequence the rear springs receive the greatest load, which caused some little inconvenience at first, until the necessary adjustment was made.

Instead of metallic piston rod packing, asbestos cord is used, as the metallic packing would be apt to be damaged when the engine is drifting down the hill without steam. The engine is equipped with pneumatic bell ringer, pneumatic sand valves, steam heat for passenger trains, and all modern improvements.

This locomotive was designed by Mr. S. P. Bush, Superintendent of Motive Power of the Southwest System, Pennsylvania Lines West of Pittsburg, and it was built at the company's shops at Columbus, O. We are indebted to Mr. Bush for the photograph and information used in the preparation of this article.

The city of Madison, Ind., is 85 miles southeast of Indianapolis, on the Ohio River. The inclined plane was built by the State of Indiana when Madison was on the transportation highway to the West. Passengers and freight came from the East over the old Portage road and the Johnstown canal to Pittsburg, thence on the Ohio River to Madison, thence through Indianapolis to central Indiana and Illinois. A portion of the plane is cut through solid rock over 100 ft. in depth, and there are two embankments nearly 100 ft. high. The incline plane was commenced in 1836 and finished in 1841. It came into the possession of the Pennsylvania System in 1874. The plane was finished in 1841 and operated by horse power until November, 1848. Andrew Cathcart's improved engine, having two sets of cylinders, and a pinion working in a rack in the center of the track, was used until July, 1868, when it was superseded by a more powerful engine designed by Mr. Reuben Wells, the Master Mechanic on the Jeffersonville, Madison & Indianapolis R. R., and built in the railway company's shops at Jeffersonville, Ind.

This old engine, which was in use until the present year, had eight driving wheels, 44 ins. diameter; cylinders, 20 × 24 ins.; wheelbase, 16 ft.; and weighed 57 tons. The boiler had a crown-bar firebox for burning wood, and carried a working pressure of 125 lbs. It was originally built with ten driving wheels, but one pair was taken off in 1886 to facilitate running over the sharp curves in the yards at Madison.

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THE AMERICANIZING OF ENGLISH RAILWAYS.

A great deal has been done in the past few years in the introduction into Great Britain of features of railway practice which are practically copied from this country; and the results have been highly pleasing to the travelling public at least. Nevertheless the well-known conservatism of the Britisher makes itself heard occasionally in denunciation of these innovations. In a recent number the London "Engineer" publishes in its correspondence department a letter from a representative of this class which is most amusing for its bluntness and for the "Americo-phobia" (if we may coin a word) which its writer discloses. It will be noted that the writer, like many of his countrymen, considers that anything of old establishment must be good, and he deprecates the use of the improved American car coupler because the clumsy English coupler has been in use for 60 years. It is also to be noted that side-chains are used with the American automatic coupler for passenger cars, and it may be inferred that the writer of the letter is not very well posted on the details or merits of the devices which he criticises.

We print the letter in full as follows:

Sir: From time to time efforts are made by various well-meaning people to Americanize our English railways, apparently under the impression that whatever is American is right, and that we do not at all understand what suits us best. Differences of climate, of average length of journey, and of long custom are taken little into account by these zealous reformers, who are quite convinced that whatever pleases the American traveller ought to give equal satisfaction here. One of these periodical waves of Transatlantic influence is now passing over this country, and no doubt, like former ones, will leave some traces of its passage. We are promised the Brown coupler, the Jones "car" heater, the Robinson lighting apparatus and what not. Because Americans are content to stew themselves in winter time at 80° at the pleasure of a black attendant, who naturally loves tropical temperatures, we ought to do the same. It is stated that the Great Western Railway, with more zeal than patriotism, is ordering steam heating apparatus from America. The steam heating, to my thinking, is both unpleasant and ridiculously unnecessary in this country. What need has there been for it during the last winter for example, when not a flake of snow or a piece of ice that would bear a dog was seen? It dries rather than warms, and brings the dampness out of wet clothes, boots, and umbrellas in a most unwholesome manner.

Another great fad of the Americanizers is that a system of coupling which has answered its purpose admirably well for sixty years should be given up for a clumsy lump of metal, which can only act by the coaches being heavily bumped against each other, and which, if it should give way, has no side chains to keep the train together. Our permanent way, the best in the world for solidity and excellence, for convenience of renewals and for durability of parts, must be abandoned for one in which the rails are fastened down with dog spikes, after the manner of contractors' temporary lines, and have nothing else to prevent them from turning over. Wood being so cheap in America that the railways can afford to almost pave their lines with roughly hewn logs, we ought in this country, where every sleeper is imported, carefully selected, dressed to a standard size, and preserved by chemical means, to make our lines a continuous wooden flooring. No proof that English railways use too few sleepers is given, but American ones use more, which, of course, quite settles the question.

Our system of conveying passengers' luggage is found to be entirely wrong by the admirers of American practice. The system of checks is all very well for long journeys of two or three days' duration, but what advantages has it for those of as many hours? It is based mainly also upon the plan of having luggage conveyed to and from the stations independently of the traveller it belongs to, a system which does not obtain here, and is not the least likely to.

Even the late regrettable outrage on the Brighton Railway is turned to account by the foes of our comfortable and cosy system of compartment coaches. If we travel in huge caravans, full of draughts and smells, dust and noise, such things, it is said, could not happen. About a thousand millions of passenger journeys are made annually in this country, and such a case occurs perhaps once in five or six years. Can any American say the same for the United States? Of course we do not over here know of every outrage which occurs in American trains, but shall need a good deal of convincing that they can possibly be rarer under any system than they are in Great Britain.

In America, where many journeys run to 2,000 miles, and even a good deal more, and where passenger traffic is of much less importance than goods, it may be necessary to induce people to undergo the fatigue of such journeys by affording them far more luxury in travelling than the vast majority ever get at home. But is it really required here, where a journey of 300 miles is considered a good day's work by most people? Are these novelties in the least demanded by the British travelling public, or are they simply forced upon it by the reckless competition between the companies? I freely admit that a good deal has been copied in this country from American practice during the last few years, and with advantage; but where is the process to stop? One of the most serious aspects of the question is that concerning the enormous deadweight per passenger of the American style of coach. The latest trains of this type, just built for the East Coast joint service to Scotland, weigh 270 tons and carry 300 passengers, or 2,016 lbs. per passenger. A train of six-wheeled stock, quite as safe and amply good enough for any one not enervated by luxury he never originally wanted, could carry as many and weigh only 90 tons, including a 12-ton van. As to lunching or dining in trains, it is simply so much money taken away from the station refreshment rooms and maintaining extra staffs to do it with. To most Englishmen it is far more agreeable to leave the train for a few minutes now and then to obtain necessary refreshment, than to take it amidst the noise and vibration of even the most gorgeous dining saloon ever put upon wheels. The fact is, many English railways are so prosperous just now that they hardly care what expense they go to in order to eclipse their rivals, whether in speed or luxury. They think nothing of using a couple of enormous engines and tenders to convey two or three dozen passengers at a break-neck speed in 25-ton vehicles costing $10,000 apiece. I very much fear that when hard times come again—and they always do come again and generally stay longer than is convenient—and the companies find people have been made dissatisfied with the comfortable and profitable English coach, they will regret the necessity for building more and more of these travelling drawing-rooms, dining-rooms, bedrooms, smoking-rooms, kitchens, lavatories, and heaven only knows what. They need not think to confine them only to the very longest journeys; passengers will want them on much shorter runs, and I shall be surprised if the companies are loyal enough to each other to hold out unitedly against such a demand. W. B. Paley.

September 8th, 1896.

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A PORTABLE ASPHALT PLANT has been built by the Hetherington & Berner Co., of Indianapolis, for the purpose of preparing asphalt for paving work in small cities where it would not pay to erect a stationary plant. The apparatus consists of two cars having steel frames and corrugated iron sheathing. Packed in one of these is a frame made of tubing and light steel beams, which forms the framework for the machinery when the plant is in use. The cars are run on a sidetrack and have the wheels blocked, the framework is erected and the mixer mounted in position on a tower between the cars. One car carries the power plant, consisting of a locomotive boiler and a steam engine. This car also contains the sand dryer and screens, while the other contains the asphalt kettles.

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The uncoupling of M. C. B. couplers while trains are running, without any evident reason for the action, forms the subject of some interesting figures recently made public by Mr. J. N. Barr, Superintendent of Motive Power of the Chicago, Milwaukee & St. Paul Ry. According to this statement and to similar statements by other railway officers, these accidents are becoming frequent enough to demand the study of motive power officials and coupler manufacturers to provide a remedy. Mr. Barr's records cover a period of two years, but he presents actual figures for only two months of the period, viz., the months of August and September, 1896. These are as follows:

Causes of Train Break-in-Twos with M. C. B. Couplers.

August.		September.	
Chain too short	3	Chain too short	1
Locking block worn	1	Locking pin worn	3
Locking pin raised	1	Locking pin raised	6
Undetermined	21	Wrong knuckle	1
		Guard arm too open	1
Total	26	Undetermined	24
		Total	36

It will be seen that out of 62 uncoupling accidents occurring during the two months designated, 45 occurred without any apparent reason as far as an examination of the coupler or the observation of the trainmen gave evidence. Mr. Barr states further that the accidents were no more frequent with one make of coupler than with another, and also that as far as his observation gave evidence the uncoupling was not due to the sliding free of the knuckles without opening. As an explanation he suggested the possibility of the "creeping" of the locking device until it finally raised sufficiently to free the knuckle, which was then pulled open. This uncoupling of automatic couplers was one of the subjects discussed at the convention of the Master Car Builders' Association in June last, as recorded in our issue of June 25, and it appears that this is a trouble which is being experienced on many railways, and Mr. Barr himself stated in his remarks that the partings of freight trains by unlocking of M. C. B. couplers were four times as numerous as those from breakages of link-and-pin couplers. The general trend of the discussion appeared to show that the trouble is mainly due to the locking pin, which is caused to rise by the jarring or buffing strains or by the nipping action of the knuckle incident to the motion of the cars. The collecting of coal and dirt under the pin, and the use of too short a chain on the pin were also adduced as reasons for this very undesirable action. It would seem to be necessary for coupler manufacturers to look very closely into this matter and to discuss it with the men who are familiar with the use of the cars in actual service, so that some means may be adopted to prevent these dangerous break-in-twos. From the evidence thus far presented, it would seem that gravity alone is not a sufficient reliance to hold a knuckle lock in place, and that the lock ought to be held in its place by some mechanical connection when the knuckle is closed.

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The advantages which tank locomotives possess for certain classes of service do not seem to be as generally recognized as they should be by American railway managers and superintendents of motive power. The advantages of such engines for yard service are pretty well known, though engines of this type are but little used in practice even for this purpose, but their advantages for a suburban service where frequent stops are required deserve to be better known. It is to be remembered that a tank engine saves the cost of a tender, and occupies less space on the track, which latter is an important consideration in yards. In yard work, also, the tank engine gives the engineman a good view to the rear, so that he can handle his engine in such a way as to do little injury to cars in switching. The New York, Pennsylvania & Ohio R. R. (Erie R. R. system) and the West Shore R. R. are among the few roads using tank engines for yard work, and the Long Island R. R. is one of the few using engines of this type for suburban service. All elevated railways operated by steam, however, are equipped with this type of engine exclusively. The Grand Trunk Ry. (following English precedents in this as in many other matters) uses tank engines for both the above classes of service, and the traffic in its St. Clair tunnel is operated by monster tank engines mounted on ten wheels (all coupled).

In this issue we illustrate and describe a new and powerful tank engine built for working the heavy passenger and freight traffic over the Madison incline on the Pittsburg, Cincinnati, Chicago & St. Louis Ry. Here the run is short, with no trouble in taking coal, and all the adhesive weight than can be obtained is desirable, while the amount of switching required makes the shortness of the engine an added advantage. In England, tank engines of various types are used almost exclusively for suburban and switching service, and we have from time to time illustrated some of these locomotives. While the new engine described elsewhere is for special service only, and cannot be taken as an indication of any intention towards a general use of such engines, it at least serves to call attention to the tank type of locomotive, and may lead to some further consideration of the advantages of this type for other classes of work.

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In his late annual report, Commodore Melville, Chief of the Bureau of Steam Engineering, directs especial attention to the number of engineer officers of the navy who have been retired during the past year for physical incapacity, and to the steadily increasing number of such officers on the retired list. He says that these retirements are conclusive proof that the physical strain to which the officers of the engineer corps are now subjected is too great, and that the only remedy is an increase in the number of such officers. Commodore Melville takes the position long held by this journal—that in the modern battleship "the guns would be powerless without the machinery; also that, other things being equal, that fleet will give the best account of itself which has the best equipment of trained men in the engine room, as well as at the guns." It is to be sincerely hoped that the next Congress will handle this subject of naval personnel in a business-like, intelligent and thoroughly unprejudiced manner; and in the spirit that the real importance of the subject demands. Our Government has been liberal for some time past in its appropriations for new warships, and the results of these appropriations are a source of national pride, and are serving as models for nations with a longer experience in naval construction. But, as Commodore Melville says, it is one thing to design and build machinery for these vessels, but it is quite another thing to keep this machinery in such condition that it may be ready to respond to every call made upon it under all conditions. This naval machinery is of such a complicated character and of such common and diversified use that constant vigilance and the greatest care are necessary to keep it in the state of efficiency required. If the number of trained men demanded by these conditions is not sufficient, the efficiency of the ship as a fighting or cruising machine is correspondingly lowered, and the skill and money expended upon her design and construction are practically wasted. In our new navy a sufficient number of trained officers and men is of quite as much importance as new ships. If we are to have a new navy it is the duty of Congress to see to it that it is made efficient in all its branches.

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That old familiar subject for discussion, the respective merits of bridges having pin connections and riveted connections, has been left in peace for some considerable time, but was brought out again at last week's meeting of the American Society of Civil Engineers. The occasion was a brief paper by Mr. George E. Gray, Hon. M. Am. Soc. C. E., referring to old riveted bridges on the New York Central R. R., and the advantages of this type of truss were ably set forth in the discussion by Mr. George H. Thomson, who is well known as an advocate of this type of construction. The greater safety in case of a derailment on the bridge was, of course, put forward, but, on the other hand, another member considered that the fact of the far greater number of pin-connected bridges made impossible any proper comparison on this ground. He instanced some severe cases in which pin-connected bridges had successfully withstood serious damage, and yet had not collapsed in the way that the opponents of this type of construction had claimed that they would (or at least ought to) collapse. The advantage of distributing the load over a great number of points were touched upon, but curiously enough no reference was made to the multiple-intersection latticed construction in which this feature reaches its highest development. The discussion turned almost entirely upon ordinary through trusses having riveted or pin-connected members, but even Mr. Thomson admitted the applicability of the latter system for deck structures. There was not a very long or comprehensive discussion, nor did it bring out anything very new, beyond the facts of the extent to which riveted truss bridges with solid floors have been introduced on the Central Vermont R. R., and it was really but a brief revival of an old but interesting subject. It may be noted, however, that the portals of the Central Vermont R. R. bridges are distressingly ugly from an aesthetic point of view. The heavy rectangular end-posts are connected by a rectangular portal girder with triangular gusset plate connections of the girder to the posts. Considering the amount of money expended in getting a good design and a good structure, a little money might surely have been spent in securing a less harsh and unsightly treatment. An arched portal girder, or curved gusset plates would have had a lighter and pleasanter appearance, without in any way reducing the strength of these important members. It is evident that bridge engineers, as a class, have not yet began to realize the demand for some regard for aesthetic principles in their structures.

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There is one matter in connection with pin-connected bridges, which especially deserves to be kept in mind by engineers, and that is the advantage which they possess with respect to erection in difficult localities. On the inset sheet in our last issue was a view of a great bridge on the Trans-Siberian Ry. over the Usuri River, a structure with three long spans all made with riveted trusses. The labor required to prepare the material for such a bridge, transport it to the site and erect it, must have been enormous; and the vast amount of field riveting necessary must have kept the structure on the falseworks a very long time. The advantage of the pin-connected structure for any such situation is obvious to an American engineer. Apparently the builders of the Trans-Siberian Ry., and similar pioneer railways, could patronize American bridge companies or at least copy their practice with a great deal of profit.

HIGH BUILDINGS AND SAFE ELEVATORS.

To the European traveler in the United States at the present day there is probably no more striking feature than the prevalence of high buildings in large cities. We do not refer by this so much to the wonderful structures of 16 or more stories, of which both New York and Chicago can boast a considerable number, but to the buildings of eight, ten or twelve stories, of which great numbers exist in all our large cities, such as Philadelphia, Boston, and St. Louis, and which are becoming quite a prominent feature even in such minor cities as Pittsburg or Buffalo. The social and economic results which come from the prevalence of high buildings are of great importance. It is of enormous advantage in the conduct of business, for example, enabling a very great number of people to be concentrated in a small area, and yet giving them an abundance of light and air, and room for convenient work. Take for example the central business district of Chicago. If all the business in this district were to be transferred to buildings not more than five stories high, it would be necessary to cover an area more than twice as great. The added difficulty and cost of carrying on business when such an extended area is included in the business district are evident.

For an example on the other side we may take the city of London. As is well known, the area which the old city of London covered, now commonly known as "The City," is almost wholly given up to business; but the vast amount of business transacted on this limited area coupled with existing restrictions as to height of buildings (few office buildings being more than five or six stories in height) has compelled a crowding which an American would find most irksome and inconvenient. The contrast between the spacious and well lit offices of an American firm in a modern office building and the cramped and dimly lighted quarters which satisfy a London firm doing a similar amount of business, is one which has often been noted.

Now, while rigid building laws in European cities are partially responsible for the absence of high buildings there, it is also true that the high buildings of American cities are made possible only by a notable American invention, the fast passenger elevator. Its development has been as rapid as has the development of the high building itself, and had this not been the case, it is certain that the latter would not have taken place. We should not see a 30-story building in process of construction in New York to-day, for example, if the elevator builders had not made great advances over the slow moving machines that were in common use 15 years ago.

But a matter not less important than the features of speed and reliability is the matter of safety. It is only because it has been possible to convey passengers up and down a vertical shaft with almost, perhaps quite, as small a percentage of casualty as occurs in travel on a railway, that the elevator has become so popular. There is a sensation of risk in moving swiftly up or down a vertical shaft, and only habit and experience of its safety dispels it. But if once a serious accident occurs to an elevator, fears are aroused, people resort to stair climbing and tenants begin to look with more favor on buildings of lower height.

From this point of view the recent accident to an elevator in the 22-story building of the American Tract Society, reported in our last issue, is of importance to every one interested in any way in high buildings, or their construction. It would take only a few such accidents, should they chance to occur at about the same time, to seriously shake public confidence in the general safety of elevator service; and should this take place, the investment in present high buildings and the construction of additional ones might be seriously affected. In other words, it behooves elevator builders and those responsible for the safety of existing elevator plants to spare no pains to keep the standard of safety at its highest, not only to make safe their own business, but the investments and business of thousands of others.

Reviewing now briefly the circumstances of the accident in the Tract Society building elevator, it appears that in the design of this plant, a high-pressure hydraulic system, using water at a pressure of 900 lbs. per sq. in., was adopted in place of the lower pressure, about 150 lbs., commonly employed. It will be apparent that by this means it was possible to materially reduce the size of the hydraulic cylinders, and thus the space taken up by the elevator plant. This was, of course, an important matter in so large an installation.

In published statements the builders ascribe the troubles which have been experienced with these elevators to the use of this system; but it appears doubtful to an engineer whether this is the sole or even the main reason for the accident.. Ever since these elevators were put into service there has been difficulty in operating them. With the best care on the part of the operators they have found it difficult to run the elevator cars smoothly and to stop them at a floor landing at exactly the right point. It can easily be believed that the valves controlling the movement of the hydraulic plungers were not so well proportioned as those which the builders had for years used on low-pressure work, and to which they were accustomed; but that is hardly a fault of the high-pressure system. An accident which occurred some months ago, in which a car dropped suddenly a story or two, we have heard ascribed to air in the cylinder, a danger against which every precaution should be taken in a hydraulic elevator system; but it is not apparent why air should be more likely to give trouble here than in a low-pressure system. Again, the recent accident was due to the breakage of a bolt in a check-valve cover; but unless the error was committed of using the same check-valves for 900 lbs. pressure that was used in ordinary low-pressure works, it is again not clear what the high-pressure had to do with the accident.

The real cause of the recent accident and the root of the difficulty with which all elevator engineers are now struggling is simply the great rate of speed at which elevators in high buildings are now required to be run. Recent specifications call for a speed of 700 ft. per minute on passenger elevators, or nearly 8 miles per hour, about the speed of a Broadway cable car. The elevator car with an average load and including its counterweight will weigh, perhaps, two tons, and this weight must be started from rest and brought up to full speed in a movement of perhaps 5 ft., must stop from full speed in a similar distance, and must be capable of control by the elevator boy, so that it can be stopped at the floor level within a fraction of an inch. Besides this, the acceleration and retardation must be suitably graduated, else the passengers will be forcibly reminded of a toboggan slide, when the car starts down, and will feel as if their avoirdupois had suddenly and uncomfortably increased when the car shoots up.

The difficulty of difficulties comes in, however, when we take up the design of the safety attachments. Every passenger elevator has, or ought to have, appliances by which, when the normal speed of the car is exceeded, whether from the breaking of the rope, the derangement of the elevator machinery or any other cause, clutches automatically grip the guides at the side of the elevator shaft and bring the car to a standstill. This was an easy enough matter when elevator cars ran 200 or 300 ft. per minute; but when we reach 700 ft. per minute difficulties thicken. There must be a considerable margin between the normal speed of the car, and that at which the safety clutches is set to operate, for variations in the load on the car and the pressure in the cylinders cause large variations in the ordinary speed of the cars. If the normal speed is 700 ft. per minute, we presume the safety clutch could not be set to operate at less than 1,100 or 1,200 ft. per minute, or nearly 12 miles per hour. But the operation of a safety clutch at such a speed is a thing to be done with caution. To bring a weight of two tons or so too suddenly to rest from such a velocity might cripple the elevator guides or cause some other breakage which would make a bad matter worse.

In the recent Tract Building elevator accident, the car did not fall. It merely ran down the shaft at a speed not high enough to operate the safety clutches and struck the buffers at the bottom. Its passengers found by experience that to be brought up with a shock from even such a speed is not unattended with danger.

It was a trifling thing that caused the accident. The breakage of a bolt in a check valve on the pipe leading from the pump to the hydraulic cylinder started a leak, which caused the movement of the plunger, just as if the discharge valve from the cylinder had been opened. But this leak was not automatically closed when the car neared the bottom of its shaft, as the valve would have been, and so the car struck the bottom buffers at full speed. Any other cause which would have started a leak from the cylinder and the system of piping to which it is connected would have been equally effective in causing the accident. In most of the newspaper accounts of the accident, in fact, it was ascribed to the blowing out of a gasket. It doubtless occurred to most engineers who saw these reports that it was a strange sort of engineering that used a gasket which could by any possibility blow out, for the joints of a hydraulic elevator system. We presume that metal to metal joints, or at least some form of metallic gasket is used for such connections.

Another fact of importance comes to light in considering this accident. Suppose that the break of this check-valve cover bolt had occurred a moment sooner, just when the elevator car was standing at a floor, and passengers were getting on or off it. The car would have instantly started down and the chances are great that one or more of the passengers would have been caught in the doorway and cut in two. This is a danger which does not seem to be guarded against as it should be in elevator construction. When the car is standing still it is held in position only by the elevator machine and any break or failure occurring at that time, if passengers are entering or leaving the car, may cause a fatal accident.

It may be urged that the chances are so remote of such an accident occurring that it is not worth while to make provision against it. There is a popular idea that an elevator is a machine so simple and safe that it is very little liable to accident or to getting out of order. In this connection we find some interesting figures in the last quarterly report of the Superintendent of the Department of Buildings of New York city. This department is by law charged with the duty of inspecting passenger elevators. We quote the summary of its work in this field in the first nine months of two successive years as follows:

	Jan. to Sept. —inclus.—	
	1895.	1896.
No. inspections of passenger elevators.......	2,632	4,257
Defective passenger elevators reported........	62	856
Elevators made safe on notice from Dept....	44	912
Pass. elev. cases sent to att'y for prosecution..	16	182

It is certainly clear from these figures that unless the present inspection is too severe by far, the inspection of a year ago was a highly incomplete and perfunctory affair. Further, the fact that the inspectors of the Building Department should be able to find an average of 95 defects a month in the passenger elevators of this city is surprising and somewhat disquieting. It must be remembered that an elevator plant ought to be and generally is in the charge of competent attendants, who should discover and remedy all defects, regardless of the occasional visits of the official inspector. In addition, a large number of elevators are regularly inspected by private firms who make a specialty of this work. It will also occur to many of our readers, doubtless, that the above figures show well that safety is not to be found in reliance upon any municipal or state bureau. If we grant that the inspection of 1896 was thorough and effective, what guarantee have we that we may not in a year or two return to the conditions of 1895?

Returning to our statement above that the real cause of present troubles with passenger elevators is the high speeds at which they are required to be run, we are far from saying that because of this fact present standards of speed should be lowered. The speed of 700 ft. per minute, which is the highest now in use so far as we recall, is no more than is actually needed to give sufficiently prompt service to buildings 14 or more stories in height. We do believe, however, that it is the duty of elevator makers, and of the engineers who specify the requirements which elevator makers must fill, to pay more attention to the matter of safety when such high speeds are required.

The most fruitful direction in which to work, it appears to us, is in connection with the safety devices on the car itself. We know of no good reason why every elevator car should not be furnished with a brake, under control of the operator, by which the car could be stopped and held at any point of its travel quite independent of the operating mechanism. If this brake were interlocked with the operating lever, or with some mechanism connected with the doors at the various landings, the car could be held absolutely in place at every stop and the danger of its starting up or down while passengers are entering or leaving, either through accident to the machinery or through the carelessness of the operator, would be wholly done away with. It may also be noted that the common annoyance of cars creeping up or down on account of minute leaks when standing at a floor would be obviated by such an appliance.

A word may be said here also concerning the provision of air cushions at the bottom of elevator shafts. These were in quite general use a dozen years ago, and many remarkable tests were made with them, such as dropping a car several stories without injury to passengers. With the advent of buildings of 12 stories and upward the air cushion idea appears to have been generally dropped. This, again, seems to us a mistake, for an air cushion is not designed to catch a car falling freely from a height of a half-dozen stories or more. Other appliances on the car should prevent any such great speed as would be obtained by a free fall from such a height. But an air cushion would serve a useful purpose in arresting a car which runs down the shaft as did the car in the Tract Society building without setting the safety clutches.

That the automatic clutch alone is not enough of a safeguard for high-speed elevator service, however, seems to be amply proved. Many of our readers will recollect in the Manufacturers' Building at the Columbian Exposition a set of hydraulic elevators which carried passengers up to the roof of the building, a dizzy height. During the exposition one of these elevators fell with a load of passengers on account of the breaking of the rope. The car fell several feet and then was stopped by the safety clutches, but these released as soon as the car stopped and again it fell, to be again brought up, and so on, till it came to a final stop some 20 ft. above the bottom of the shaft.

It is a well-known principle in the operation of safety devices of every sort, that unless provision is made for their regular use or testing, they are very apt to be out of order and inoperative when the emergency comes which they are designed to meet. This is an inherent fault of the ordinary safety attachment on an elevator car. In the regular course of events it is never used during the entire life of the elevator, and it is, therefore, never certainly known whether it will operate effectively when an accident occurs which it is designed to meet. This affords another reason why the plan of having the safety clutch operated by the elevator boy at every stop of the car would furnish additional safety as compared with the present system.

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LETTERS TO THE EDITOR.

Early Bridge Trusses without Diagonals.

Sir: In your issue of Nov. 19 you refer to a bow-string truss bridge at Hoosick Falls, N. Y., which was constructed without diagonals or their equivalent, and remark that it is the only instance in your knowledge of such construction.

The Mosely Bridge Co., of Cincinnati, Ohio, built bow-string highway bridges at a very early date. This firm constructed one at Galena, Ill., in 1858, and one at Rush St., Chicago, at about the same time. These were swing bridges with an iron tower, and carried rods or hog chains, which suspended two bow-string trusses. These trusses had no diagonals, being constructed on the same principle as shown in your cut. The upper chord was triangular, consisting of three plates. Several of these bridges were constructed in Illinois, but they were stationary, with the exceptions noted. One was at Golconda, Pope Co., one at Clay City, Clay Co., and one on the Little Wabash, in Wayne Co. The latter was still in use three years ago, but all the others mentioned have either fallen or been taken down.

Yours truly,
Bloomington, Ill., Nov. 21, 1896. J. H. Burnham.

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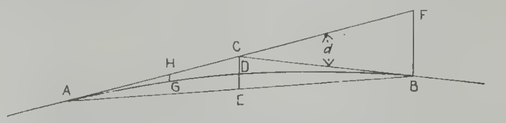
Vertical Curves for Connecting Railway Grades.

Sir: The accompanying table of corrections for grade elevations, to be used where vertical curves are used on railways in rounding off the angle formed by the junction of two grade lines, may be of interest as indicating a convenient method of tabulating corrections for any given difference of grades and length of curve desired.

The curve employed is the usual parabola, chosen because of the ease with which any correction may be found when the correction at the vertex, or meeting point of grade lines, is known. Two properties of the parabola are utilized; 1, that ordinates from tangent to curve vary as the square of the distance from the point of tangency; and, 2, that the curve bisects the vertical intercepted between the vertex and long chord joining the P. C. with the P. T.



Vertical Curves For Connecting Railway Grades.

In the figure let H G, = T, be the correction at distance x from A; M = C D, the correction at the vertex, and 2 L the length of the curve in stations, then the property first referred to gives the relation

$$T = M \frac{x^2}{L^2}. \qquad (1)$$

To find M, produce A C to F to meet a vertical through B, the end of curve. Call the algebraic difference of grades d, then will F B = L d, and since C D = ½ C E by the second property, M = ¼ F B, or

$$M = \tfrac{1}{4} L d. \qquad (2)$$

The length of curve, 2 L, may be fixed by the circumstances of the case or may be found by assuming a certain rate of change of grade per station, the rate of change increasing with d. Call this rate of change R, then for L in stations.

$$L = \frac{d}{2 R}. \qquad (3)$$

To find the correction at a point one station distant from the P. C. at A, insert the value of d from (3) in (2), and the resulting value for M in (1), x being one station; the result is

$$T_1 = \tfrac{1}{2} \frac{L^2 R}{L^2} = \tfrac{1}{2} R. \qquad (4)$$

At two stations from A, $T_2 = 2$ R; at three stations, $T_3 = 4\tfrac{1}{2}$ R; at half a station, $T_{\frac{1}{2}} = \tfrac{1}{8}$ R, etc.

The table gives values of T for points 50 ft. apart for a few values of L and d. These corrections must be added when the algebraic difference of grades is minus, and subtracted when the algebraic difference is plus. Similar tables for other lengths of curves or differences of grades may be prepared at the engineer's leisure, and time in the field may be saved by their use.

Yours truly, J. C. Nagle.
College Station, Tex., Oct. 10, 1896.

Table of Corrections for Vertical Curves.

Algebraic difference of grades.	Rate of change per station.	Distance from Vertex in Feet.								
%	Ft.	0	50	100	150	200	250	300	350	400
0.3	0.075	0.15	0.08	0.04	0.01	0	...	...	...	...
0.4	.1	.20	.11	.05	.01	0	...	...	...	...
0.5	.125	.25	.14	.06	.02	0	...	...	...	...
0.6	.15	.30	.17	.08	.02	0	...	...	...	...
0.7	.175	.35	.20	.09	.02	0	...	...	...	...
0.8	.20	.40	.23	.10	.03	0	...	...	...	...
0.9	.225	.45	.25	.11	.03	0	...	...	...	...
1.0	.25	.50	.28	.13	.03	0	...	...	...	...
1.1	0.1833	.83	.57	.37	.21	.09	0.2	0	...	..
1.2	.20	.90	.63	.40	.23	.10	0.3	0	...	...
1.3	.2167	.98	.68	.44	.24	.11	0.3	0	...	...
1.4	.2333	1.05	.73	.47	.26	.12	0.3	0	...	...
1.5	.25	1.13	.78	.50	.28	.13	0.3	0	...	...
1.6	.2667	1.20	.83	.53	.30	.13	0.3	0	...	...
1.7	.2833	1.28	.89	.57	.32	.14	0.4	0	...	...
1.8	.30	1.35	.94	.60	.34	.15	0.4	0	...	..
1.9	0.2375	1.90	1.46	1.07	.74	.48	.27	.12	.03	0
2.0	.25	2.00	1.53	1.13	.78	.50	.28	.13	.03	0
2.1	.2625	2.10	1.61	1.18	.82	.53	.30	.13	.03	0
2.2	.275	2.20	1.68	1.24	.86	.55	.31	.14	.03	0
2.3	.2875	2.30	1.76	1.29	.90	.58	.32	.14	.04	0
2.4	.3	2.40	1.84	1.35	.94	.60	.34	.15	.04	0
2.5	.3125	2.50	1.91	1.41	.97	.63	.35	.16	.04	0
2.6	.325	2.60	1.99	1.46	1.02	.65	.37	.16	.04	0

(The advantages of the use of vertical curves in relation to the operation of train service is discussed at some length in Wellington's "Economic Theory of Railway Location," and it is there pointed out that these advantages are of far greater importance at sags than at summits, the length for such curves being recommended as 200 ft. on each side of the vertex. It is also pointed out, however, that with the universal adoption of an automatic close coupler much of the importance of these vertical curves would disappear. With trains having much slack in the couplings a rate of change of grade of 0.025 per station of 100 ft. would best fill the required conditions, but for ordinary service (especially after the introduction of improved couplers) 0.05 per station will be ample. Wellington's book, however, gives only the vertical distance between vertex and curve, while the table given with our correspondent's letter gives the vertical distances at intermediate points. —Ed.)

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NAVAL PRACTICE IN SHIP RIVETS AND RIVETING.*

By J. H. Linnard, Naval Constructor, U. S. N., Member.

Among the most important details of hull construction are the methods by which the different parts are attached to each other to give strength to the whole. Too much care cannot be taken to secure such arrangements as will provide strength combined with cheapness of execution. Too often in shipyards insufficient attention is given to this matter, and while general indications as to the riveting are usually put on plating plans, the details of spacing, etc., in important connections are frequently left to the judgment of foremen, or, indeed, the ironworker who lays out the work.

In merchant work, Lloyd's rules have been adopted as the general standard, but they fail to give information in several particulars. Thus the spacing of rivets in the angles uniting water-tight frames and bulkheads to the outer skin plating is not specified. No information is given as to what is considered a suitable size of rivet head, etc. In the hulls of the very large passenger steamers these matters have assumed great importance, and we hear of riveting proving defective and of rivets having to be cut out and replaced more frequently than in times past.

In men-of-war, where scantlings have been cut down to the lowest limit of safety, the detailed consideration of the riveting becomes of capital importance. In such work, where weight-saving without sacrifice of strength becomes so necessary, certain departures from merchant practice as exemplified in Lloyd's rules have been very general in the different navies. These relate principally to the breadth of laps and straps, connection of frames to outside plating, the shape of rivet heads, etc.

In our own Navy it has been the practice to follow in general the rules of the British Admiralty. Some years ago, in the course of the work in which I was then engaged, it became desirable to draw up rules for riveting for the guidance of draftsmen and foremen in considerably greater detail than any given in the Government specifications. At that time the available information on the subject was collated, the practice in different services compared, and the results embodied in a series of tables which have since been adopted, with some minor modifications, in a number of yards in which our new vessels have been building. It has been thought that these tables might be found of interest to the Society and might lead to a profitable discussion as to whether modifications in them are desirable.

In no particular of riveting work is greater diversity shown than in the shapes of the rivet heads. This is due to the fact that, in by far the greater part of riveted connections, the principal stress on the rivets is a shearing stress and the heads are usually more than ample to resist the forces exerted on them. Where it is necessary to study weight-saving, the size and shape of the rivet head becomes of considerable importance. In a vessel such as the armored cruiser "Brooklyn," the weight of rivets driven is upward of 330,000 lbs., and, of this weight, from one-fourth to one-third is in the rivet heads. Any method by which any considerable percentage of weight can be saved in the heads is therefore worthy of consideration.

The rivet head which has the least weight is the countersunk head, since practically all of the head is simply a replacement of metal taken from the plate. It has, however, the disadvantages of increased cost due to the labor of countersinking, and the decrease in the tensile strength of the plate or shape, owing to the greater section of metal removed from the hole. In the French service the saving of weight is considered of sufficient importance to counterbalance these disadvantages, so that the greater part of the riveting, except very light work, is executed with countersunk heads. In our own Navy, such heads are only used where the character of the work requires it on other grounds. It should be pointed out that where countersunk heads are used it is important that they should fit the countersunk holes in the plate. The angle at the apex should be a very little sharper, so that the head will be sure to bottom well. The blow of the hold up will then cause the head to completely fill the countersink.

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*A paper read at the fourth general meeting of the Society of Naval Architects and Marine Engineers, New York, Nov. 12, 1896.

In Fig. 1 are shown the dimensions of the different shapes of rivet heads adopted. The pan heads are those adopted by the British Admiralty. The tap rivet heads have squares on them of dimensions determined by experiment. They are the minimum necessary to set the rivet home strongly without wringing off the square with the wrench. It has been found by our own rivet makers that it is difficult to get these pan heads sufficiently well centered on the shanks of the rivets to meet the requirements of the inspectors.

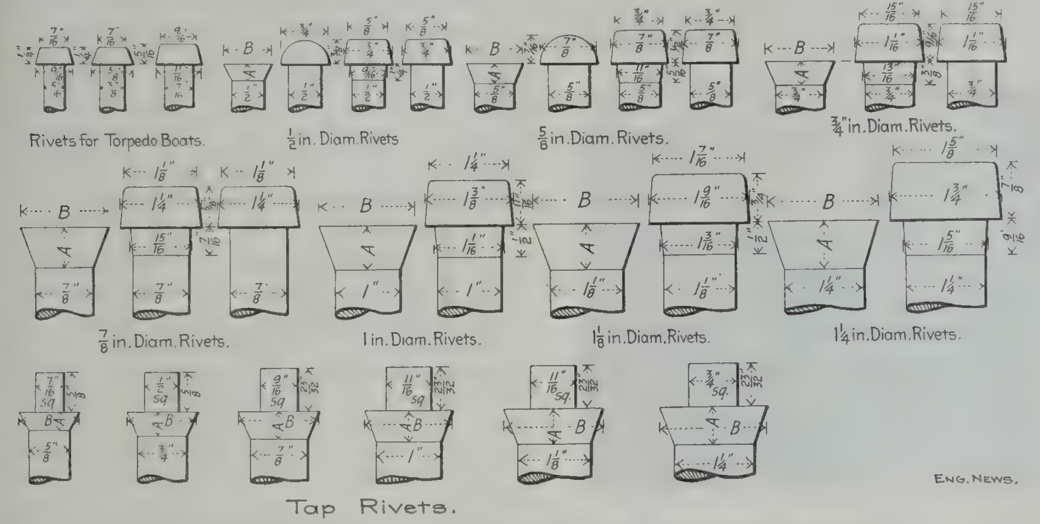


FIG. 1.—STANDARD RIVET HEADS IN USE BY THE BUREAU OF CONSTRUCTION AND REPAIR, U. S. NAVY.

(For all countersunk head and tap rivets make dimension A equal thickness of plate plus 1-16 in. Dimension B as per angle of countersink for given depth of head. Tap rivets will be ⅛-in. larger than the corresponding rivets for the same thickness of plate; except those in stem and stern post, which will be ¼-in. larger.)

The Bureau of Construction and Repair considers it of vital importance that these cone-head rivets should be true to figure. A slight eccentricity of the rivet holes is sometimes unavoidable, and if the closing rivet itself should also be eccentric, the lip would not cover as it ought, and therefore, whenever there is eccentricity apparent to the eye, the rivet must be rejected. Experienced rivet makers with the best appliances have found it practically impossible to make rivets with these heads absolutely concentric. The shortest diameter of the head is considerably greater than the diameter of the rivet blank. The result of the heading operation is that if there is the slightest crookedness in the blank, or if it is not sheared perfectly square, the head will be formed unavoidably on either one side or the other of the centre line of the rivet, because the rivet blank is free to wabble about, and is not held centrally as it should be by the heading die. A rivet head whose shortest diameter is exactly equal to that of the rivet avoids this difficulty, because if the rivet blank is bent, or in anywise eccentric or sheared obliquely, it will be caught by the header and straightened up and the head formed true and central in every instance. This is the form of cup largely used in making boiler rivets.

Years ago the Government adopted a standard for bolts and nuts, including form of threads, and this standard has been of great use not only to manufacturers of bolts, but to engineering establishments throughout the country, most of whom have adopted it. In a similar way, if the Navy Department were to establish a consistent standard for forms of rivets, it would also, no doubt, be adopted by other users of rivets throughout the country, with equal advantage.

A large manufacturer of rivets writes:

The proportions we adopted for our boiler rivet heads several years ago, and which have been used ever since with the greatest satisfaction, are as follows: The height of cone head is ⅞ the diameter of the rivet shank. The least diameter of cone head is equal to the diameter of the rivet shank. The greatest diameter of cone head and button head, 1¾ times the diameter of the rivet shank.

The height of the head of button-head rivet is equal to ¾ the diameter of the rivet shank.

This manufacturer suggested the adoption of these heads for hull-riveting also.

TABLE I.—Relation Between Diameter of Rivets and Rivet Holes and Weight of Plates.

Weight of Plates.	Diameter of corresponding rivets. ins.	Diameter of corresponding rivet holes. ins.
Up to 6 lbs. exclusive	⅜	7-16
6 " 8 " "	½	9-16
8 " 13 " "	⅝	11-16
13 " 20 " "	¾	13-16
20 " 30 " "	⅞	15-16
30 " 40 " "	1	1 1-16
40 " 61 " "	1⅛	1 7-32
61 lbs. and above	1¼	1 11-32

TABLE II.—Breadths of Laps and Straps for Riveting.

(Centers of rivets to be placed not less than 1⅝ times the diameter from the edges. In double and treble riveting, the distance from center to center of rows to be not less than 2¼ diameters in laps, and 2½ in straps.)

Breadth of laps for single riveting	3¼ diameters.
Breadth of laps for double riveting	5½ "
Breadth of laps for treble riveting	7¾ "
Breadth of edge strip for single riveting	7 "
Breadth of butt-strap for double riveting	11½ "
Breadth of butt-strap for treble riveting	16½ "

It will be observed that the rivet head proposed is considerably heavier than the Admiralty head. With the authority of the Bureau of Construction and Repair, a new type of rivet head has been adopted for the most recent vessels. They are substantially as follows: The diameter of head at top is equal to the diameter of rivet, at bottom is 1⅝ diameters; and the height is ¾ of the diameter of shank. These heads are substantially identical in weight with the Admiralty heads, except for the smaller sizes, which are from 5 to 10% heavier. The detailed dimensions of these heads are shown in Fig. 2. They have proved amply strong in use and are easily manufactured. It is possible that the height of the head could be still slightly reduced.

In sizes above ½ in., intended to be driven in punched holes, there is a taper enlargement under the head, the diameter just under the head being 1-16 in. greater than that of the rivet, and tapering down in about half a diameter. This taper under the head is better adapted to fill the hole made by the punch than the straight shank. It has been claimed by some that they are more troublesome to drive, but no difficulty has been found by those who have adopted them, and they unquestionably add materially to the strength of the riveting by better filling the rivet holes.

In table S. 8 of Lloyd's rules is indicated the shape of countersunk points required for outside plating. This requirement cannot be practically carried out with exactness, for it requires a different angle of countersink for each size of rivet and each thickness of plating. After some experiments, it was found that the countersinks could be greatly simplified. The angles adopted are indicated in Fig. 2. The trapezoids shown give convenient dimensions from which templates can be made for keeping the countersunk tools true. It will be observed that the 45° countersink answers for three-quarters of all rivets driven in a ship-yard.

TABLE III.—Spacing for Rivets.

Connection.	Number of diameters from center to center.
Single-riveted laps and straps	3½ +
Double-riveted laps and straps 15 lbs. and over	4 —
Double-riveted laps and straps under 15 lbs.	4 +
Treble-riveted laps	4½ —
Treble-riveted straps with alternate rivets in third row omitted	4 —
Longitudinal seams of plating required to be water-tight	4½ —
Connections of transverse frames not water-tight to outside plating	8 +
Deck plating to beams, and in general where special strength is not required	8 —
Connections of floor-plates, brackets, lightened intercostals, etc., to clips and angles	7 +
Connections of vertical keel angles where not water-tight, of angles and other stiffeners to bulkheads, of boiler and engine bearings and foundations generally	6 —
Connections of inner-bottom plating to all non-water-tight frames and longitudinals	5 +
Connections of angles of water-tight frames and longitudinals to all plating, and in general where water-tightness is required between plates and shapes	5 —
Connections of armor-shelf angle to shelf and outside plating	4½ —
In special cases of intercostals, beam ends, etc., where strength is required in connections of limited extent, spacing to be as required by circumstances, except that rivets in the same line should never be spaced less than	3

Notes.—The sign + indicates that if the exact spacing cannot be used, take the nearest over. The sign — indicates that if the exact spacing cannot be used take the nearest under.

A reasonable discretion should be used in connection with the signs + and — of the table, and where the spacing as laid off comes quite close to the requirements, but with the wrong sign, it will generally be better to use it than to depart too widely from the exact spacing in the direction indicated by the sign.

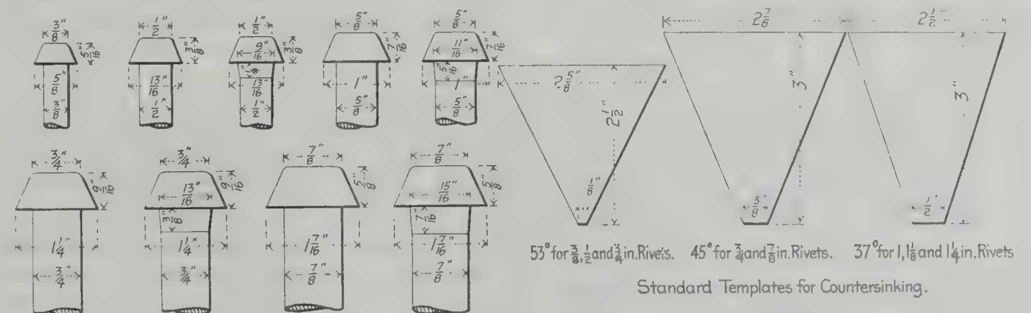
It is intended that the rivet holes should be countersunk through the plate to within 1-32 in. of the bottom of the hole in all cases. This has the advantage of removing most of the metal weakened by the punching.

This varying depth of countersunk holes leads to some slight inconvenience in ordering countersunk-head rivets, and it has been proposed to fix standard depths as follows:

Diam. rivet., ins.	½	⅝	¾	⅞	1	1⅛
Depth countersink, ins.	5-32	7-32	11-32	½	⅝	¾

The relation of the diameters of rivets to thickness of plates and shapes is regulated by a number of conditions. The rivet hole must not be too small to be punched through the plate. It must not be too large as to crush down the plate before shearing. It must not be so large as to require placing so far back from the edge as to prevent satisfactory calking. For a given thickness of plate, the strongest joint is obtained by the largest permissible rivet. The rivets must not be too large for ready hand driving. Out of these conditions there has grown up a tolerably uniform practice for ship work in all countries. The introduction of steel plates and steel rivets caused an augmentation of the size of rivet relatively to the plate, owing to the relative weakness of steel rivets to steel plates as compared to iron rivets in iron plates.

Table I. shows the sizes adopted.


53° for ⅜, ½ and ¾ in. Rivets.
45° for ¾ and ⅞ in. Rivets.
37° for 1, 1⅛ and 1¼ in. Rivets
Standard Templates for Countersinking.

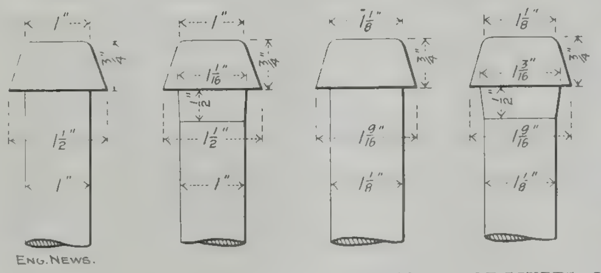


FIG. 2.—RIVETS USED ON RECENT U. S. NAVAL VESSELS.

Note.—The allowances for length of rivets over thicknesses connected, as given, are for two thicknesses only. An additional allowance of 1/16-in. is added to this length for each additional thickness of plates connected. The exception to this rule is only where the plates connected are very thin (less than 3/16-in.) then the allowance will be 1/32-in. for each additional thickness.

	DIAMETER OF RIVETS—INCHES.									
Type of points.	5/16	⅜	7/16	½	⅝	¾	⅞	1	1⅛	1¼
	ALLOWANCE FOR LENGTH OF RIVETS, OVER THICKNESSES CONNECTED=INCHES.									
Countersunk.	⅜	⅜	7/16	7/16	[illegible]	[illegible]	[illegible]	[illegible]	1	1 1/16
Mashed.	7/16	7/16	½	½	[illegible]	[illegible]	[illegible]	[illegible]	1	1 1/16
Button.				½	[illegible]	[illegible]	[illegible]	[illegible]		

In cases where a rivet connects different thicknesses of plating together, the size of the rivet indicated for the greater thickness is to be used, provided it is not more than ⅛-in. larger than the size of rivet required for the lesser thickness. But in no case is the rivet to be less in diameter than the thickness of the thickest plate. Tap rivets will be ⅛-in. larger than the corresponding rivets for the same thickness, except those in stem and stern post, which will be ¼-in. larger.

Table II. gives laps and straps suitable for plating. The widths are cut down from the requirements of Lloyds' rules, resulting in a considerable saving of weight. It is believed they are sufficient with first-class workmanship:

Table III. shows the rivet spacing adopted. The endeavor has been made to make it sufficiently detailed to provide for the greater part of the cases arising in hull work.

Where strength is required in laps and butted connections of plating, with the spacing indicated, single riveting is suitable only for plating under 12½ lbs., and double riveting under 25 lbs. Where strength is required in connections above 30 lbs., a special calculation should be made, and generally quadruple riveting will be required.

The tables of spacing have been slightly modified from those originally determined upon in the direction of closer spacing, which has seemed desirable, in view of the comparative weakness of the steel rivets used in the Navy.

In the French Navy a very elaborate series of rules for spacing of rivets in butts, laps, etc., has been adopted. These include the general use of staggered riveting, usually an irregular spacing of rivets in different rows, and, in special cases, the use of different sizes in the same joint. Some additional strength is doubtless thus obtained in the connections, but it does not appear worth the increased cost. The simpler methods of chain riveting have always been adopted by the British Admiralty and in our own service.

It has been mentioned above that on account of the comparative weakness of the steel rivets used in the Navy, it has seemed desirable to decrease the spacing. The requirements for rivet steel for the first steel cruisers were a minimum tensile strength of 60,000 lbs. per sq. in., and an elongation in 8 ins. of not less than 23%, with a shearing strength of not less than 50,000 lbs. per sq. in. The actual average results obtained from the tests were 64,740 lbs. per sq. in., and 27.41% elongation, with an average shearing strength of 53,695 lbs. per sq. in.*

The requirements for the recent ships have been between 55,000 and 62,000 lbs. tensile, with a minimum elongation of 29% in 8 ins., and a minimum shearing strength of 45,000 lbs. per sq. in. I am not informed as to the average results actuallly obtained, but with the limits between which the tensile strength is required to be maintained, the average shearing strength cannot exceed about 50,000 lbs. It seems very desirable to make a return towards the earlier specifications and sacrifice a little of the ductility in order to obtain increased shearing strength. A rivet steel for hull work, similar to the requirements of the present specifications for rivets for longitudinal boiler seams, appears very desirable. These requirements are between 58,000 and 67,000 tensile strength, with a maximum elongation of 26% in 8 inches. The maximum allowances of sulphur and phosphorus, which for hull rivets are .04 and .05° respectively, are for these boiler rivets .035 and .04 respectively, and with a metal of this character no difficulties should occur in the satisfactory driving of the rivets.

REMOVAL OF IRON FROM WATER FROM A FILTER GALLERY AT READING, MASS.

Sulphate of iron is being removed from the ground water supply of Reading, Mass., by the addition of milk of lime, combined with thorough aeration and rapid filtration, the treatment proceeding in the order named. This process was adopted by the water commissioners after some two or three years of investigation, which will first be outlined.

Water-works for Reading were completed in 1891, with the late M. M. Tidd, M. Am. Soc. C. E., as engineer. Water is pumped from a filter gallery near the Ipswich River to a covered standpipe, 30 ft. in diameter and 100 ft. high. It was first proposed to put in driven wells, but after more extended investigation Mr. Tidd recommended a filter gallery at about the same locality, and this recommendation was followed. The estimated cost of the driven wells was $5,931, and of the filter gallery, $9,000. When bids were received for the work the water commissioners found it would cost $16,000; but the bidder who named that price, Mr. J. H. Leavitt, of Boston, also offered to do the work at a stated price per day. The latter proposition was accepted and the work was done at a cost of $16,562.

The bottom of the gallery is 22 ft. below the level of the meadow. The gallery is 3½ ft. wide and 4 ft. high, inside, L-shaped, with a total length of 250 ft. The walls are of rough field stone, like "an ordinary culvert under a street," and the gallery is covered with flat stone laid in cement. A 14-in. passage, controlled by a gate, connects one end of the gallery with a circular brick well 6 ft. in diameter, covered by a house of the same size and material. A 12-in. suction pipe, 450 ft. long, leads to the pumps. Another pump well and suction main makes possible an emergency supply from the Ipswich River. About 75 ft. of the gallery is parallel with and about 40 ft. from the river; the remaining 175 ft. extends away from the river at a right angle.

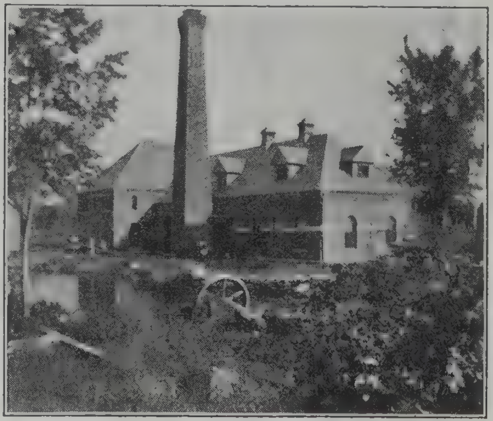


Fig. 1.—View of Pump and Filter House; Reading, Mass.

It appears that the quantity of water obtained from the filter gallery has been satisfactory, but not so the quality. The studies which have been made of the quality of the water have been very interesting.

The Massachusetts State Board of Health had recommended a "supply from the ground near the Ipswich River," in 1889, before construction was started*. In its report for 1890 it says nothing regarding the proposed supply, further than to present two analyses, without comment, of water from a test well. In its report for 1891 the Board states that the meadow beneath which the gallery is located

> is subject to flowage to a depth of 5 ft. during the six months from Oct. 12 to April 12, * * * * and it is probable that the quality of the water is effected to some extent by the fact that the meadow has always acted to a greater or less extent as a filter every time it has been flowed on account of the difference in the water level above and below the dam.

The dam mentioned was just below the filter gallery, and has since been removed to prevent flooding, the water right and a mill at this point having been bought by the water commissioners in 1895, at a cost of $2,544.

In this same report, 1891, the chemical analyses of water from the filter gallery show marked turbidity and heavy sediment throughout the greater part of the year, although the average residue on evaporation was only 12.96 per 100,000, ranging from 9.35 in August to 26.40 in November. As a whole, the monthly samples of water collected during the last ten months of 1891 are described as having an odor "generally disagreeable, sometimes offensive." Regarding this odor and the iron in the water it is stated that:

> The water contains iron in solution, which precipitates out as a reddish-brown deposit on exposure to the air. Waters of this character often have a disagreeable odor from carburetted or sulphuretted hydrogen. * * * Sample No. 8,255 (the one with high residue on evaporation.—Ed.) is exceptional in this series, containing much more mineral and organic matter than the other samples. The amount of metallic iron in this sample was 1.33 parts per 100,000, or 0.78 grains per gallon. The colors given in the table are doubtless all due to the separation of iron oxide. The water as it comes from the ground is colorless.

No determinations for iron are given except the one cited. The color was zero in April, May and the first part of July, and during the balance of the year ranged from 0.02 in December to 0.40 in August, averaging 0.13, and being only 0.04 in November, the month of heavy sediment.

In 1892, the color was higher, averaging 0.44, and ranging from 0.00 in January to 0.80 in December. Iron determinations were reported for the last four months of the year, averaging 0.235 parts per 100,000. Crenothrix, a species of fungi, were present in large quantities during the greater part of this year, as were also zo-ogloea, an organism classed neither as plant or animal, but as miscellaneous, "owing to the uncertainty which attaches to the precise nature of the substance." The peculiar characteristic of these micro-organisms is that they are massed or bound together by a gelatinous envelope. Crenothrix thrives in water containing "decomposing organic matter and iron in solution as protoxide."* Partially filtered water, like the ground water from a filter gallery, would furnish the organic matter, and with iron present in addition as at Reading, crenothrix might be expected in profusion. The color of the water at Reading in 1892 was attributed to "crenothrix or zo-ogloea and iron."

In 1893 the State Board of Health found an average of 0.1251 parts of iron per 100,000 in the water, as the result of the twelve monthly analyses, the iron ranging from 0.01 in August to 0.54 in November. The color averaged 0.64, and the odor was "faintly moldy or unpleasant, often none; in June and July disagreeable." The sediment was often heavy and rusty. Organic matter, in a partial state of nitrification, was quite prominent. The comments on the analyses were as follows:

> The water offers a good instance of the effect of a marshy soil on the character of the water percolating through it. The organic matter of the soil consumes the free dissolved oxygen in the water and reduces the insoluble iron salts to the condition of protoxide, so that iron passes into solution in the water. On exposure of the water to the air the iron is again oxidized, forming first a precipitate which gives the water a milky appearance and ultimately settles as a rusty sediment. Conditions in some respects similar to those of Reading are found in Provincetown, Bradford and Watertown, and were found in the test wells at Attleborough (see 23d Annual Report, 1891).
>
> The determinations of turbidity and color in waters of this kind do not have the same significance as in surface waters, but they are, nevertheless, of interest as showing a condition which the water may assume, and are therefore given in the table.

The first three reports of the Reading Water Commissioners, two of which were published after the works were put in operation, contain no reference to the quality of the water, but evidently it occasioned anxiety as early as the latter part of 1892, at least, for in the report for 1893 it is stated that in February of that year Mr. Desmond FitzGerald, M. Am. Soc. C. E., was engaged

> to make a careful examination of our source of supply, to ascertain, if possible, the cause of the disagreeable odor and color of the water and to advise us what steps to take to remedy the existing troubles. He was also requested to advise us in regard to other sources of supply, both within and without the boundaries of the town.

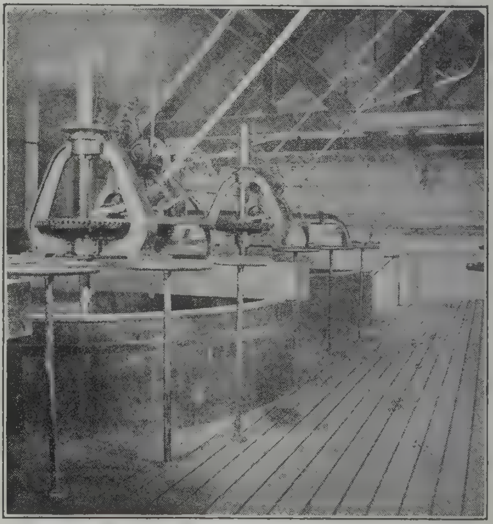


Fig. 4.—View of Top of Warren Filters; Reading, Mass.

Mr. FitzGerald continued his studies for a year, not reporting until February, 1894 (the report appears, however, in the annual report for

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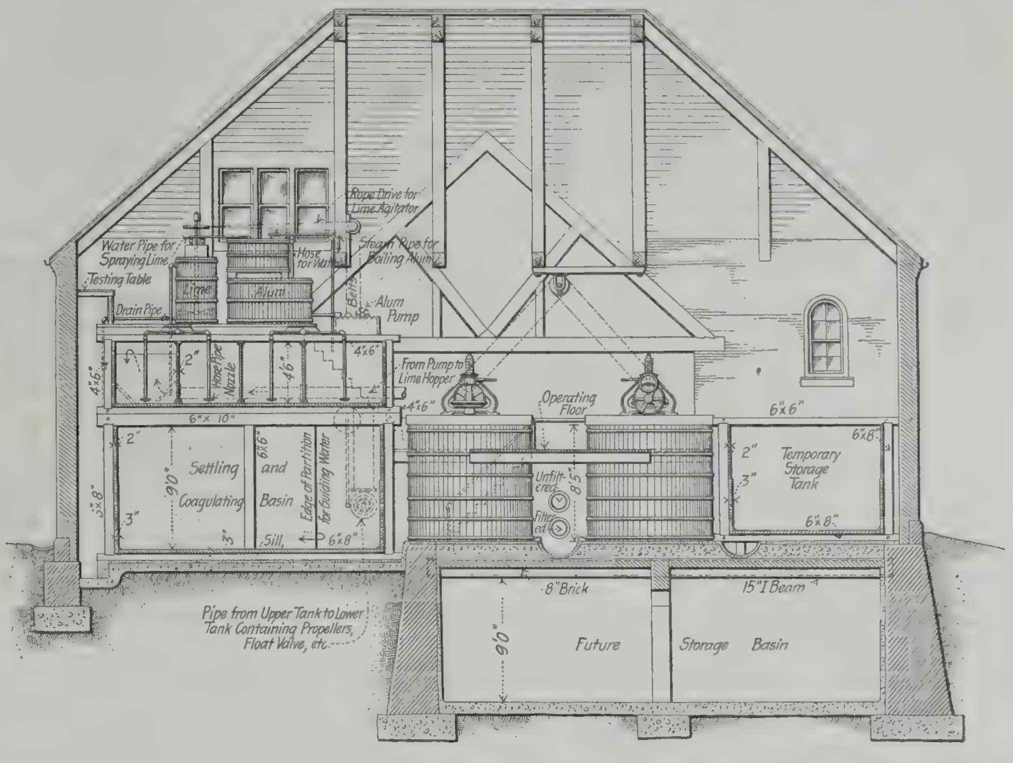
*Report of the Naval Advisory Board on "Mild Steel, etc.," prepared by Assistant Naval Constructor R. Gatewood, U. S. N., Washington, Government Printing Office, 1886.

**It must not be inferred that this recommendation related to the mode adopted years later to develop water, but only to the general source.

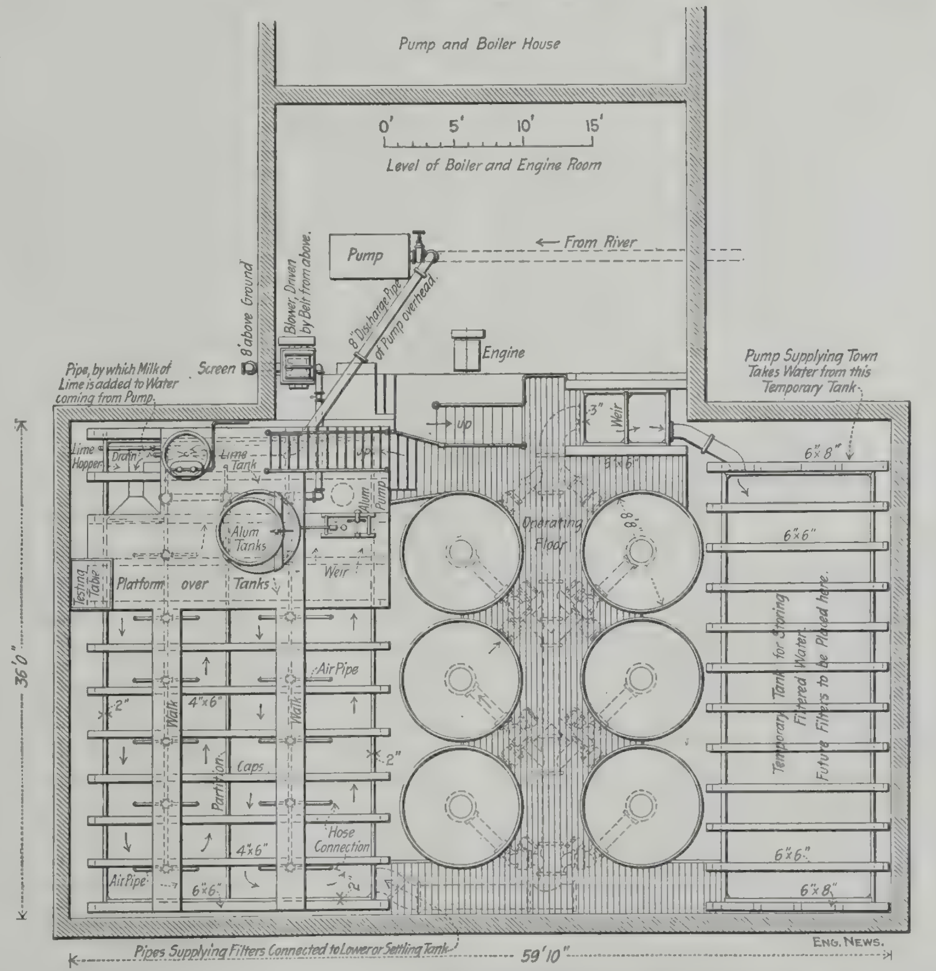
*Examination of Water Supplies. Special Report Mass. State Board of Health, 1890, p. 781.

1893). After preliminary remarks the report discusses the situation as follows:

> I first began to investigate the quality of the water as delivered to the consumer, and have found some curious phenomena. On the same street and in houses supplied from the same main, the quality of the water seemed to vary. At one house the water contained so much iron and had such an offensive odor that there was much just complaint. At the very next house there was no cause for complaint, the water appearing to be free from objection and used freely for drinking, for use in the teakettle and for the laundry. I soon found that the cause for this peculiar condition of things was due to the fact that where a service pipe had been in use long enough to lose its coating, the carbonic acid in the water acted with rapid effect upon the pipe.
>
> The Reading water was already known to contain a considerable amount of iron; but after I became intimately acquainted with its peculiar and varied properties, I learned to have a wholesome respect for it. At one house I found that they could either draw good or bad water from the same main.* After some thought upon this condition of things, I advised your board to use nothing but cement-lined services until the quality of the water should be improved.
>
> As might be expected, a certain amount of crenthorix is almost always present in the Reading water, and I first expected to find that this was one of the causes of complaint; but I found that this was not the case. Crenothrix is hardly abundant enough unless it is stirred up in the gallery or in other portions of the work. Samples from the manholes in the filter gallery can be taken in almost any variety of condition, according to the method of selecting the samples.
>
> In the distribution system there is generally an almost entire absence of oxygen in the water; but there is no lack of offensive gases of one kind or another to annoy the water taker. If the lack of oxygen was the sole trouble, the remedy would be a simple one. More aeration would only have the effect to drive off the obnoxious gases and change the form of the iron from the ferrous to the ferric condition; in other words, to deepen the color of the water and hasten precipitation of the iron. It soon became evident that the Reading water was no ordinary liquid. A great many experiments were made, both by myself, and under the direction of Thomas M. Drown, M. D., of the Massachusetts Institute of Technology, to whom I am much indebted for long and patient advice upon the chemical side of the subject. Assistant F. L. Hollis made many able investigations and analyses to ascertain the effect of the gases and acids in the water. A great many determinations were also made of the amount of iron in the water, and I left no stone unturned to ascertain the condition of the water in the different portions of the system at different times of the year.
>
> I found that generally one-half of the water came from the river directly down into the gallery by very rapid and imperfect filtration, and that the other half came from the ground. A careful examination of the materials in the ground between the filter gallery and the high land by means of driven wells, some of them put down especially for this investigation, showed that there was not enough water for the supply of the town from the ground alone. An extension of the driven wells up the valley of the Ipswich River gave no better results. The material underlying the meadows is of too fine a quality for a successful application of the artesian or driven well system.
>
> Having found after due consideration that there was no easy way to make the Reading water acceptable, or to procure an additional supply in the immediate neighborhood of the works, I next turned my attention to other sources of supply.
>
> The further I went into the study of the question of other sources, the more convinced I became that it would be a very expensive matter for Reading to abandon its present supply, so I applied myself diligently to the question of purification of the present water. After much study and thought and the consideration of many plans, I finally recommended to your Board the following outline of works for purifying the Reading water which, to the best of my belief, will render the quality of your water perfectly satisfactory to the citizens of Reading:
>
> 1. Pump the water from the filter gallery into a covered reservoir built in two sections, each of which should hold 500,000 gallons.
> 2. Aerate the water thoroughly on its way to this reservoir.
> 3. Build invert to the reservoir with a steep inclination towards the drains, so that the sediment precipitated upon the bottom will scour easily.
> 4. Place this reservoir high enough to filter the water and return it to its present pumps. The water drawn from this reservoir can be filtered rapidly through any cheap form of filter which can be readily cleaned.
> 5. After the plans are made, I should recommend you to put in the filters at once, and run them without the reservoir until the opening of the coming season.
> 6. The outlets or drains to the reservoir should be so arranged that the flocculent iron can be collected for use, if found necessary. I have found in my experiments, and it was suggested by Dr. Drown, that by adding some of this flocculent iron to the water, the precipitation of the iron is somewhat hastened.



Transverse Section.


Pump and Boiler House
0' 5' 10' 15'
Level of Boiler and Engine Room
Pump
← From River
8' above Ground
Blower, Driven by Belt from above.
8" Discharge Pipe of Pump overhead
Engine
Screen
Pipe, by which Milk of Lime is added to Water coming from Pump.
Pump Supplying Town Takes Water from this Temporary Tank
Lime Hopper
Drain
Lime Tank
Up
Weir
3"
6"x8"
Alum Pump
Alum Tanks
Operating Floor
8'8"
6"x6"
Testing Table
Platform over Tanks
Weir
Walk
Walk
Air Pipe
4"x6"
2"
Partition
Caps
Hose Connection
4"x6"
Air Pipe
6"x6"
Temporary Tank for Storing Filtered Water. Future Filters to be Placed here.
6"x6"
6"x8"
36'0"
Pipes Supplying Filters Connected to Lower or Settling Tank
59'10"
Eng. News.

Sectional Plan.

FIGS. 2 AND 3.—PLAN AND SECTION OF WATER PURIFICATION PLANT; READING, MASS.
Cumberland Manufacturing Co., Boston, Mass., Contractors.

The water commissioners stated in their report for 1893 that Mr. F. L. Fuller, M. Am. Soc. C. E., was then preparing plans for the settling tanks, filters and reservoirs necessary to carry out Mr. FitzGerald's recommendations, and that the work was to be done at once. For some reason it was concluded to investigate the matter still further before beginning work. In March, 1894, the State Board of Health was asked for advice regarding the proposed purification scheme, and also whether it would recommend the securing of water from a new source. Other sources were investigated, but none were approved, the Board recommending that Reading take steps to secure a permanent supply from the new works then proposed and now under construction for the metropolitan district of Boston, and concluding:

> In the meantime, provision should be made to improve the present supply by preventing the flooding of the meadow over the filter gallery, and it may be advisable to adopt temporarily, some system for filtering the water rapidly through sand.

The report of the State Board of Health was not made until February, 1895, owing to the desire to study the problem during the fall and winter of 1894-5, when the meadows above the filter gallery were flooded. The portion of the report relating to the studies of water from the filter gallery is as follows:

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*The explanation of this, Mr. FitzGerald states in a letter to this journal, is that there were two service pipes of different material in the same house.—Ed.

> A very large number of examinations of the water of the filter-gallery have been made during these investigations and previously, and from these results it appears that the objectionable character of the Reading water is due chiefly to the presence at nearly all times of an excessive amount of iron in connection with other mineral and organic matter. The amount of iron found in the water varies greatly at different times, being very large in the portion of the year when the meadow is covered with water and much smaller during the summer when the meadow is dry. It has also been observed that the quantity of iron present in the water may vary greatly in the course of a single day's pumping.
>
> In contrast with other waters in which a sufficient amount of iron has been found to effect the appearance and quality of the water, it has been found that the iron in the Reading water is present as a sulphate instead of being in the form of a bicarbonate. When iron is present as a sulphate its removal from water is very much more difficult than when it is present as a bicarbonate.
>
> Many experiments have been made at different times with a view to a removal of the iron by oxidation and subsequent filtration of the water through sand to remove the precipitated iron oxide. The results obtained by this means have been very variable. But, in general, it may be said that when the iron is present in the water in small amount, say not over 0.3 of a part per 100,000, the iron will separate out of the water almost completely on exposure to the air for 24 to 36 hours in the form of a rusty precipitate, which can be removed entirely by filtration through sand at a rapid rate. This method is substantially that proposed by Mr. Desmond FitzGerald in his report to your Board. Forced aeration by filtering through sand with a current of air was found in almost all cases to hasten the oxidation and separation of the iron oxide.
>
> But in one case, at least, when the iron was only 0.14 parts per 100,000, aeration in this way had but little effect on the iron. The failure to remove the iron in this case seemed to be connected with a considerable amount of organic matter in the water which prevented the precipitation of the iron after oxidation.
>
> Again, the difficulty in removing the iron appears to increase rapidly with the amount of iron in the water, and when large amounts are present, say from one to two parts per 100,000, which has been frequently the case the past winter, the means found adequate to remove the iron when present in small amounts are unavailing. Exposure to the air for two days had practically no effect on the iron contents of the water of this character, and even after thorough aeration, it separated out only in part, leaving most of the iron still in the water, upon which filtration had no effect.
>
> During the progress of this investigation, advantage has been taken of the presence at the Reading pumping station of a small mechanical filter placed there and first operated about the middle of the summer. This filter consisted of two upright cylinders, one said to contain 30 ins. in depth of sand, and the other 30 ins. of bone-char, each having an area of about 1 sq. ft. Later in the season the number of cylinders was doubled.
>
> Experiments with this filter showed that with iron not exceeding 0.1 of a part per 100,000, rapid filtration alone without exposure to the air was capable of removing practically all of the iron in the water, but when the water contained large amounts of iron, the action of the filter was uncertain. With very high iron, say one part per 100,000, the filter had no effect whatever on the amount of iron. No special advantage was found in the use of bone-char in these experiments, and it is, therefore, probable that any sand filter capable of being readily and thoroughly cleaned would do equally good work.
>
> Any treatment by filtration which will remove the iron will be very likely also to remove the objectionable odor and appearance of the water.
>
> When the amount of iron in the water was very high, experiments were made to learn whether it could be removed by chemical means, a cheap form of which would be filtration through carbonate of lime, in the form of marble chips. The experiments in this line have indicated that the iron can be completely removed by filtration through carbonate of lime, but that in this process the water takes up lime in large amount and is made very hard. A combined process of aeration and filtration through sand and with subsequent filtration through carbonate of lime, leaves the water much less hard than when it is put directly on to a filter containing marble, and the results indicate that the hardness of the water after treatment in this way would be at least 16 to 18 parts per 100,000, while the hardness of the water after filtration through carbonate of lime, without previous aeration and filtration through sand, is likely to be at least 25 parts per 100,000.
>
> While the hardness of the water, if treated chemically, by filtration through carbonate of lime as suggested, would be very little or no greater than that of waters supplied to some of the towns in the vicinity of Boston, the board does not recommend the use of so hard a water for a permanent supply.
>
> Since the higher amounts of iron and organic matter are found when the meadow is flooded, it would seem that the quality of water in these respects might be greatly improved and the water rendered more susceptible of further improvement by filtration or other treatment if this flooding were prevented.

In 1895 the water commissioners purchased and removed the dam which had caused the flooding of the meadows and contracted with the Cumberland Manufacturing Co., of Boston, to put in a purification plant, which combined lime treatment, aeration and rapid sand filtration through mechanical filters of the Warren type. Mr. Walter B. Nye, Manager of the company, states that his company had been studying the water for three years. The purification plant is located in an addition to the pump house, as shown in the general view, Fig. 1.

The character of the plant can best be set forth by using a description of it kindly sent us by Mr. Nye, under date of Sept. 14, 1896, as follows:

> Stated briefly, we proposed to add lime to the water, aerate it, and if necessary to still further coagulate the oxidized iron in suspension in case it did not coagulate sufficiently of itself, to render it removable by mechanical filtration.
>
> The plant, shown in plan and section by Figs. 2 and 3, consists of a settling and coagulating basin, approximately 33 × 19 × 9 ft., above which is placed an aerating basin, 33 × 19 × 4½ ft., and six Warren filters, 8⅔ ft. in diameter and 8 ft. 5 ins. deep, together with a temporary storage tank for filtered water, approximately 31 × 10½ × 8 ft., from which the pumps take their supply. The water is taken from the existing suction main by a low duty Worthington pump, and by it delivered to the aerating basin. The water is delivered through a hopper at one end of this basin, and as it rises in the same meets the descending supply of milk of lime, which is prepared by the automatic slaking device used in our Keyport plant (Eng. News, June 4, 1896). On receiving the lime it passes into the aerating basin proper, which is so divided by partitions as to cause the water to travel back and forth four times before passing over the final weir and entering the settling basin below. The water, during this passage, receives violent aeration by means of 23 1¼-in. nozzles, perforated with 15 1-32-in. holes. Air for this aeration is supplied by a No. ½ Wilbraham Baker blower, which has a guaranteed capacity of 150 cu. ft. of air per min., at a maximum pressure of 3 lbs. The actual pressure due to the friction of the pipe, aerating nozzles, and the depth of the column of water at the outlet is about 2½ lbs., as shown by a mercury gage. By this method, each particle of water receives 23 successive aerations, thus thoroughly oxidizing the iron, and the water together with the suspended iron passes over the last weir and through a 10-in. pipe, at the outlet of which is one of our standard alum propellers (Eng. News, Jan. 4, 1894) whereby the water is supplied with the amount of dilute alum solution necessary for its coagulation. In this basin the water remains for about one hour, and from there passes to the filters, which are of standard type. The upper portions of two of the filters, with the mechanism for driving the sand agitators are shown by the view, Fig. 4. The filtered water, now bright, clear and sparkling, passes over the weir shown in Fig. 1, and from this is taken to a temporary storage tank, which occupies the place prepared for the addition to the filter plant.
>
> As shown on the section, Fig. 2, a storage tank for filtered water is provided underneath the filters, but owing to the necessity of constructing it in winter it was found difficult to secure a tight wall and the temporary wooden tank was constructed for use during the present season.
>
> Owing to the changeable character of the water a strict watch is kept upon it and every hour the incoming water is tested for iron, and the water both before and after aeration and after coagulation is tested both for alkalinity and iron. For the taking of these tests we have prepared a sufficient supply of standard indicator, together with the necessary simple apparatus, and the engineer in charge has no difficulty in making his tests and in so regulating the amount of lime and of alum as to prevent the use of an excess and enable the plant to properly handle the water.
>
> We use in this case our 8⅔-ft. filter instead of the larger size, for the reason that its use seemed to allow a better arrangement of the plant, both for the present and future, in view of the size of basin necessary, and the fact that the land and the development of the plant were limited by water on two sides.
>
> We enclose copies (Table I.) from the State Board of Health reports both for July and August (September and October sent since.—Ed.) and also our own analyses, recently made.* At the time the July and August samples were taken, the plant was being worked to its fullest capacity, pumping about 14 hours a day, which with the small force employed prevented giving the plant as close chemical attention as they desired and in consequence the hardness is a little greater than expected. At the present time (Sept. 14, 1896) they are pumping 7½ hours a day; the average pumpage is 247,486 gallons; the average alum consumed is 36 lbs., and the average lime, 70 lbs.
>
> As the engineer in charge becomes better acquainted with the plant and with the methods, it is probable that the consumption can be materially decreased. as in this particular instance the skill of the operator would have much to do with the economy of the operation.
>
> On starting the plant, we met with some difficulty, owing to the character of the lime, and it was only after considerable experiment that we found that a perfectly pure lime made from marble was much better adapted to this purpose than the ordinary lime of commerce, and a supply is now secured from northern Vermont which meets the requirements in every particular. The necessity for coagulation is due to the fact that the iron varies greatly in its behavior under treatment by lime and aeration. At times the hydrate of iron forms in sufficiently large flakes to serve as its own coagulum; at other times the oxidized iron is in so minute a form as to render the water brown like beer, under which conditions it will pass through any form of filtering medium, unless a coagulant is used. Without a coagulant water can be secured which will be perfectly clear and apparently white, except in large volume, where it might show a slightly greenish tinge, but by using a coagulant this is removed and the water is perfectly limpid and clear. The citizens are thoroughly pleased, the water seems to be useful in more commerical ways than it was before, and apparently the only evil to result from the installation of the apparatus is the great increase in the consumption of water, which has taxed both men and facilities ever since the plant was put in.

In a more recent letter (Oct. 31), Mr. Nye writes as follows:

> In the analyses recently sent you I would call your attention to two of them in particular, one showing about 83% removal of iron and one showing 100%. The difference in total hardness and total solids, as you will note, bears a very close relation to the removal of iron and reduction in ammonias, and the two samples show, first, the result of insufficient lime, and, second, the result of too much lime. During the warm weather the character of the water varied greatly and the consumption was large, and as a result the operators did not always catch the changes in the water sufficiently early, but at no time has there been any hardness which was appreciable to the community, and there has been nothing but complete satisfaction.

With the letter from which the above was taken

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*The analyses sent by Mr. Nye were only partial. They showed a reduction of iron from 0.356 to 0.020 or 94%. —Ed.

TABLE I.—Anaylses of Unfiltered and Filtered Water from Reading, Mass., Made by the Massachusetts State Board of Health.
(Parts in 100,000.)

Date of collection. 1896.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Odor. Cold.	Odor. Hot.	Residue on evpration.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen consum'd.	Hardness.*	Iron.	P. c. of rem. of iron.	Remarks.
July 27	Decided.	Cons. rusty.	[1]0.40	Faintly vegetable.	Faintly vegtble.	9.50	.0048	.0076	.53	.0050	.0000	.3420	3.6	.0850	.....	Unfiltered.
" 27	None.	None.	0.13	None.	None.	15.50	.0058	.0056	.52	.0030	.0000	.1520	8.2	.0090	89.41	Filtered.
Aug. 10	Decided.	Considerable	0.63	Faintly mouldy.	Faintly mouldy.	8.70	.0048	.0056	.54	.0000	.0001	.3635	2.6	.1400	.....	Unfiltered.
" 10	Very slight.	None.	0.30	None.	Faintly mouldy.	14.50	.0040	.0046	...	.0000	.0002	.2410	7.9	.0210	85.00	Filtered.
" 25	Decided.	Considerable	0.60	Faintly vegetable.	Dist. vegetable.	7.40	.0070	.0064	.56	.0000	.0000	.3542	2.5	.0950	.....	Unfiltered.
" 25	None.	Very slight.	0.20	None.	Distinct.	14.20	.0044	.0056	.52	.0020	.0010	.2010	8.0	.0030	96.84	Filtered.
Sept. 8	Dist. from iron.	Cons. brown.	0.50	Faintly vegetable.	Faintly vegtble.	8.50	.0066	.0046	.62	.0030	.0030	.1725	2.6	.0950	.....	Unfiltered.
" 8	None.	Very slight.	0.20	None.	None.	13.90	.0030	.0044	.61	.0030	.0018	.1725	7.3	.0160	83.16	Filtered.
" 21	Decided from iron.	Heavy rusty.	0.38	None.	Faintly vegtble.	12.20	.0084	.0088	.56	.0050	.0000	.3160	3.9	.3350	.....	Unfiltered.
" 21	None.	None.	0.10	None.	Dist. unplsant.	18.00	.0048	.0062	.55	.0040	.0025	.2291	10.0	.0000	100.00	Filtered.
Oct. 6	Decided from iron.	Cons. rusty.	1.10	Faintly vegetable.	Dist. vegetable.	12.20	.0090	.0120	.56	.0030	.0001	.4068	4.0	.3800	.....	Unfiltered.
" 6	Very slight.	None.	0.09	None.	Faintly vegtble.	20.40	.0010	.0086	.57	.0030	.0035	.2923	11.3	.0100	97.37	Filtered.

*In terms of an equivalent amount of carbonate of lime in parts per 100,000. [1]Turbid.

Mr. Nye sent a copy of some analyses made for the Cumberland Manufacturing Co. by Prof. Henry Carmichael. These analyses are presented in Table II., the analyses made by the State Board of Health being given in Table I.

The total cost of the Reading purification plant has been about $19,000, divided as follows:

Building and clear water basin	$11,000
Suction pipe	1,436
Pumps, engines and connections	1,900
Settling basin, aerators and filter, about	7,000
Total	$21,336

As stated above, $2,544 was paid in 1895 for water rights and a mill in order that a dam might be torn down to prevent the flooding of the meadow over the filter gallery. In addition, $514 was expended for a dike in 1895. These items, however, should be added to the $16,562 paid for the filter gallery, making $19,630 as the cost of developing the supply.

The total pumpage in 1895 was 72,375,448 gallons, or an average of 198,289 per day. The total estimated population of Reading in 1895 was 4,717, of which it was estimated that 4,140 were on the lines of the distributing pipe, and 3,550 actually supplied. On the above basis the pumpage per inhabitant would average 42, and per consumer, 56 gallons per day.

Mr. Lewis M. Bancroft is superintendent of the Reading water-works, formerly one of the water commissioners, and has had charge of the construction of the works since their beginning. The water commissioners are now as follows: Messrs. Edward C. Nichols, Geo. E. Abbott and Calvin E. Martin.

TABLE II.—Analyses of Unfiltered and Filtered Water from Reading, Mass., made by Prof. Henry Carmichael (Samples Collected Sept. 26, 1896).

(Parts per 100,000.)

	Before filtration.	After filtration.
Total residue on evaporation	12.3000	19.1000
Organic and volatile matter	3.1000	4.6000
Chlorine	0.2655	0.2655
Free ammonia	0.0066	0.0020
Albuminoid ammonia	0.0090	0.0050
Iron as iron oxide	0.1070	0.0107
Hardness Clark's scale*	2.64°	4.51°

*Or, to make these comparable with the State Board of Health, analyses, by giving an equivalent amount of carbonate of lime in parts per 100,000, 3.80 before, and 6.40 after filtration.—Ed.

◆

AN INLAND HARBOR AT THE SOUTH END OF Lake Michigan and just southeast of Chicago, Ill., is proposed in a measure to be presented, it is stated, at the coming session of the Indiana State Legislature. The measure authorizes North Township, Indiana, to issue bonds to the amount of $200,000, for the purpose of constructing a waterway between Lake Michigan and the Grand Calumet River, at a point one mile east of Hammond, Ind. It is stated that plans for the project, which involves the building of inland harbors in Wolf and George Lakes, have been drawn in accordance with Major W. L. Marshall's views, and submitted to him for approval. They show a canal 300 ft. wide from Wolf River, where it enters Lake Michigan, to the Calumet River. Entrance will be made at Wolf Lake, where a basin 600 ft. wide and 7,500 ft. long will be dredged, the canal continuing in a direct line to George Lake, where a basin 450 ft. wide and a mile long will be built. Leaving the lakes, there will be a canal 300 ft. wide and 20 ft. deep, through sections 19, 30 and 31. The committee having charge of the movement is composed of Edward Roby, C. A. Shedd, C. F. Mott, General Charles F. Griffin, A. F. Knotts, Marcus M. Towle, Senator William H. Goslin and others. Congress has appropriated $80,000 for the Wolf Lake Harbor, and if the Indiana Legislature approves the project, it is stated that it will be begun early next spring. The place seems to be one of several which have been the outcome of the inadequate harbor facilities of the Chicago River, which were discussed at some length in Engineering News of July 16, 1896.

◆

A CHARLESTON-LIVERPOOL STEAMSHIP LINE, the Johnson Blue Cross Line, is to commence operations in December under the management of the Charleston Shipping Co. It is the first step in a proposed development of direct trade between Europe and Charleston, S. C.

◆

A $3,000,000 FILTRATION ORDINANCE has passed the Philadelphia Common Council by a vote of 99 to 3. The ordinance authorizes a loan of the above amount "for the purpose of constructing and erecting a filtration plant or plants, to connect with the several pumping stations embraced in the water supply of the city of Philadelphia." The ordinance must still pass the Select Council.

WEATHER TABLE FOR OCTOBER, 1896. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.)				Wind.			Precipitation—rain or melted snow—inches.		
		Average.	Max.	Min.	Range.	Velocity in miles per hour. Average.	Velocity in miles per hour. Max.	Direction at time of max. velocity.	Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities	Northfield, Vt.	42.5	64	20	44	7.4	34	SE	2.42	0.79	16
	Portland, Me.	46.1	70	30	40	7.8	34	S	3.19	1.46	15
	New York City	51.9	72	36	36	14.2	45	NW	1.71	0.76	11
	Pittsburg, Pa.	50.6	79	30	49	5.5	23	SW	2.26	1.03	13
	Chicago, Ill.	49.6	75	29	46	16.5	62	S	1.36	0.92	6
	Omaha, Neb.	51.5	82	26	56	7.2	24	N	3.72	1.83	10
	St. Paul, Minn.	45.5	75	21	54	6.8	26	SE	3.39	1.74	9
	Duluth, Minn.	41.8	75	19	56	10.4	55	NE	3.46	1.16	11
	Bismarck, N. Dak.	42.0	77	13	64	8.2	37	NW	0.48	0.31	5
	Average	46.8	74	25	50	9.3	38		2.44	1.11	11
Southern Cities.	Washington, D. C.	54.0	76	31	45	6.7	28	NW	0.34	0.16	7
	Louisville, Ky.	56.3	82	32	50	6.5	31	SW	1.61	1.03	7
	St Louis, Mo.	57.2	80	36	44	10.3	46	SW	1.20	0.40	8
	Savannah, Ga	67.4	86	47	39	8.0	27	N	0.99	0.49	7
	Kansas City, Mo.	54.9	86	31	55	7.8	31	SW	2.99	1.59	6
	Jacksonville, Fla	70.4	87	50	37	6.6	26	NE	3.03	1.45	8
	Chattanooga, Tenn.	60.3	81	35	46	6.3	40	S	1.06	0.60	3
	New Orleans, La.	70.4	91	54	37	7.8	54	N	5.33	2.66	9
	Memphis, Tenn.	62.0	85	40	45	8.2	36	SW	1.49	0.66	5
	Palestine, Tex.	66.4	92	45	47	4.8	22	SE	7.16	2.73	11
	Average	61.9	85	40	44	7.3	34		2.52	1.18	7
Western Cities.	Helena, Mont.	47.9	75	30	45	6.2	25	NW	0.24	0.18	3
	Port Angeles, Wash.	48.0	66	34	32	4.4	24	W	2.13	0.78	10
	San Francisco, Cal.	58.8	85	47	38	9.6	35	SE	1.55	1.46	5
	Salt Lake City, Utah.	54.4	82	33	49	5.7	34	NW	0.70	0.32	4
	Santa Fe, N. Mex.	48.5	70	30	40	5.6	27	NE	3.19	1.01	13
	Denver, Colo.	50.1	82	25	57	6.7	32	NW	0.84	0.42	5
	Yuma, Ariz	75.5	102	48	54	4.4	24	SW	0.10	0.07	3
	Average	54.7	80	35	45	6.1	29		1.25	0.61	6

A WATER POWER AND ELECTRIC POWER PLANT is being built in Calaveras county, Cal., by the California Exploration Co., the power to be used for mining purposes. The head is about 1,043 ft.

◆

THE UTILIZATION OF WATER POWER of the flow through the Tequixquiac drainage tunnel for the city of Mexico is being arranged for by the Electric & Irrigation Co., which proposes to put in a water wheel plant for driving dynamos to generate current which can be used for lighting and power purposes. Mr. Thomas W. Orbison is the Chief Engineer.

◆

A WATER POWER AND ELECTRIC PLANT is to be established at York Haven, Pa., on the Susquehanna River. It is proposed to build a power canal parallel with the river, and using the water to drive 20 water wheels which will be connected to dynamos. It is proposed to transmit the current to neighboring towns for lighting and power purposes. Mr. Harry L. Carter, of Philadelphia, owner of the York Haven Paper Mills, is interested.

◆

THE NEW WATER POWER PLANT at Indian Orchard, Mass., will have three pairs of horizontal turbines of 950 HP. On the second floor will be three electric generators of 450 HP., with a capacity of 15,000 incandescent lights of 16 c. p., and seven generators with a capacity of 840 arc lamps. The current will also be used for driving a 400-HP. motor for commercial arc lighting. It is intended to use the current for lighting the city and the mills, and for driving mill machinery.

◆

LAND BELOW HIGH WATER MARK, on the New York water front, can not be held as private property, according to a late decision of the Appellate Division of the Supreme Court, in the case of Henry W. Sage vs. the City of New York. Mr. Sage owned land on the East River water front, between 94th and 95th Sts., and he enjoined the city from filling in there and claimed title to the bulkhead line. The majority of the court held that the property right to land between high and low water mark is invested in the city by the Dongan charter of 1686, affirmed by the charter of 1777 and reaffirmed by all subsequent charters to 1894. These charters were based on grants made by James II. and George II., through Governor Nicholls and others, and these grants expressly state that waterways up to high water mark shall not be at any time private property. The minority of the court held that in some private grants water fronts were included, and that in this case the evidence was not sufficient to show that they were not to be included. As fifty other cases depend upon this one, the Sage case will probably be carried to the Court of Appeals.

◆

THE WATER CONSUMPTION OF PARIS, says the "Revue d'Hygiene et de Police Sanitaire," touched its maximum on July 9, last, with 633,200 cu. m., or 167,290,440 U. S. gallons per day. Of this volume 64,042,080 gallons were derived from springs, or "eaux de sources;" 62,826,760 gallons were taken from the Seine; 39,101,600 gallons came from the Ourcq and 1,321,000 gallons came from the artesian wells or from Arcueil. Between July 5 and 11 the aggregate consumption was about 62.4 gallons per day per inhabitant; of which only 26 gallons, however, was from the springs, or sources of purer water. While the Parisian authorities note this consumption as abnormal and due to a season of unusual heat, the figures given prove either that the supply of potable water is a limited one, or that there is unusual care in its distribution. Considering the very liberal public use of water in fountains, etc., in that city, the aggregate daily consumption per head of population is very small compared with the lavish use, or waste, of water in American cities. And in the latter cities the best water is used for all purposes, instead of there being several distinct supplies of varying quality to draw upon, as in Paris.

◆

THE GREAT YERKES TELESCOPE, which is to be erected at Lake Geneva, Wis., for the University of Chicago, is nearly completed and the observatory building will be ready for dedication and occupancy on Dec 15. The 40-in. lens for the telescope, which Alvan Clark, of Cambridgeport, Mass., has been grinding for the last year and a half is ready for shipment. This lens is the largest in the world, the next largest being the 36-in. lens in the Lick telescope in California.

◆

BOOK REVIEWS.

POCKET COMPANION, Containing Useful Information Appertaining to the Use of Steel, as Manufactured by the Carnegie Steel Co., Limited, Pittsburg, Pa. For Engineers, Architects and Builders. Edited by F. H. Kindl, C. E., 1896. Morocco flap; 4¼ × 6½ ins.; pp. 284; $2.

A feature of the present edition of this well-known pocket-book is the conformation of shapes, weights and tables of various sections, as well as specifications, to the new standards adopted by the Steel Manufacturers' Association. It also contains additional data on steel construction.

THEATRE FIRES AND PANICS:—Their Causes and Prevention. By William Paul Gerhard, C. E., Consulting Engineer for Sanitary Work. New York: John Wiley & Sons. 12mo.; 175 pp.; $1.50.

This is not a general treatise upon theatre planning and construction, but a statistical study of theatre fires and panics, their causes and frequency, and a series of hints upon the methods of preventing the same, as deduced from the experience of recent years. The prevention of fire and panics is only accomplished by proper location, planning and construction, backed by efficient management and constant inspection. The author briefly outlines these essential elements of safety. Fireproof curtains, stage ventilators, the arrangement of aisles and chairs, fireproof treatment of stage scenery, and safe heating and lighting, are all discussed along with fire-service, life-saving appliances, fire alarms and general questions of management. The work closes with a long list of books, pamphlets, reports, etc., bearing upon theatre construction and theatres generally.

INDUSTRIAL ORGANIC CHEMISTRY: A Hand-Book Adapted for the Use of Manufacturers, Chemists, and All Interested in the Utilization of Organic Materials in the Industrial Arts.—By Samuel P. Sadtler, Ph. D., F. C. S., Professor of Chemistry in the Philadelphia College of Pharmacy and in the Franklin Institute of the State of Pennsylvania; author of a "Hand-Book of

Chemical Experimentation;" etc., etc. Second Revised and Enlarged Edition. Philadelphia: J. B. Lippincott Co. 8vo.; pp. 537; 127 figures; diagrams and tables. Cloth, $5.00; half leather, $5.50.

The range of subjects covered by this volume is amazing. The general plan followed has been (1) to present for the several industries an enumeration and description of the raw materials concerned; (2) the process of manufacture is described; (3) the products are set forth; (4) analytical tests and methods are presented; (5) the bibliography and statistics of each industry, or the most important ones, are given. Owing to the scope of the work the treatment of each subject is generally brief.

The main divisions of the subjects taken up are oils, fats, resins, sugar, starch, fermentation processes, industries based on animal and vegetable fibers and animal tissues, dyeing and coloring.

The first edition of the work was published in 1891. In this edition the body of the text has not been altered further than to make corrections, but some new sections have been added, and the bibliography and statistics have been brought down to 1895. The volume seems to be a most excellent one for ready reference where only the salient features of a process are described. If one does not find here all that is desired the bibliography will direct him to more extended sources of information.

BUILDING CONSTRUCTION AND SUPERINTENDENCE.—By F. E. Kidder, C. E., Ph. D., Architect, Author of "The Architects' and Builders' Pocket Book." Part I.—Masons' Work. New York: William T. Comstock. 8vo.; cloth; pp. 409; 250 illustrations. $4.

This author has long been well and favorably known among architects, and also to a considerable extent among engineers, through his "Architects' Pocket Book." The present volume bids fair to be a very useful book for all who have to do with the construction of buildings. It is written in the light of the most recent practice and seems to cover the subject admirably. It is essentially a practical book, but is founded on good engineering, architectural and business principles.

The first two chapters discuss, respectively, foundations on firm and compressible soils. Next comes a chapter on masonry footings and foundation walls, shoring and underpinning, followed by chapters on limes, cements and mortars, building stones, cut stonework, brick work, and architectural terra cotta. Fireproofing is given some 40 pages, in which the subject seems to be well treated, including a description of some of the best systems of construction now in use. As closely allied to the main subject, a chapter is devoted to iron and steel supports for mason work and skeleton construction. Lathing and plastering and concrete foundations, followed by a chapter on specifications, close the body of the book. Seven brief appendices give some useful tables relating to the strength and other physical characteristics of building materials and a list of building stones.

Aside from the fact that some of the illustrations were made from very poorly drawn originals, and therefore are blurred and dirty, the make-up of the book is very good.

BLOCK AND INTERLOCKING SIGNALS.—By W. H. Elliott, Signal Engineer, Chicago, Milwaukee & St. Paul R. R. "Locomotive Engineering," New York; 1896. Flexible leather; 6 × 9 ins.; pp. 277; illustrated; $3.

Books on railway signaling are so few and, for the most part, so antiquated, that this volume is especially welcome to those who desire a convenient and up-to-date work on a subject which is demanding more and more attention from railway engineers. In the past signal engineering has been almost wholly monopolized in this country by the various railway signal manufacturers, comparatively few engineers outside of these companies having devoted especial attention to it. The reason for this has been doubtless the small use of interlocking and block signals by American railways as a whole, but this condition of things is changing. The railways are rapidly coming to a realization of the advantages of thoroughly signaling their lines, and are demanding the services of men competent to superintend the installation, operation and maintenance of these signals. This makes the field for a good treatise on railway signaling practice a promising one, and the author of this book has shown a timely judgment in presenting his work.

The book before us has its limitations. It aims more toward a popular and general exposition of the subject than toward an exhaustive and technical treatment. As published in "Locomotive Engineering," a paper devoted especially to the interests of the motive power departments of railways, the original articles were admirable for the class of men they were intended to reach. It cannot be said, however, that they serve so well the purpose of the mechanical and civil engineers who desire a technical, scientific presentation of signaling problems and their solution. The book gives these engineers more information than can be had in any other one place, but not as much and not in as technical a form as they would like to have such information given, in view of the great lack of good literature upon railway signaling. These remarks are not presented as a criticism upon the matter given in the volume before us, since this matter is admittedly intended for a certain class of men only, but they are necessary to give a clear idea of the book's limitations.

To give an idea of the contents of the volume in more detail it may be stated that the first nine chapters treat of block signaling, and in them the different manual, automatic and staff systems are explained, with considerable information in relation to maintenance. In Chapter VIII. the costs of operating the simple and controlled manual systems are compared with each other and with those of operating the various automatic systems. The remainder of the book describes the operation and construction of interlocking signals, with special chapters on switch signals and on agreements, contract specifications, installation and repairs. With some of the author's opinions and examples of practice there will be dispute. We note especially the diagram of interlocking signals for a junction of a single with a double track railway given on page 166, which can hardly be recommended as representing the best practice.

In typography and make up the book is generally excellent. The type is good and the illustrations are fairly engraved and printed. The faults are the numbering of cuts by chapters and often an omission of explanatory titles. The book has no index and an inadequate table of contents to supply in part the deficiency. On the whole, however, signal engineers will find the volume an interesting and valuable description of railway signaling practice in this country at the present time.

A MANUAL OF BRIDGE DRAFTING.—By Chas. H. Wright, M. Am. Soc. C. E., Chief of Drafting Department, Edge Moor Bridge Works, and Chas. B. Wing, Professor of Bridge Engineering, Leland Stanford Junior University. University Press, Stanford University, California, 1896. 4to.; 9½ × 12 ins.; flexible canvas; pp. 214; illustrated; $4.

Bridge literature has reached such an unprecedented volume within the last few years that one turns with considerable curiosity to each addition to ascertain what new features or original method of treatment the book presents as an argument for its claim upon the attention of bridge engineers. It is gratifying in the present case, therefore, to find that an attempt has been made to cultivate quite a new field. Each year our technical schools are graduating an increasing number of men who intend to make a specialty of bridge engineering, and usually the first practical work of these men is drafting in the office of some bridge engineer or bridge shop. Fresh from the schoolrooms, these students strike the unfamiliar field of practical exigencies; individual methods of carrying on work peculiar to location, machinery and prevailing requirements of patrons; shop and drafting room precedents and rules; manufacturers' standards; consideration of erection facilities, etc. It is to connect more closely the work of the student and that of the practical bridge draftsman that this book has been written. One of its authors is a practical bridge draftsman; the other is a teacher of bridge designing to college students.

The contents of the volume before us are perhaps best given by repeating the chapter headings under which the matter is presented. These are: (1) Details of Plate Girders, Lattice Girders, Trestle Bents, Floor Beams and Track Stringers; (2) Details of Pin Connected Spans; (3) Details of Pin-Connected Spans, Continued; Tables of Useful Information, etc.; (4) Bridge Drafting; (5) Shop Work and Inspection; (6) Bridge Erection. Each chapter contains drawings of details illustrating and supplementing the text and a variety of standard tables and diagrams for facilitating calculations. These tables and diagrams have the value of being those actually used by a large and well-known bridge company, and besides their practical working value are useful as indicating the manner and methods of using time-saving devices by practical bridge builders. In the chapter on Bridge Drafting is given the organization of a bridge drafting department, and instructions for arranging, lettering and recording drawings, forms for shipping bills, etc. A portion of this chapter and of that on Bridge Erection was published in Engineering News of Feb. 7 and April 25, 1895.

In the particular field it is designed to cover, the book is on the whole a useful one, but it fails in not being uniformly useful in all parts. Some of the tables and diagrams are of universal and lasting usefulness, some are useful only locally, and still others are already antiquated, or will soon become so. The authors, however, partly atone for this last fault by announcing that additions and revisions to these tables will be published from time to time.

In the matter of its make-up the book deserves some criticism, especially in respect to the clumsy and careless lettering of many of the drawings. In this respect, however, the conditions are no worse than those found in most sheets of bridge drawings which come from our bridge manufacturers' drafting rooms, and which are the natural result of hasty production. Despite this, one ought not to find in a manual for the instruction of bridge draftsmen a seeming encouragement of the fault so common and yet so easily corrected as careless lettering. It is not copper plate letters that are wanted, but neat letters, and no such slovenly letters of mongrel style and form should appear as are some of those on the drawings on Plate 28. It is interesting to compare this, to illustrate our point, with the lettering of the cuts on pp. 211 and 213, which are reprinted from Engineering News with the standard lettering used by this journal.

HIGHER MATHEMATICS.—A Text Book for Classical and Engineering Colleges. Edited by Mansfield Merriman, Professor of Civil Engineering in Lehigh University, and Robert S. Woodward, Professor of Mechanics in Columbia University. New York: John Wiley & Sons; 8vo.; pp. 600; $5.

This book, according to the publishers' announcement, is designed especially for the use of junior and senior classes in colleges and technical schools, but is equally well adapted to the use of advanced students and readers of mathematics generally; containing a concise treatment of subjects not commonly found in text books, but upon which lectures are now given in the best classical and technical institutions. The work is divided into eleven chapters, each by a different author. Each chapter, so far as it goes, is complete in itself, and is intended primarily to give a clear idea of the leading principles of the subjects treated. The headings of the several chapters are as follows

I. "The Solution of Equations," by Prof. Mansfield Merriman. II. "Determinants," by Laenas Gifford Weld, Professor of Mathematics in State University of Iowa. III. "Projective Geometry," by Geo. Bruce Halstead, Professor of Mathematics in University of Texas. IV. "Hyperbolic Functions," by James McMahon, Associate Professor of Mathematics in Cornell University. V. "Harmonic Functions," by William E. Byerly, Professor of Mathematics in Harvard University. VI. "Functions of a Complex Variable," by Thomas S. Fiske, Adjunct Professor of Mathematics in Columbia University. VII. "Differential Equations, by W. Woolsey Johnson, Professor of Mathematics in the U. S. Naval Academy. VIII. "Grassmann's Space Analysis," by Edward W. Hyde, Professor of Mathematics in University of Cincinnati. IX. "Vector Analysis and Quaternions," by Alexander Macfarlane, Lecturer in Electrical Engineering in Lehigh University. X. "Probabilities and Theory of Errors," by Prof. Robert S. Woodward. XI. "History of Modern Mathematics," by David Eugene Smith, Professor of Mathematics in Michigan State Normal School.

The well-known reputation of Professors Merriman and Woodward is a sufficient guarantee of the excellence of this work, and it will, no doubt, prove a valuable addition to the libraries of those whose tastes incline in the direction of higher mathematices, and a useful text book to mathematical students. The progress of mathematical investigation during the present century has been so great that, in the words of the preface, "the mere quantity of information available presents a formidable obstacle to the simultaneous attainment of the breadth and depth of knowledge which characterized the mathematician of a generation ago. * * * Hence the student who seeks to gain a comprehensive view of the mathematics of the present day needs most of all that sort of guidance which fixes his attention on essentials and prevents him from wasting valuable time and energy in the pursuit of non-essentials." Quoting further from the preface:

> During the past 20 years a marked change of opinion has occurred as to the aims and methods of mathematical instruction. The old ideas that mathematical studies should be pursued to discipline the mind, and that such studies were ended when an elementary course in the calculus had been covered, have for the most part disappeared. In our best classical and engineering colleges the elementary course in calculus is now given in the sophomore year, while lectures and seminary work in pure mathematics are continued during the junior and senior years.

The change in the college course here referred to gives rise to the question whether it is a beneficial one. If the mathematical course ending in calculus is not given for the purpose of disciplining the mind then its only other reason for existence is that it furnishes a tool which is necessary to the prosecution of the higher courses in mechanics and in engineering theory and practice. The spending of time in an engineering course on higher mathematics, beyond calculus, can only be justified on the ground that a knowledge of these higher branches is a useful tool, enabling the engineer to accomplish something which he could not accomplish without it. It cannot be claimed for it that it is needed as a mental discipline, for if a student in his sophomore year acquires the calculus so well as to be able to use it in problems of applied mechanics and thermodynamics, and during the junior and senior years studies those branches of engineering science and art which require the application of the calculus, together with the most intense concentration of the mind upon the problems at hand, no higher form of mental discipline can be given by quaternious or hyperbolic functions. On the contrary it is well known that too great devotion to mathematical studies tends to narrowness of intellect, and is therefore detrimental to the training of an engineer. The use of the higher mathematics as a tool in engineering problems is exceedingly rare. Probably not one in a hundred engineers in practice can, five years after graduation, work out a problem in calculus without reference to a book, and not one in a thousand probably ever needs hyperbolic functions. Calculus may be necessary for the engineering student both as a mental discipline and as a tool to be used in the study of applied mechanics, but higher mathematics, we think, he can do very well without, unless he intends to devote his life to original research in physics, electrical theory, etc., in which case, of course, it may be of great service.

ENGINEERING NEWS AND AMERICAN RAILWAY JOURNAL.

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ONE HUNDRED PER CENT. OF THE GROSS RECEIPTS is the basis on which a street railway franchise was awarded in New York city by Controller Fitch on Nov. 27. This sum was bid some time ago by the People's traction Co. for a franchise for 29 miles of streets in the upper part of the city. A competing company at the time bid 6,975⅛% of the gross receipts, but the People's Co. urged that such a bid was farcical. The matter has been in the courts since October, 1895. The routes involved form connecting links between that portion of the city south of the Harlem River and outlying territory both within and without the city.

◆

AN ELABORATE SYSTEM OF SUBURBAN ELECTRIC lines in Cook county, Ill., is projected by the Metropolitan Traction Co., incorporated in Illinois, in 1895, with a capitalization of $6,000,000. When first incorporated the company introduced an ordinance into the Chicago City Council petitioning power to build underground and surface or elevated electric railways within the central part of the city, but the ordinance was never pushed and finally died of inanition. It is now alleged that the charter has been purchased by a number of responsible Chicago business men, who have remodeled the scheme and are prepared to push work as soon as the proper authority is granted. The present franchise asks permission of the Cook County Commissioners to construct electric trolley lines on practically all of the unocupied highways under the jurisdiction of that body, nearly 100 miles in all, and connecting Chicago with the suburban towns of Evanston, Wheeling, Elgin, La Grange, Blue Island, Harvey, Thornton, Chicago Heights, Hammond and others. The terms of the franchise are entirely inadequate to protect the rights of the public in the matter of fares, damages, guarantees of construction, compensation, and in other respects, and public sentiment in Chicago particularly is against its passage. The County Commissioners are divided in their attitude toward the ordinance, however, and it is entirely possible that it will be granted with certain modifications. The ordinance as it now stands is an entirely vicious one in its neglect of the interests of the public, but the scheme, if properly regulated, has considerable merit in its favor.

◆

THE ELECTRIC MOTOR CARS ON THE BROOKLYN Bridge have been successfully applied to the switching of trains at the terminals and pushing them out to the point where the cable is taken; and they are now in regular service taking the place of the old steam locomotives. The chief advantage of the new system is that while one train is loading the next train can be backed down near to it, ready to take its place. The result is that there is much less crowding and the platforms are clear even in the rush hours. Chief Engineer Martin expects to shortly run trains on 45 seconds headway, and promises to do even better when the double, or gauntlet tracks are ready. The new motor cars have also been tried in running trains all the way across the bridge, with success. Four cables will soon be in place across the bridge; two of these always being in service with the weight of the heavier trains proposed divided between them.

◆

THE TUNNELING OF UNION SQUARE, New York, to avoid the two present dangerous curves on the Broadway cable road, seems to be an eminently sensible and practicable idea. The cable company is willing to build the tunnel at its own expense, and thus to substitute a practically straight line for the present curves around the square, provided the city authorities grant permission. The tunnel would be three blocks long and interfere with no streets, as the cable would readily overcome the steep gradients required.

◆

THE CASCADE TUNNEL, on the Great Northern Railway, in Washington, is to be completed, says the St. Paul "Press." This tunnel is 2½ miles long and would reduce the elevation of the traveled line from 4,055 to 3,150 ft. above the sea. It would be 16 ft. wide and 23 ft. high, and the estimated cost is $2,000,000. At the present time the mountain is crossed by a switchback, 235 miles west of Spokane, famed for its scenic beauty. The tunnel would save 10 miles in distance and one hour in time.

◆

THE NEW RADEBAUGH TUNNEL on the realinement of the Pennsylvania R. R., near Greensburg, Pa., was "holed through" Nov. 19, the heading meeting about 3 p. m. The tunnel is 2,100 ft. long, for a double track line, as described in our issue of Dec. 12, 1895. The work has been done by the Drake & Stratton Co., of New York, with Mr. James Day, as General Superintendent, and Mr. W. R. Michie, Engineer in Charge.

◆

A NEW DOUBLE TRACK STEEL VIADUCT over Ridley Creek, one half a mile west of Media, Pa., on the Philadelphia, Wilmington & Baltimore R. R. was put in service November 28. It consists of six towers carrying 40-ft. girders, with intermediate girders 60 ft. long; the total length, backwall to backwall, being 641 ft., and height above water, 102 ft.. It supplants a single track Linville & Piper truss, with Howe truss approach at the east end, which was erected in 1877. Mr. H. C. Smith of Media, Pa., is the Engineer in charge of this division of the road.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the wreck of the Southern Express on the Pennsylvania R. R., near New Brunswick, N. J., on Nov. 25, resulting in the death of the engineer and fireman. The cause of the accident was the breaking in two of a freight train on the opposite down grade track; the wild section ran into the first section and two freight cars were derailed and thrown upon the other track just as the express came along at a high speed. The engine of the express rolled down the embankment and the two express cars and a mail car of the train left the track and were wrecked; the two first sleepers were also badly damaged, but the only persons injured on these cars were the express messenger and the baggage master.——Two engines were wrecked on the Lehigh Valley Ry., near Mud Run, on Nov. 24. An engine that had been flagged by a broken coal train ahead was run into by another engine coming after it. Both engines rolled down a 40-ft. embankment, but as the crews of both jumped before the collision, no one was injured.——One man was killed and 12 persons injured near Ensley City, Ala., on Nov. 20, by the failure of an old-fashioned wooden highway bridge of very crude design.

◆

A GAS EXPLOSION AT PITTSBURG, PA., on Nov. 30, blew off a few sewer manholes and broke a number of plate glass windows.

◆

THE PINTSCH SYSTEM OF CAR-LIGHTING has been adopted for the trains of the Manhattan Elevated R. R., after a thorough investigation of the subject and in compliance with the requirements of the New York Legislature. The contract with the Safety Car Heating & Lighting Co. was signed on Dec. 1 and the cars must be equipped by April next. Gas-works will be erected by the Pintsch Compressing Co., at 159th St. and Eighth Ave., from which the cars will be supplied.

◆

THE NEW TWIN-SCREW STEAMER "La Grande Duchesse" for the Savannah Line (to run between New York and Savannah) left New York on its first regular trip Nov. 28. The vessel is 404 ft. long over all, 47 ft. 9 ins. beam, and 37 ft. 4 ins. deep, the hull framing being specially designed for mounting guns, as the vessel is classed as an auxiliary cruiser. The twin screws are driven by two quadruple expansion engines of 3,500 HP. each, steam being supplied by eight Babcock & Wilcox water tube boilers. The coal is brought from the bunkers by a conveyor, and the fireroom coal buckets are suspended from trolleys running on an overhead rail. The normal steam pressure is 210 lbs. There are two Sturtevant blowing engines delivering air to the firerooms, and two Westinghouse high speed engines for the electric light plant. A vertical engine drives the anchor hoist, this engine having been built by the American Ship Windlass Co., of Providence, R. I. The ship can accommodate 700 passengers, and all the first class staterooms have telephone connection with a central station. The ship and engines were built by the Newport News Shipbuilding & Engine Co., of Newport News, Va., for the Ocean Steamship Co., of New York city, which company operates the Savannah Line.

◆

THE HAMBURG-AMERICAN STEAMSHIP "PENNsylvania," now nearly completed at Belfast, is to be the largest merchant steamship afloat. She is 560 ft. long on the water-line, 62 ft. beam, 41 ft. deep from upper deck to top of keel, draws 26 ft. of water, and is 20,000 tons dead weight with 30,000 tons displacement. The average speed is to be 14 knots, and she will accommodate 1,228 passengers.

◆

THE LOWEST BIDS FOR STREET CLEANING, garbage collection and removal for the year 1897, received at Philadelphia on Nov. 25, aggregated $847,750, which was $65,832 more than the appropriation for the same service for the current year, and $78,750 less than the estimates. The garbage collection and disposal bids for 1897 make up $520,550 of the $847,750. The lowest bids for this service were submitted by the present contractors on the territory now covered by them, three districts being served by the American Incinerating Co., which uses the Arnold system of utilization, and two districts by the Philadelphia Incinerating Co., which employs Smith furnaces. The lowest bids for each class of work in each district are given in our Construction News Supplement.

◆

TYPHOID FEVER AT PATERSON, N. J., is reported as far above the normal for November. The water supply is said to be the source of infection, but results of a careful investigation of the subject have not been made, or at least have not been made public. Water is taken from the Passaic River, above the Great Falls. The population above this point is small, compared with that below.

◆

TRAFFIC ON ASPHALT PAVED STREETS in Milwaukee has recently been investigated at the instance of the Warren-Scharf Co., which requested the city authorities to take a count of the traffic on the principal streets. This covered seven days in September and the period between 6 a. m. and 7 p. m. Four of the seven days were cloudy; in two of them there was slight rain and in one a continuous rain. The greatest number of vehicles passing in any day of 13 hours was 5,146, and the smallest was 1,328, on Sunday. The daily average was 4,090.61. The greatest number of horses was 6,930, and the least 1,700; the daily average of horses being 5,433.40. Electric street cars were not counted as traffic, as they were supported by the rails; but the daily average of such cars was 1,902 for the 13 hours selected. The speed record showed that 48% of the horses were walking and 52% trotting. Of the weights moving, 38% were moving at a walk and 62% at a more rapid rate. The proportion of vehicles weighing less that one ton, with their load and outfits, was 29.7% of the whole; of heavier loads, 24.83%, and of horses 45.47%. The pavements showed the effect of three years' use. The average daily number, class and weight of horses, vehicles and loads is shown in the following summary of the schedules:

	Horses.	Vehicles.	Tons.
Loads under one ton:			
Walking	1,633	1,243	1,438
Trotting	2,719	2,304	2,512
Loads from one to three tons:			
Walking	543	281	834
Trotting	119	61	182
Loads from three to five tons:			
Walking	393	196	982
Trotting	5	3	13
Loads over five tons:			
Walking	3	1	5
Horses not attached:			
Walking	17	—	8
Speeding	1	—	½
Electric cars	—	1,902	—
Total daily average	5,433	4,091	5,974½

The average weight of daily traffic to each foot in width of roadway, not including weight of street railway cars, was 119,486 tons.

◆

THE NEW YORK AND NEW JERSEY BRIDGE CONstruction Co. has made a contract with the Union Bridge Co., of New York, for the building of the bridge over the Hudson River, at a cost not to exceed $25,000,000, and under a bond of $1,000,000 for faithful performance of the contract. Mr. Swan, the secretary of the bridge company, says that the bonds for this work will soon be offered to the public.

◆

RESTRICTION IN THE HEIGHT OF BUILDINGS, in New York city, is being considered by a special committee of the New York Board of Trade and Transportation, with Mr. G. Waldo Smith as Chairman. While the majority of the committee seem to favor restriction in height, there is considerable difference of opinion as to where the line should be drawn.

THE MT. NEBO RESERVOIR AND CANAL SYSTEM, UTAH.

By W. P. Hardesty, C. E.

(With inset.)

The Mt. Nebo Irrigation Co.'s reservoir and canal system is located in central Utah, in the counties of Juab and Utah. The system consists essentially of a reservoir with its dam for impounding water, a main canal line for carrying water, employing pipe and flumes as well as open canal, and a fine body of irrigable land well situated for general farming and fruit growing. This undertaking was first projected in 1892 by the Mt. Nebo Reservoir & Canal Co., and the preliminary surveys were made then, but it was not until early in 1895 that the present company was formed and construction begun.

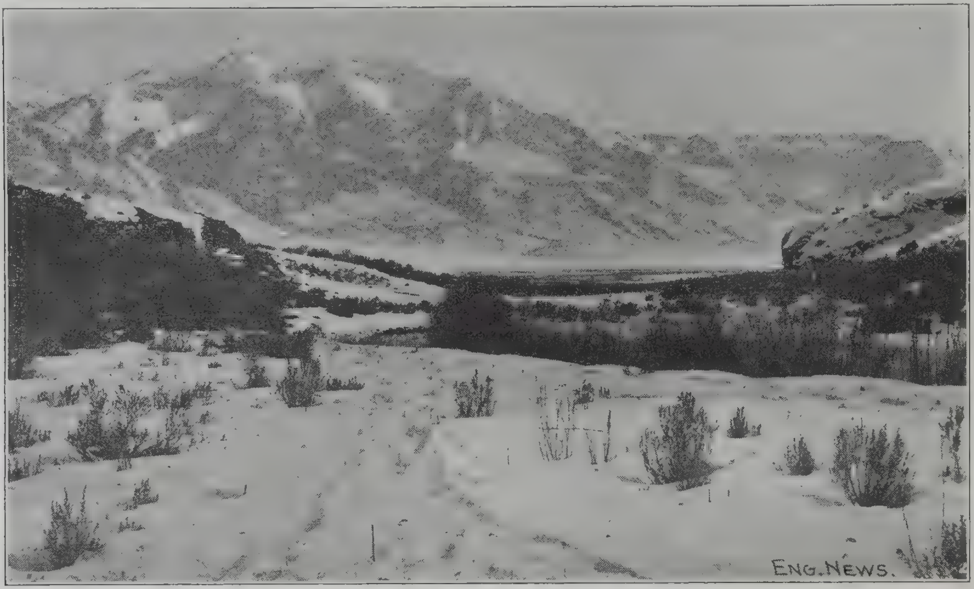


FIG. 1.—VIEW OF MT. NEBO, SHOWING DAM SITE BETWEEN PROJECTING ROCKS IN FOREGROUND.

The Mt. Nebo reservoir is located in Juab Co., in the Mona Valley (being the northern end of Juab Valley), which lies between the Wasatch Range of mountains on the east and another but much lower range on the west. The valley is a broad basin with gentle slopes, and covering the lowest part of it is the reservoir site. The reservoir is mainly fed by Salt or Currant Creek, which runs through the valley from south to north. The culmination of the Wasatch Range here is Mt. Nebo, shown in the view, Fig. 1, from which the reservoir takes its name, whose summit is 12,000 ft. above sea level. Salt Creek heads on the east side of this mountain, a branch of it coming down from the divide between San Pete and Juab Cos., and, after flowing south and southwest through Nephi canyon to the town of Nephi, it turns north through Mona Valley. It has a drainage area of over 250 sq. miles, including Mt. Nebo and surrounding mountains.

Near the north end of Mona Valley the creek cuts through the low range on the northwest, the summit of which forms the line between Juab and Utah Cos. Above this point in Mona Valley the fall of the stream is very slight, but through the mountains in Currant Creek canyon the fall is quite heavy. This canyon extends but about three miles, opening out into the Goshen and Kimball Creek valleys, where are located the lands to be irrigated. The broad basin in Mona Valley spoken of, together with the narrow outlet through the solid rock at its lower end here, constitutes an ideal natural reservoir site. Near the head of this gorge, and where two solid rock ridges face each other, the dam is located.

Reservoir.—The Milford branch of the Union Pacific Ry. traverses the Mona Valley, and on the west side of this lies the reservoir, as shown in the map, Fig. 2. It reaches from Mona at the south end to beyond Starr Station on the north, the latter being just 75 miles from Salt Lake. With the present arrangements the reservoir covers 1,850 acres, to an average depth of over 10 ft., being five miles long by ½ to ¾ miles wide. This gives a storage capacity of 838,000,000 cu. ft., or over 19,000 acre-ft.

By enlarging the dam so as to raise the water 5 ft. higher, as is contemplated in the future, the reservoir will cover an area of over 2,400 acres, giving a storage capacity of 1,300,000,000 cu. ft., or nearly 30,000 acre-ft. In surveying the site, four complete contour lines were run around it and eight cross-section lines run across it, to obtain full information as to areas covered, capacities, etc., at different elevations of water.

Besides all the flow during the non-irrigation season of Currant Creek, whose channel runs through the reservoir, it also receives the discharge of numerous springs within and adjacent to it on the east side. It is estimated that just one year will be required to fill the reservoir.

Dam.—The dam is 210 ft. long at the top, 130 ft. at the bottom and 30 ft. high. Its base is 110 ft., and its top 8 ft. wide. A plan and profile of the structure are shown by Figs. 3 and 4. The up-stream side or back of the dam has a slope of 1½ to 1 from the crest down for 10 ft., with a slope of 2 to 1 for the remainder; the down-stream side or face has a slope of 1½ to 1, with a 3-ft. berm at 10 ft. down. The high water mark for the reservoir is 5 ft. below the top of the dam.

The body of the dam is of selected clay, hauled a few hundred feet from a borrow pit on the reservoir site. The clay was thoroughly sprinkled, harrowed and rolled in layers as built, a 5,000-lb. corrugated iron roller, shown by Fig. 5, being used. The back is faced with loose rock and heavy boulders to a thickness of 3½ ft., all laid by hand and with the interstices filled with earth by washing in with water.

The face is composed entirely of heavy gravel and loose rock, the horizontal width of the layers decreasing from 12 ft. at the foot to 4 ft. at the top, the stones being assorted and graduated in size so as to have the largest on the outside and smallest inside next to the body of the dam.

Before construction, the foundation for the dam was stripped of the surface soil, and three trenches, one at each toe and one at the middle of the dam, each about 12 ft. deep by 4 ft. wide at the bottom, were dug through the gravelly clay and into the bed rock for about 2 ft. These were refilled with the best material obtainable, sprinkled and thoroughly tamped, to shut off any possible seepage of water under the dam. Where the dam joined the solid rock ledges or abutments at the ends, these were scored or trenched to form a perfect bond between the dam and the rock faces, cement being liberally used.

At the west end of the dam is located the outlet tunnel, for draining off the water from the reservoir. This is cut through the solid rock ledge or abutment at the end of the dam, thus avoiding any risk that might be incurred in passing the water through the body of the dam itself. The tunnel is 140 ft. long, has an arched top, and is 6 ft. high by 4 ft. to 5 ft. wide, and a portion of it is located on a curve. All seams in the walls of the tunnel were well filled with cement. It was put through before the dam was built, to allow the creek to be diverted through it.

The most interesting feature of the tunnel is the gate-shaft, with the gates for regulating the flow of water. The shaft is sunk from the top of the rocky ridge directly over the tunnel, and is 4×5 ft. by 34 ft. deep. At the bottom of the shaft and closing the tunnel are the gates, two in number, of the "butterfly" type. Each gate is 2 ft. 11 ins. wide by 4 ft. high, with a clear opening of 2½ ft. wide, and is revolved by a vertical shaft 39 ft. long. The head of water sustained when the reservoir is full is 30 ft. The construction of the gates is shown by Fig. 6, while Fig. 7 is a view of the gates taken in the tunnel.

Each gate is constructed as follows: Around the 2¼-in. round cast-steel shaft a core of iron is cast, to which as a central frame are riveted the plates forming the faces of the gate. These plates are of ⅜-in. flange iron of 60,000 lbs. tensile strength. Three layers are used, one for each face and one between. The frame or casing for the gates is of cast-iron, resting on old railway rails laid horizontally and fitted to rails set vertically at the sides of the tunnel, the whole being well set in concrete.

At the top of the shaft is located the operating gear. This consists of a horizontal shaft having a worm cast on it and engaging segments of gear wheels keyed onto the ends of the vertical shafts. The horizontal shaft has a hand-wheel at each end for turning. These gates and the operating gear were made by Silver Bros., of Salt Lake City. The top of the gate-shaft is enclosed by a frame gate-house.

At the head of the tunnel is a screen for catching drift, etc., and a strong frame with slides is also in place for supporting an emergency gate, should such ever be needed.

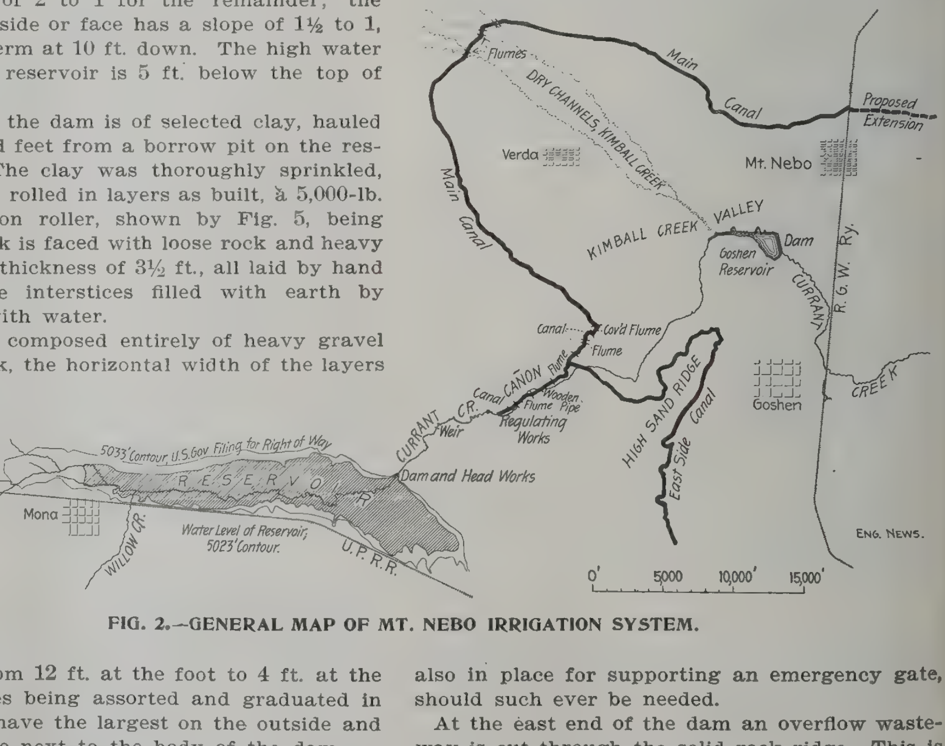


FIG. 2.—GENERAL MAP OF MT. NEBO IRRIGATION SYSTEM.

At the east end of the dam an overflow wasteway is cut through the solid rock ridge. This is 25 ft. wide and has its bottom at the flood level of the reservoir. It has ample capacity for carrying off any surplus of flood waters that may ever flow into the reservoir. The dam and all appurtenances, except the wasteway, were built by day labor, and cost about $12,000. The outlet tunnel cost $7.85 per lin. ft.

Canal System.—The water is drawn off from the reservoir during the irrigation season, being allowed to return to the creek and flow in it for about two miles before being diverted into the

UNIVERSITY OF ILLINOIS

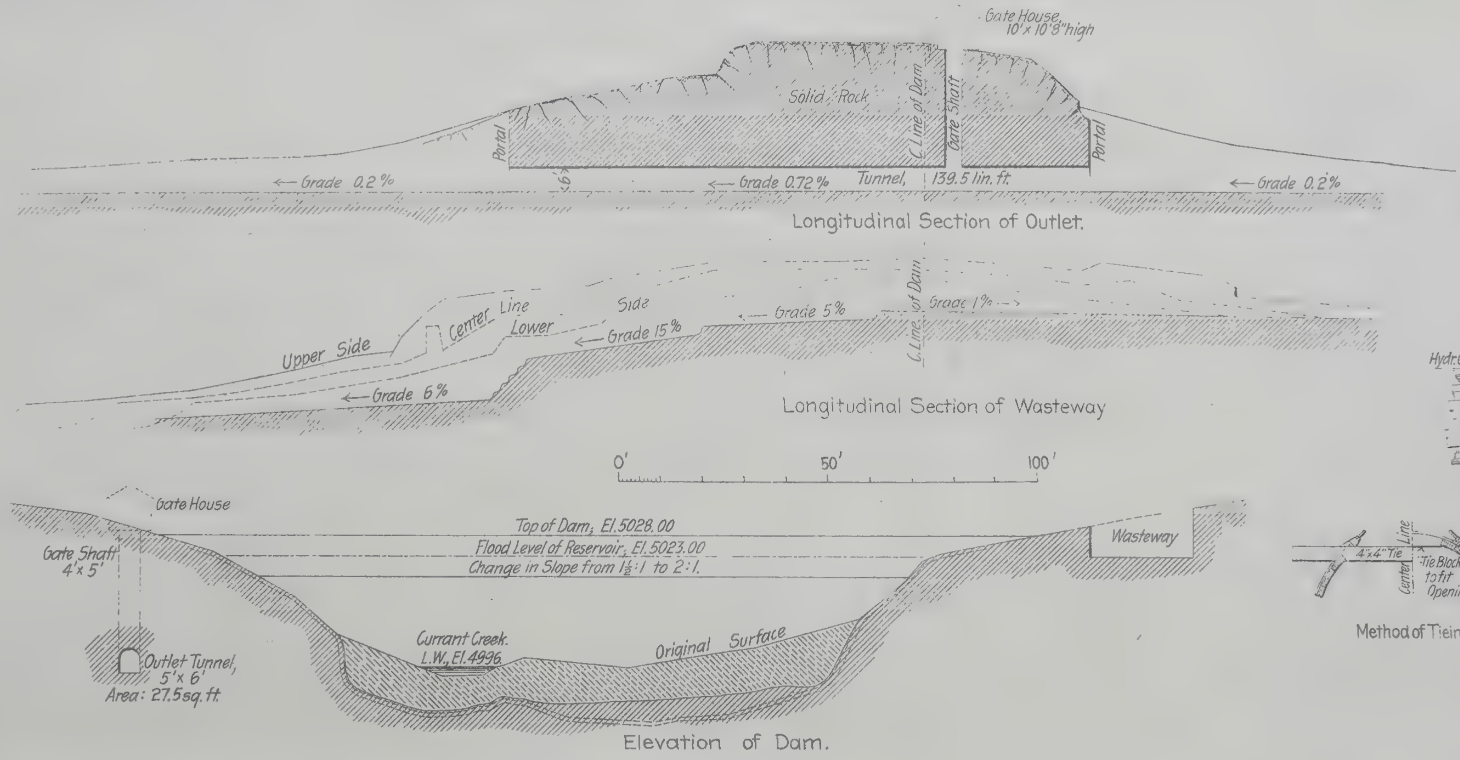
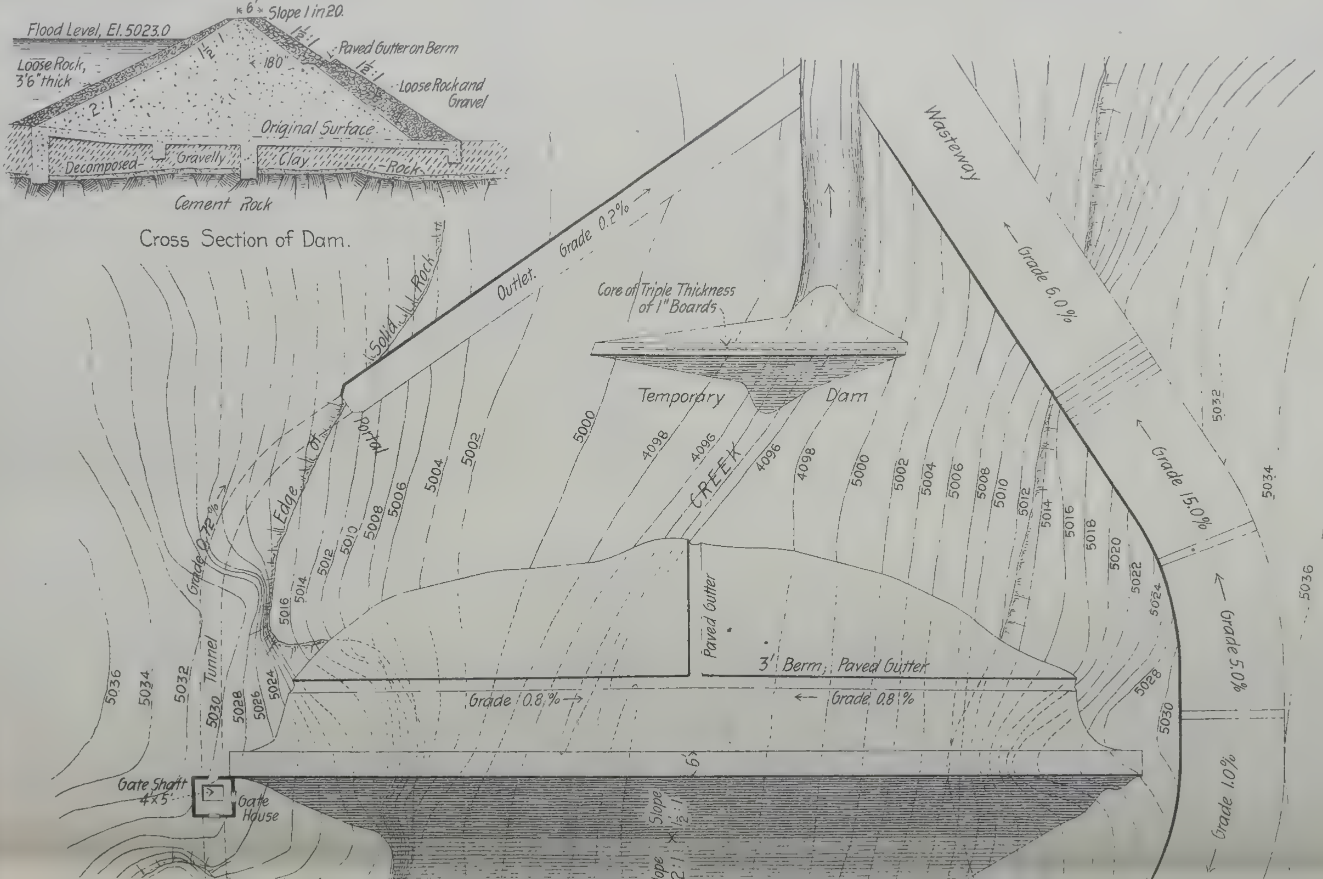


FIG. 4. ELEVATION AND LONGITUDINAL SECTIONS OF DAM, OUTLET AND WASTEWAY.



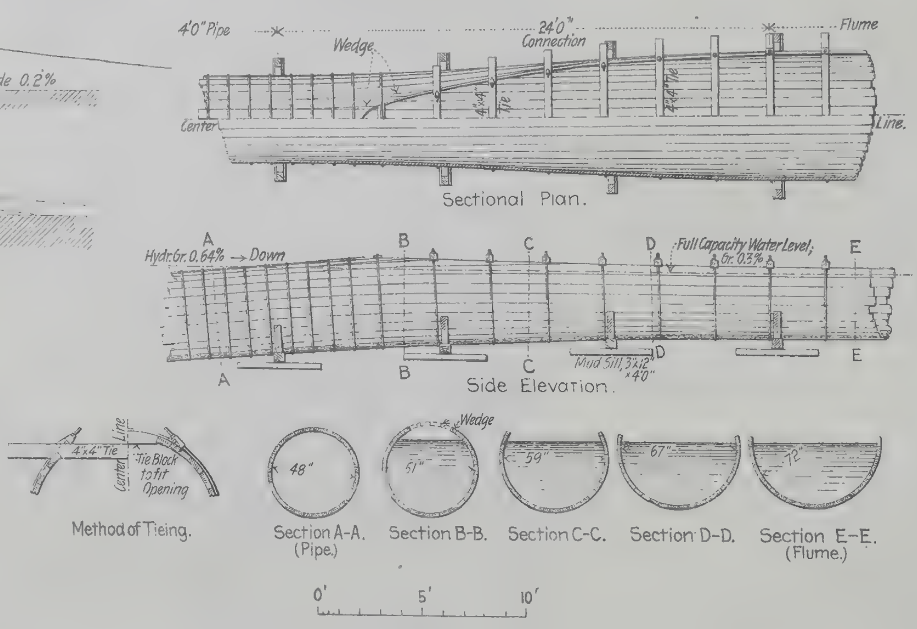


FIG. 16. CONNECTION BETWEEN PIPE AND FLUME.

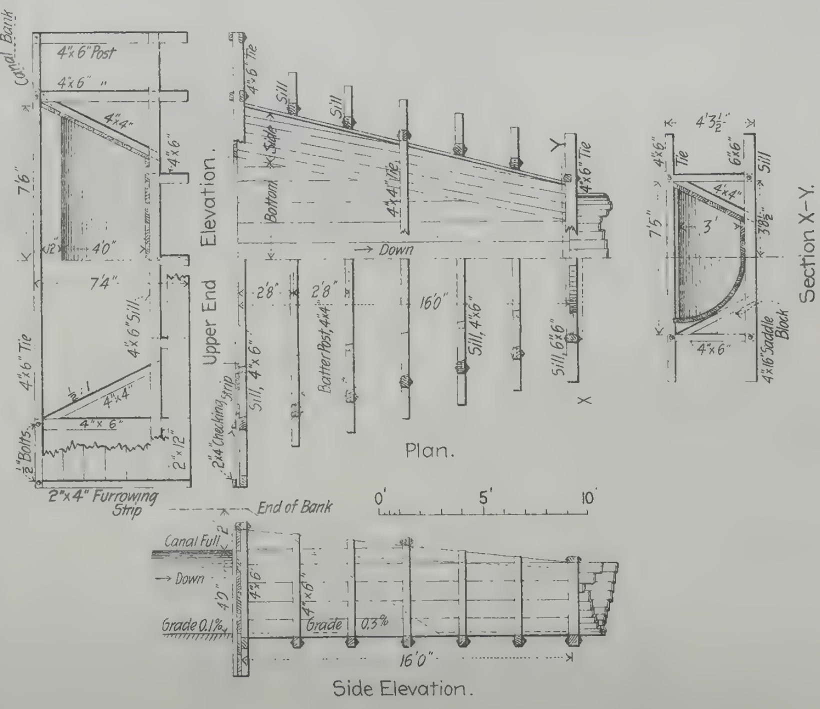


FIG. 13. JUNCTION OF FLUME AND CANAL.

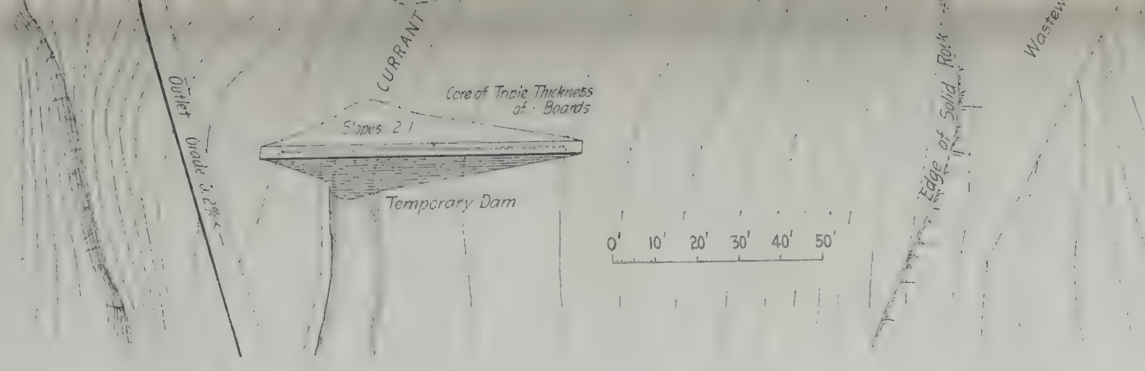


FIG. 3. PLAN AND CROSS SECTION OF DAM.

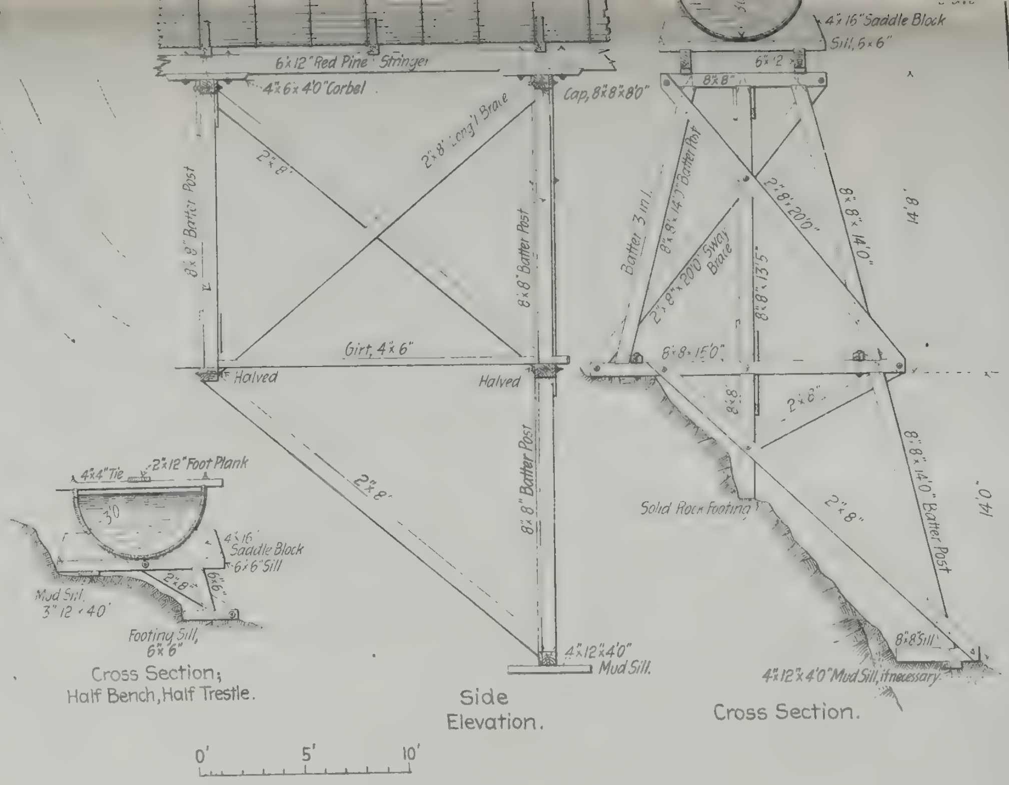


FIG. 9. STANDARD FLUME ON TRESTLE.

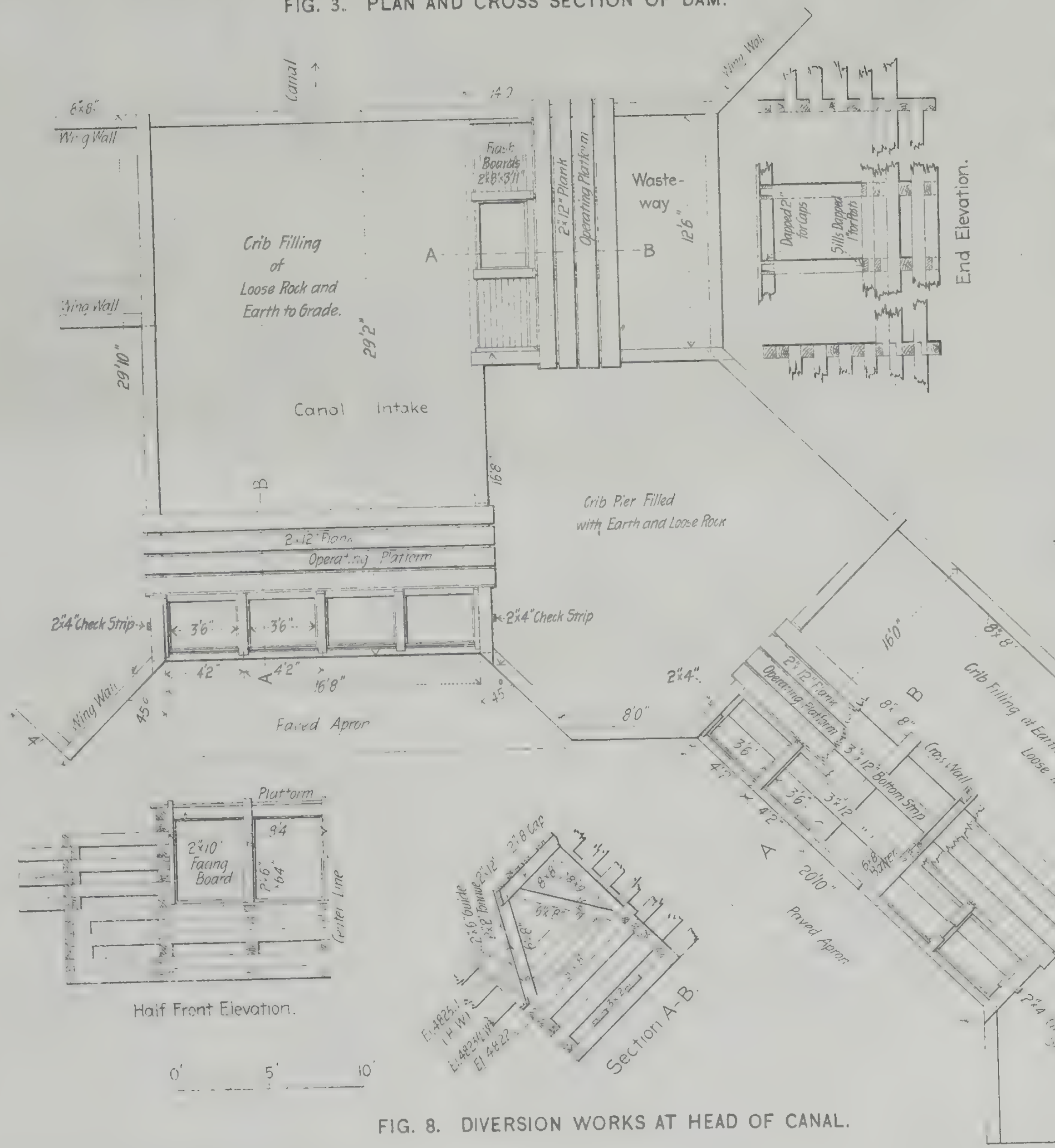


FIG. 8. DIVERSION WORKS AT HEAD OF CANAL.

THE
MOUNT NEBO RESERVOIR
AND
CANAL SYSTEM,
UTAH.

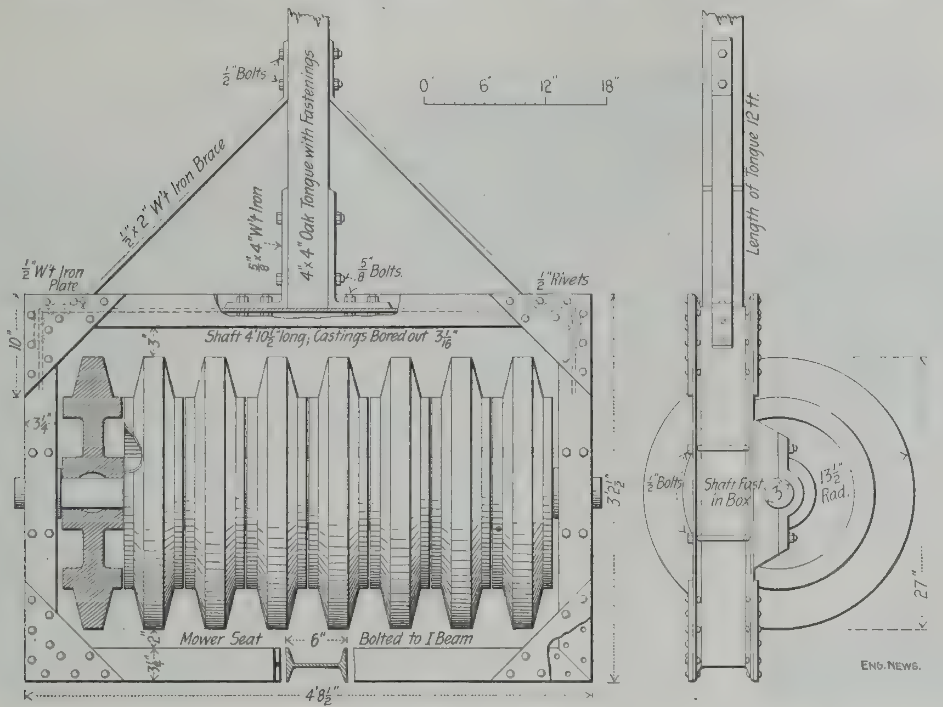
O. R. Young, Chief Engineer.

Wm. Hammond Hall, M. Am. Soc. C. E.,

Consulting Engineer.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

company's canal. In this distance there is a fall of but 31½ ft., and the diverting weir and headgates are located just above a very rapid fall in the creek's descent, amounting to 150 ft. in less than 1½ miles, thus securing all the elevation possible consistent with a short length of canal.

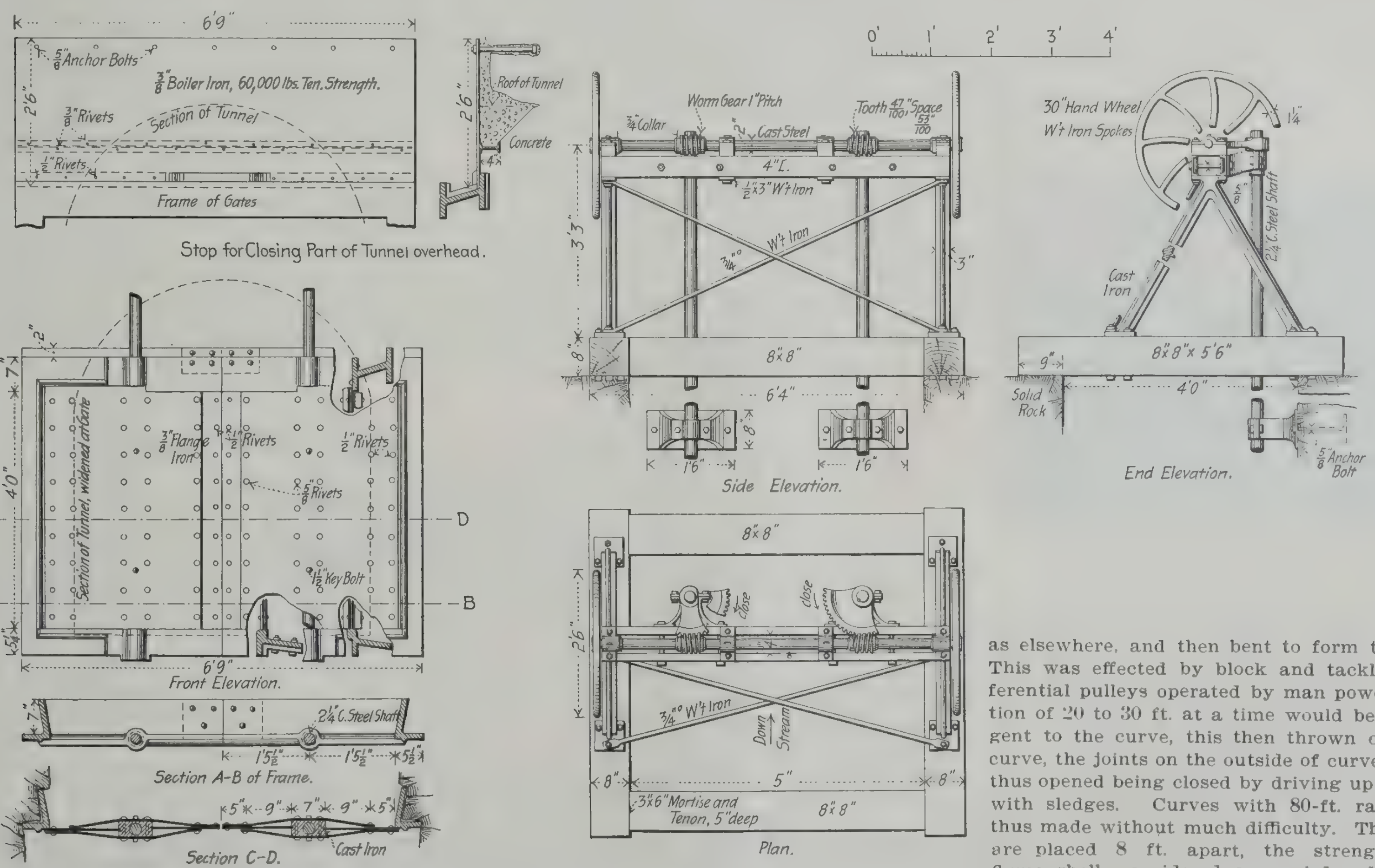


Plan. End Elevation.

FIG. 5.—DETAILS OF GROOVED ROLLER.

The diverting weir headgate proper, and the waste weir are all of the same type, with flash boards for controlling and regulating the water. Details of these are shown by Fig. 8.

There are five bays or openings to the diverting weir, four to the headgate and three to the waste weir, each opening being 3¼ ft. wide by 4½ ft. high. The flash boards slide in guides laid at an angle of 60° with the horizontal. The structures supporting the gates are of cribwork of 8×8-in. timbers, drift-bolted together and filled in with heavy rocks; a plank flooring is placed at the bottom, 4 ft. below grade, and heavily weighted.



Gates and Frame. Operating Gear.

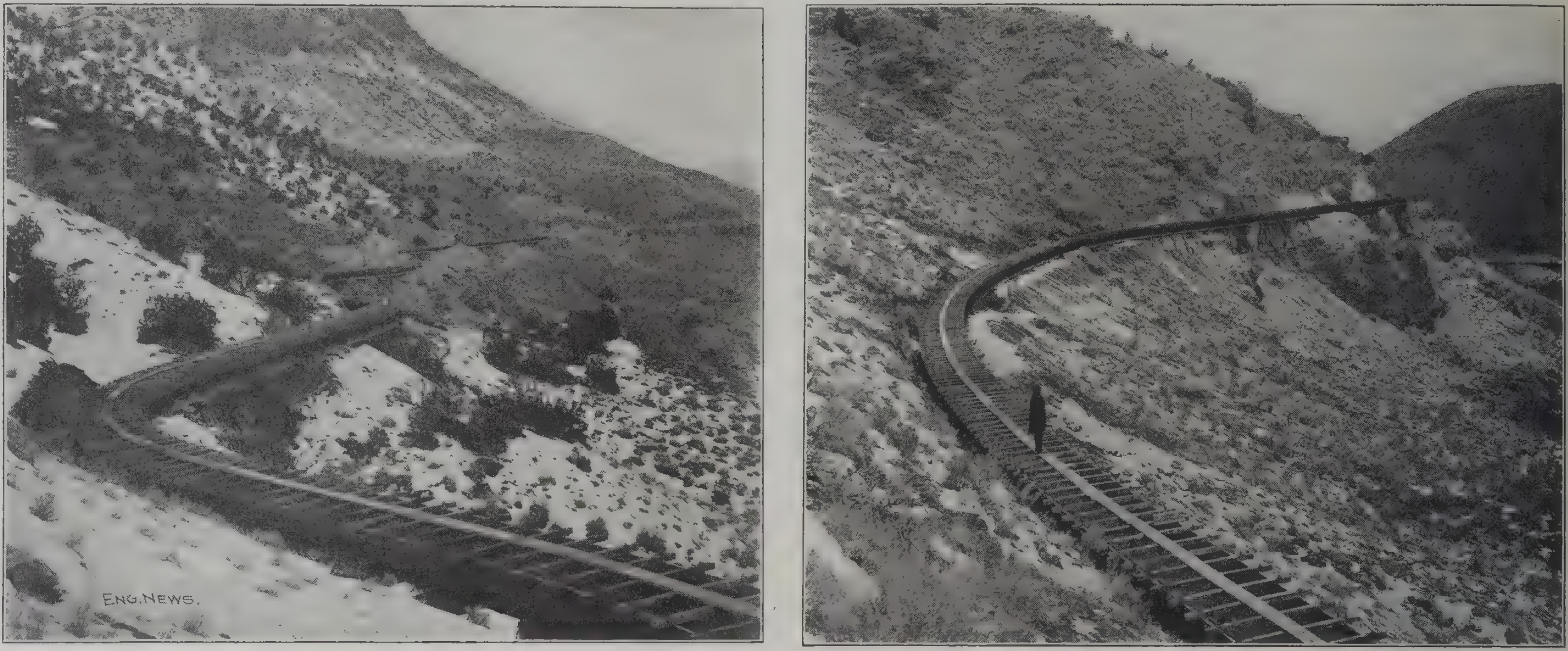
FIG. 6.—DETAILS OF OUTLET GATES AT DAM.

The gates are on the west side of the creek. The main canal follows down the canyon or close valley for over two miles before emerging and reaching the open valley to be irrigated. The line necessarily runs through a very rough and difficult country, requiring engineering skill of the highest order to successfully overcome all the obstacles. But about one-third of this portion could be built as open canal, the remainder being in pipe line and flumes. The fluming used is of a new and unusual type, being patented by Mr. Guy Sterling, C. E., of North Yakima, Wash. The section or shell forming the water-carrying channel is semi-circular, constructed of redwood staves, with true curved faces and radial joints, banded with ½-in steel bands, very similar to wooden stave pipe. Fig. 9 shows this flume and the standard type of trestle used to support it along the steep hill-sides. The section used for most of the flumes is U-shaped, being composed of a semi-circle of redwood 6 ft. in diameter, above which is a 6-in. fir stave on each side, with 4 ins. of it set vertically or tangent to the curved part. This gives increased depth. Fir is used because it withstands compression better than redwood in cinching up the bands.

This section allows 3 ft. depth of water, and is used where the flume has a fall of 0.3 ft. per 100 ft., giving an estimated capacity of 150 cu. ft. per sec., with velocity of nearly 11 ft. per sec. Where the fall is only 0.1 ft. per 100, a true segment of a circle is used, the shell being carried up three staves on each side above the semi-circle, the top ones in all cases being of fir. A clearance of 4 ins. above the water level is allowed. Outside the canyon, some short sections of flume have a true semi-circular shell, the diameter in all cases being 6 ft. The outer side of the flume shell was elevated, and the inner side depressed on curves, the amount being calculated by the usual formulas, the factors given being the top width of the water and the velocity. The right position was given by rolling or canting the flume in its supports, it not being nailed nor fastened to these in any way. No change is made in the supports of the flume on account of the elevating.

This type of flume was first used on the Santa Ana Canal of the Bear Valley irrigation system in California by Mr. Wm. Hammond Hall, M. Am. Soc. C. E., over 2½ miles of 5½ ft. flume being built. (See Trans. Am. Soc. C. E., Feb., 1895, for very full description of the Santa Ana works.) This was built with mitered joints on curves. The Mt. Nebo flume was built the same on curves as elsewhere, and then bent to form the curves. This was effected by block and tackle and differential pulleys operated by man power. A section of 20 to 30 ft. at a time would be built tangent to the curve, this then thrown over to the curve, the joints on the outside of curve that were thus opened being closed by driving up the staves with sledges. Curves with 80-ft. radius were thus made without much difficulty. The supports are placed 8 ft. apart, the strength of the flume shell, considered as a girder, being quite sufficient for this span. The flume is used in all places where a canal could not be built, except one pipe line which divides it into two sections. At the head of the upper section the creek is crossed from west to east by a trestle, 400 ft. of which averages 20 to 25 ft. high. Altogether some 5,800 ft. of flume is used in the canyon.

Figs. 10 and 11 are views of the flume in the lower part of the canyon, and Fig. 12 is a view showing the junction of the flume with the canal below. The details of one of the flume and canal connections are shown by Fig. 13.



FIGS. 10 and 11.—VIEWS OF FLUME IN LOWER PART OF CANYON.

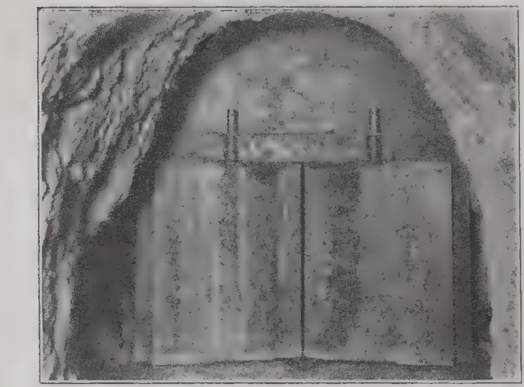


Fig. 7.—View of Outlet Gates in Tunnel at Dam.

The flume is used in some places where the canal section was first built, but where the difficulty of keeping it in repair, on account of treacherous ground or of filling up, became so apparent that the flume was afterward added. The main points of superiority of this flume as compared with the ordinary rectangular or box flume are: (1) Its adjustibility to all conditions of wetness and dryness, by means of the cinching bands. (2) Its very much greater durability, there being no nail-holes nor undrained joints in which decay can set in. (3) It requires, as an average, 40 to 50% less lumber or perishable material in the flume and its framing. (4) Curves can be followed with no special construction or joints, the flume shell being built the same as on tangents.

Just before reaching the open Kimball Creek Valley a sand ridge is passed through by a cut 700 ft. long and 30 ft. deep. As sand was drifted into this by winds, the flume was run through and covered over by a double layer of 1-in. plank, as shown by Fig. 14.

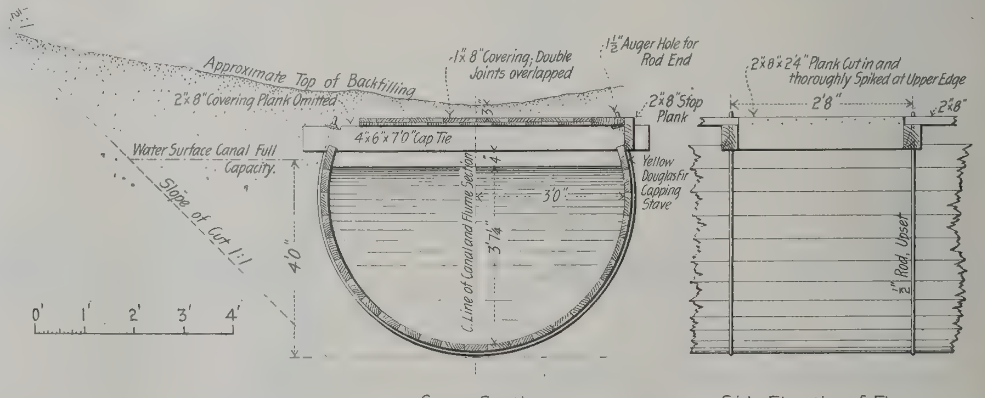
There is also one pipe line in the form of an inverted siphon for crossing from the east to the west side of the canyon. This is of wooden staves, banded at intervals of 12 to 3¼ ins., according to the head or pressure of water. The pipe is 4 ft. in diameter, and has the full capacity of the canal. It is 1,967 ft. long and has a maximum head of 75 ft. at its lowest point. Here there is a 6-in. draw off or blow-off valve for emptying the pipe when necessary.

Currant Creek is crossed on a trestle with trussed stringers, the pipe being housed in for protection against freezing, as shown by Fig. 15. The rest of the pipe is covered by 2 ft. of earth.

The connections between pipe and flumes are made by gradually changing or merging one into the other, as shown by Fig. 16, instead of using penstocks at the junction, as is customary. All the pipe and the flume shell were built by the Excelsior Wooden Pipe Co., of San Francisco, of which Mr. D. C. Henny, M. Am. Soc. C. E., is engineer and manager. The contract price for the former was $3.46, and for the latter $1.54 per lin. ft. All the other lumber structures on the canal system were built by Newton & Hobbs, of Mona, Utah, native pine being used. (See Eng. News, Sept. 5, 1895, for all contract prices, under head of same).

The Main Canal is designed to irrigate the Kimball Creek Valley, reaching west and southwest from the mouth of the canyon. The East Side canal is to branch off from the other, crossing the canyon to the east side and reaching the lands in the neighborhood of Goshen on the Rio Grande Western Ry. The connection between the two canals is shown in detail by Fig. 17. This canal line drops over 100 ft., where it leaves the Main Canal, and crosses the creek by a flume.

At the connection the Main Canal has a capacity of 120 cu. ft. per sec. and the East Side canal of 30 cu. ft. The total length of the Main Canal is over 13 miles, of the East Side line, 6¾ miles.


2:1
Approximate Top of Backfilling
2"x 8" Covering Plank Omitted
1"x 8" Covering; Double Joints overlapped
1½" Auger Hole for Rod End
2"x 8" Stop Plank
4"x 6"x 7'0" Cap Tie
Water Surface Canal Full Capacity.
Slope of Cut 1:1
Yellow Douglas Fir Capping Stave
3'0"
4'0"
3'7¼"
C. Line of Canal and Flume Section
0' 1' 2' 3' 4'
2"x 8"x 2'4" Plank Cut in and thoroughly Spiked at Upper Edge
2'8"
2"x8"
½" Rod, Upset

Cross Section. Side Elevation of Flume.

FIG. 14.—COVERED FLUME USED IN 30-FT. SAND CUT

The grades and sizes of the Main Canal vary according to the nature of country encountered and the capacity required. In the canyon the grade for canal excavation is 0.1%, for flumes 0.3%, and for pipe 0.63%. Out in the Kimball Creek Valley the grade of canal is 0.08%. The side slopes for earth excavation in the canyon work are mostly ½ to 1. For much of it a compound slope is used—that is, 1 to 1 above the water level, and ½ to 1 below that, or, in some cases, the reverse of this. Outside of the canyon the slopes are 1 to 1. All embankments are 1½ to 1. At one point a section of masonry retaining wall was put in where no bank could be used.

The following condensed table shows how the dimensions are gradually reduced, the first two portions being in the canyon, and all the dimensions being feet:

	Bank. Height.	Bank. Width.	Bottom.	Depth water.
First section	6	5	10	4
Second section	6½	5	6	4¾
Station 109 to 211	5½	5	6	4
Station 224 to 258	4	5	8	3
Station 258 to 452	3½	5	8	2¾
Station 508 to 640	3½	4	8	2¾
Station 640 to end	3¼	4	4	2½

Only one bank, that on the lower side, is used for nearly all the canyon work. Out in the open valley both banks are built. The grading was all done by Reynolds & Roylance, of Springville, Utah.

Box culverts are used for passing the minor drainage channels under the canal. Kimball Creek and its two branches are crossed by flumes like those in the canyon work, with an aggregate length of 375 ft. All the surveying and engineering fieldwork for this undertaking have been characterized by the most thorough methods, and elaborate designs and plans for all parts of the system were carefully worked out. The works and structures are all built in the most substantial manner, furnishing a good example of modern irrigation engineering.

About 15,000 acres of land can be irrigated from the system as at present designed, the amount being based on the supply of one acre-foot of water to each acre of land. The land to be irrigated is contiguous to the Tintic branch of the Rio Grande Western Ry. All this land to be watered lies in the large basin sloping to the north to

Utah Lake, and has plenty of fall, so as to insure ease of irrigation and drainage.

The original projector and organizer of the first company was Mr. H. M. McCartney, C. E. The chief engineer for the enterprise was Mr. O. R. Young, who designed and had entire charge of the construction of the whole system. Mr. Wm. Hammond Hall, M. Am. Soc. C. E., of San Francisco, was retained as consulting engineer. The president of the company is Mr. Gill S. Peyton, the secretary and treasurer Mr. E. G. Rognon. All of these gentlemen named, except Mr. Hall, reside in Salt Lake City, where are located the offices of the company.

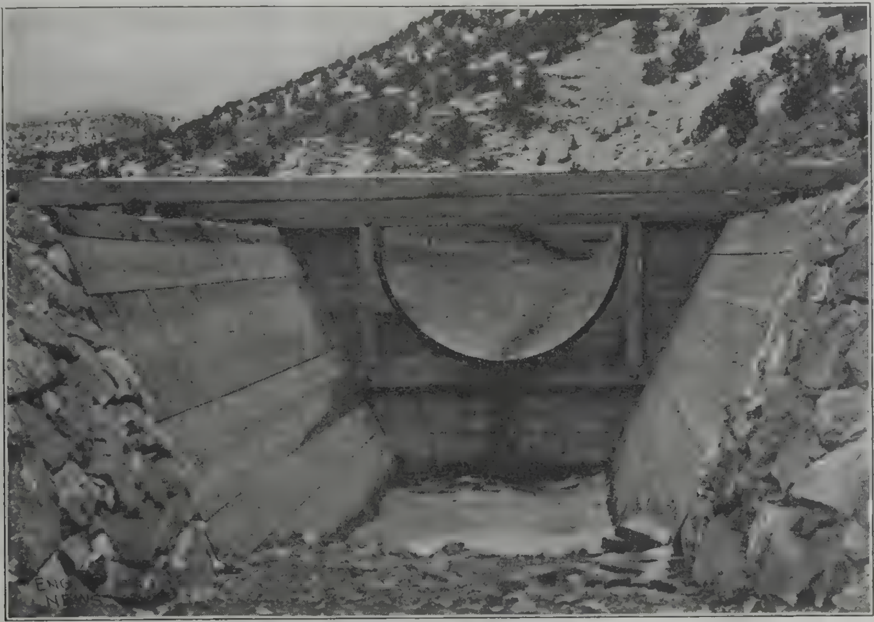


FIG. 12.—VIEW OF JUNCTION OF FLUME WITH CANAL AT LOWER END OF FLUME.

The construction work so far done has cost upwards of $100,000. The East Side canal and the laterals are yet to be constructed, but will probably be completed in the summer of 1897. The Main Canal and the two laterals so far built were operated the first season very successfully.

THE SINKING OF A WHARF AT ST. JOHN, N. B.

From the "Daily Sun" and the "Daily Telegraph," of St. John, New Brunswick, the following account is taken relating to the late collapse of a wharf on the west side of the harbor at that city: The wharf in question formed a continuation of what is known as Connoly Wharf, near the deep water terminus of the Canadian Pacific Railway. At this point a slip runs into the shore line about 1,200 ft., following the general course of what was formerly the outlet from a large tidal mill pond. Connoly Wharf occupies 400 or 500 ft. of the outer end of this slip and is a close faced cribwork structure, nearly 60 ft. high and founded 28 ft. below low water on a dredged bottom. The extreme rise and fall of the tide at St. John is about 28 to 30 ft.

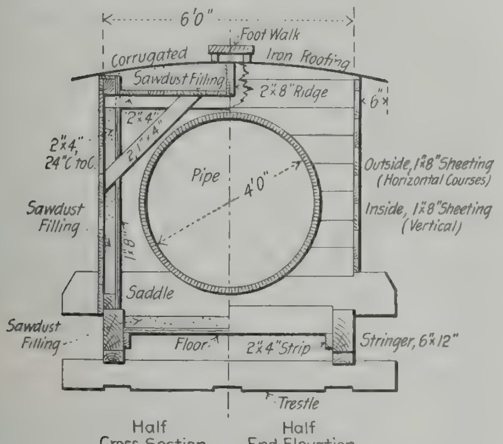
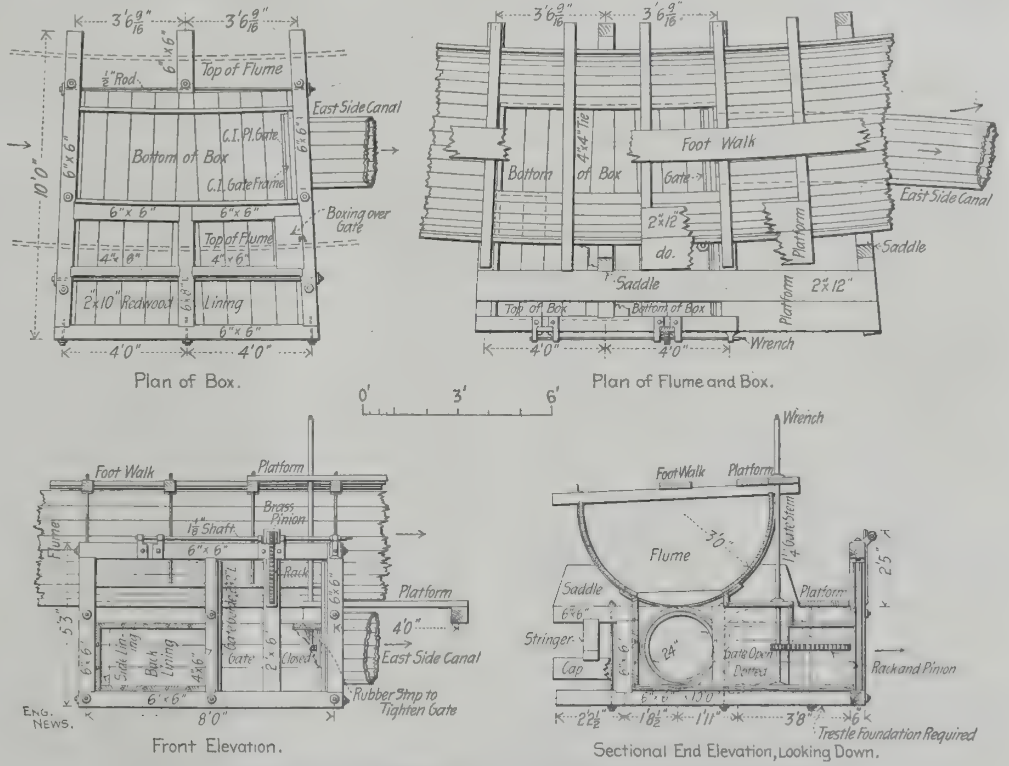


Fig. 15.– Pipe Housed In to Prevent Freezing.

The Canadian Pacific Ry. Co. practically used this terminus for the first time last winter, and in anticipation of a large increase in business the Common Council of St. John determined to increase its wharf accommodations. The Council ordered its engineer, Mr. Peters, to prepare general plans, with the expectation that the Canadian Pacific would make more detailed examination and carry out the work in accordance with an agreement which required that company to provide terminal facilities as fast as the trade would develop, in consideration of the Carleton Branch Ry. handed over by the city authorities. Mr. Peters made no cross-sections, but submitted a general plan calling for dredging and a crib structure similar to Connoly's Wharf. But the railway company, says the "Telegraph," objected to the crib plan as being too expensive, and recommended a pile wharf, and it proposed to pay a cash sum of $50,000, and to lay tracks and otherwise provide for loading and discharging steamers, but to leave the actual construction to be done by the city.



Plan of Box. Plan of Flume and Box. Front Elevation. Sectional End Elevation, Looking Down.

FIG. 17.—CONNECTION BETWEEN MAIN AND EAST SIDE CANAL SYSTEMS.

The City Council adopted the cheaper plan, with a supposed saving of $60,000 in cost, though City Engineer Peters objected to the piling system and declined to have anything to do with it. Another engineer was put in charge who attempted to make the best of the plans, though a director of works, not an engineer, was placed upon the work with almost equal authority under the specifications. The result was the slipping out of the new wharf and its total collapse. The Canadian railway engineers defend their recommended plan by claiming that a cribwork would have met the same fate, as the accident was due to a land slip. The papers mention similar slipping away of the ground at this same Sand Point on March 17, 1870.

The "Daily Sun" enters more fully into the actual construction of the pile wharf as follows: In the first place the basin for vessels had to be dredged to a depth of 28 ft. below low water. On one side of this dredged space the wharf was built by driving four rows of piling, 8 ft. apart, between centers of rows, making a wharf 24 ft. wide. Along the line of the wharf the piles were 10 ft. apart. These piles projected about 4 ft. above low water mark as driven, and they were supposed to be driven as deeply into the mud, mixed with chips and sawdust, as a heavy hammer would drive them; but how far is not stated. Upon the piles, as cut off 4 ft. above low water, a 24-ft. stick of hemlock was drift-bolted to the heads of the four piles, and upon this was built up, log-house fashion, the alternating courses forming the crib. For about 100 ft. in length of the wharf the top of the crib was 57 ft. above the bottom dredged, while the rest was not completed at the time of the accident.

About 40 ft. back of this wharf and just behind the top of the slope a shallow crib had been built to act as a retaining wall in supporting the gravel filling brought in on trains running on two lines of pile trestles. Between this crib and the wharf a large number of piles were driven, forming supports to proposed warehouses, etc., and these piles were tied to the wharf and to the back-crib with the purpose of anchoring the whole structure and especially the main crib.

At the time of the accident about 1,600 tons of gravel and sand had been unloaded on a length of 350 ft., and six gravel cars were standing upon the trestle; these cars were first noticed as canting inward along with a settling of the trestle. The cars were hauled out, but the settlement continued and the anchor piles, designed to add to the strength of the structure, transmitted the thrust of the settling trestle and back-crib to the superstructure of the wharf; finally about 300 ft. of the wharf was pushed out for a distance of 5 to 8 ft., and the piling close behind the wharf sunk from 6 to 10 ft. The trestles carrying the tracks canted in towards the shore, and the anchor piles and back-crib canted out towards the wharf. Repairs will require the removal of the whole superstructure, and of most of the piles; and it is suggested that as this would cost probably as much as the original work, it would be wiser to reconstruct with cribs, similar to the Connoly Wharf, sunk to dredged bottom without piles.

Mr. Earle, the engineer in charge of the wharf in question, recommended an entire change of plan. Mr. Earle says that piling is not practicable on this site as there is evidence of soft clay strata underlying the line of the wharf, and the pile foundations of other wharves nearby show gradual outward settlement. He now proposed to dredge to 4 ft. below the channel to a width of at least 55 ft., and to build a crib-wharf with a base of 50 ft., and return cribs 20 ft. wide, extending back about 100 ft. at intervals of 120 ft. Col. Moore, in criticising this plan, approved of cribwork, but thought that return cribs 12 to 15 ft. wide and extending back 25 or 30 ft. would be sufficient for the conditions imposed.

The "Daily Record," of St. John, of Nov. 9, gives the results of a special meeting of the harbor improvement committee, from which it appears that the dredged slope was 1 on 1½. Soundings taken after the accident show that whereas the water was originally 25 to 28 ft. deep in front of the wharf, depths of 13, 16 and 20 ft. are now found. The piling of the wharf proper and the lines of anchor piles were driven into this slope; but the question not determined by any evidence given is that of how far into this mud the piles were driven. The general evidence favors a slide of the original bottom material, carrying out with it the cribs and the piles; the slide being brought about by the back-filling disturbing the general conditions of load which this material would usually support. An almost similar case occurred in connection with the Chignecto Marine Ry., in building a wharf on the Aulac River. In this case the same extreme range of tide was encountered and the piles were firmly driven into the natural slope of the river bank. They were simply capped and floored, without any cribwork; but it was proposed to fill in behind this wharf, and when a very small portion of the filling was in place the superincumbent weight forced the mud out below and the whole structure was carried into the river. We are indebted to the courtesy of Mr. G. Simeon Armstrong, M. Am. Soc. C. E., for collecting and furnishing to us the general information upon which this account is founded. While stating that the pile wharf was the contractor's idea, and had no connection with the engineering operations of the railway company, Mr. Armstrong believes that the case was one calling for a well-ballasted crib of proper dimensions and foundation, with the filling deposited immediately behind it and carried back, to guard against any sweeping slide. Since writing the above, the whole cribwork has slipped out into the basin, and the entire work is a wreck. Great cracks appear in the ground at the top of the inshore slope. While the evidence points to a land-slide as the active cause, the case may be quoted as one where a board of aldermen knew more than the engineers and contractors, and, as is usual in such cases—"got left."

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WORK OF THE HOOVER & MASON CONVEYOR ON THE CHICAGO MAIN DRAINAGE CHANNEL.

In Engineering News of June 20, 1895, the double cantilever conveyor used for excavating and conveying earth on Section H of the Chicago Main Drainage Canal was described in some detail. At that time, however, very little actual work had been done by the machine and figures of output could not be given. These figures are now available, and are given herewith. By referring to the accompanying illustration reproduced from the issue above noted, the method of operating the conveyor will be understood. The truss spans the channel and carries an endless belt to which are attached steel pans. This belt carrier follows closely the finished lines of the bottom of the channel, and lies close up against the working face. A double-ended plow operated by steam cuts successive prisms of material off the end face and the excavated material rolls into the pans. As the pans reach the extremity of the cantilever and pass over the drums, the earth with which they are filled falls out. For further details of construction and operation the article referred to above can be consulted.

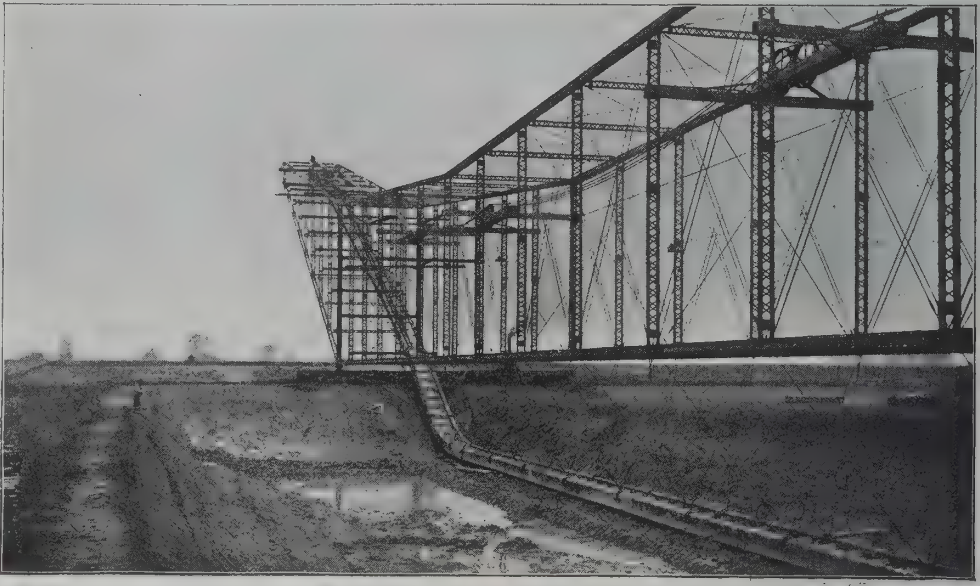
The figures of operation given us cover the three months from April 25 to July 25, and include every operation and expense to complete and trim the channel to grade. They are as follows:

Labor cost, as per pay roll	$4,714.85
Coal, 270.9 tons, at $1.70 per ton	460.54
Oil, waste, repairs, supplies and all other expenses	192.39
Total cost for three months	$5,367.78
Total cu. yds. excavated as per engineers' estimate	66,238
Total cost, per cu. yd.	8.1 cts.

This cost per cu. yd. is made up as follows:

Cost of labor	7.12 cts.
Cost of coal	0.69 "
Cost of grease, oil, waste, repairs, supplies and all other expenses	0.29 "
Total	8.10 cts.

These figures cover every detail, and moreover have been obtained while working on a face only 33 ft. high while the machine was designed for a face 36 ft. high. This reduction in height was of considerable significance on the canal work as the top 3 ft. comprised a large percentage of the total excavation and was moreover a soft prairie loam, while the material beneath was a very hard clay. As it is, however, the results are very favorable when it is remembered that the actual contract price of excavating this class of material on the Drainage Canal runs from 19 cts. to 29 cts. per cu. yd., the last being the price on Section H.


ENDLESS BELT CONVEYOR FOR EARTH EXCAVATION ON SECTION H, CHICAGO MAIN DRAINAGE CHANNEL.
Designed by Hoover & Mason, Kansas City, Mo. Gohan & Byrne, Contractors on Section H.

◆

PROPER SPEED FOR ROPE POWER TRANSMISSION

According to a paper read recently by Mr. Abram Combe, before the British Institution of Mechanical Engineers, the speed of rope originally adopted over 30 years ago, 3,300 ft. per minute, has been found to give the best results, although speeds far exceeding this have been used in many instances. With the higher speeds it is said that the gain of power is counteracted by loss from atmospheric friction, centrifugal action, and wear on ropes and bearings. Mr. Combe gives the following sizes of ropes and diameters of pulleys, with the horse-power that may be transmitted by each size for each 100 revolutions per minute:

Diam. of rope.	Diam. of pulley.	Ratio of diams.	HP. for 100 revs. per min.
1¼ in.	3 ft.	1 to 28.8	5
1½ "	4 "	1 to 32.0	8
1¾ "	5 "	1 to 34.3	11
2 "	6 "	1 to 36.0	15

For other sizes of pulleys the power transmitted is calculated to be increased in direct proportion to the diameter of the pulleys. Mr. Combe further says:

> When working under the most advantageous conditions—for instance, where the ropes are running horizontally at good speeds, with the pulleys at a proper distance apart, and with the bottom rope acting as a driver—the above bases may be increased by 20 to 25% with safety. On the other hand, when the ropes are working under unfavorable conditions, with centers of pulleys too close together or ropes running vertically, these bases must be diminished by 20 to 25%. The exact amount of increase or decrease on these standard bases has to be determined in each individual instance, according to the circumstances under which the ropes are working.

Desiring to compare the figures given above for horse-power transmitted by different sizes of ropes with those given by American writers on the subject, we have calculated the horse-power for a speed of 3,300 ft. per minute from the figures given for 100 revolutions per minute and compared the result with figures obtained by interpolation from a table published by the C. W. Hunt Co., of New York The results are as follows:

Diameter of rope, ins.	1¼	1½	1¾	2
HP. at 100 revs. of pulley (Combe)	5	8	11	15
" " 3,300 ft. per min. (Combe)	17.5	21.0	23.1	26.5
" " 3,300 ft. per min. (Hunt)	18.5	25.4	36.1	47.1
" " 5,000 ft. per min. (Hunt)	21.4	30.8	41.8	54.8

In Mr. Hunt's table the driving power of a rope appears to increase as the square of its diameter, as might be expected if the larger ropes were of the same quality and strength throughout as the smaller ones, but in Mr. Combe's table the driving power increases at a rate which is even less than the direct ratio of the diameters. An American designer working by Mr. Hunt's table would use a 2-in. rope at 5,000 ft. per minute to drive 54.8 HP., while an English designer following Mr. Combe's figures and his statement that the best results are obtained with a speed of only 3,300 ft. would obtain less than half the power from the same rope, or only 26.5 HP. By the latter rule more than twice as many ropes would be required for a given installation, and the consequent expense might, in American practice, at least, lead to the adoption of belts instead of ropes.

We doubt, however, if the figures given by Mr. Combe are to be accepted as a record of actual English practice, for an article by Mr. Wm. H. Booth, an English contributor to the "American Machinist," a few years ago, gave the "most usual practice" in Lancashire as follows: 1¾-in. cotton ropes at 5,000 ft. per minute equal 50 HP., and he gives a table of data from English practice from which we take the following:

Diameter of rope, ins.	1¼	1½	1¾	2
HP. per rope, at 4,800 ft. per min.	24	34	49	63

These figures are in every case larger than those given in Mr. Hunt's American table. It would appear that the smaller figures given by Mr. Combe for 1¾ and 2-in. ropes are due to extreme conservatism, and to the English habit of being slow but safe and sure, carried to too great an extent, and to an extent which, according to Mr. Booth's figures, is not followed by Lancashire manufacturers.

◆

A 5,000-MILE PHOTOGRAPHIC INTERCHANGEABLE railway ticket has been agreed upon by the Central Passenger Association Committee. These tickets will cost $100 each, will bear a photograph of the purchaser and will not be transferable. The 1,000-mile "wide-open" ticket, now on sale, will also be used. The 5,000-mile tickets will cover roads in the Central district, between Pittsburg and St. Louis, but will not include the Pennsylvania R. R. lines.

THE ORIGIN OF THE BESSEMER PROCESS.*

By Sir Henry Bessemer, London, Eng.

(Honorary Member Am. Soc. M. E.)

It is generally well known that this invention had its origin in certain experiments commenced in January, 1855, for the purpose of improving the quality of cast-iron employed for founding heavy ordnance, by rendering the iron more tough, increasing its tensile strength, and making it less subject to injury by abrasion. I was aware that Fairbairn and others had sought to improve cast-iron by the fusion of some malleable scrap-iron along with the pig-iron in the cupola furnace; this fusion of scrap-iron, intermixed with the mass of coke, was found to convert the malleable iron into white cast-iron, which was at the same time much contaminated with sulphur, and thus, to a great extent, this method had failed in its object. In my experiments I avoided the difficulties inseparable from Fairbairn's plan, by employing a reverberatory furnace in which the pig-iron was fused, forming a bath; into this bath I put broken-up bars of blistered steel, made from Swedish or other charcoal iron, its fusion taking place without being further carburized by contact with the solid fuel, or contaminated by the absorption of sulphur. The high temperature necessary for the fusion of a large proportion of steel in the bath, was attained by constructing the fire-grate much wider than the bath, by contracting the width of the furnace considerably at the bridge, and also by continuing to taper the furnace slightly all the way from the fire-bridge to the downcast flue, which was connected with a tall chimney shaft. My English patent for this arrangement bears date Jan. 10, 1855. Many alterations and modifications of this furnace were made from time to time; it was found that the large volume of flame sweeping over the open hearth of the furnace was mixed with a considerable quantity of combustible gas, to consume which a hollow fire-bridge was employed, having numerous perforations made in the fire-clay lumps of which it was composed, and so arranged as to allow jets of hot atmospheric air to mingle with these combustible gases, which had the effect of producing an intense heat close down on the surface of the bath; it was also found that the admission of hot air all along the back of the fire-bridge produced a decarbonizing action on the bath; and hence the degree of carburation of the metal might be altered by regulating the admission of air. The flow of air through the hollow fire-bridge served also to moderate its temperature and render it more durable.

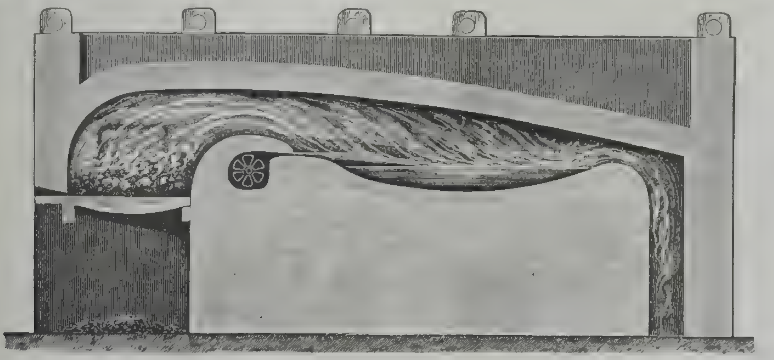


Fig.1.

Fig. 1.—Vertical Section.

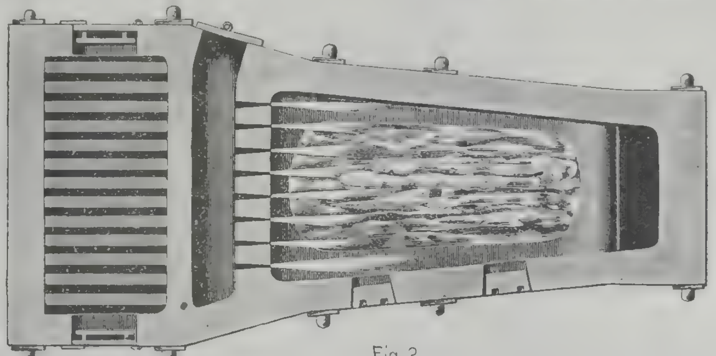


Fig.2.

Fig. 2.—Horizontal Section.

FIG. 1 and 2.—DECARBURIZING CAST IRON IN A REVERBERATORY FURNACE.

Some of the samples of metal which I produced by this process were, when annealed, of an extremely fine grain and of great strength. At this stage of my experiments I determined on casting a small model gun which in the lathe gave shavings slightly curled, and closely resembling the turnings from a steel ingot. The metal when polished also looked white and close-grained like steel. I was so well pleased with this casting that I took it over to Paris, obtained an audience with, and showed it to, the Emperor, who had, in fact, encouraged me to make an attempt to improve iron employed in founding heavy ordnance. His Majesty, who had desired me to report progress, accepted this experimental gun, remarking that some day it might have an historical interest, and it was in recognition of this circumstance that His Majesty, later on, intimated to me, through Colonel Belleville, his desire to confer on me the Grand Cross of the Legion of Honor, provided I could obtain permission to wear it, a privilege which our ambassadors twice refused. His Majesty also gave me permission to erect my furnace at the government cannon foundry at Ruelle, near Angouleme, to which place I went, with proper introductions, for the purpose of arranging all the necessary details. I also sent over from England several thousand special fire-bricks, etc., for the erection of the furnace.

But on resuming my further researches, after returning to London, an incident occurred which suddenly put a stop to the intended works at the Ruelle gun foundry, and, in fact, altered all my future plans and investigations.

The furnace, as it was then arranged, is shown in vertical section by Fig. 1, and in horizontal section on a line passing through openings in the perforated hollow fire-bridge by Fig. 2, where the narrowing of the body of the furnace is clearly shown, and the manner in which the jets of air were directed so as to produce an intense ignition of the combustible gases mingled with, and passing over, with the large volume of flame, from the over-charged fire-grate.

The small scale on which this experimental furnace was built (viz.: a capacity of three hundredweight only), was much against my obtaining the high temperature necessary to melt a large proportion of steel in the pig-iron bath. I was of course fully aware that a furnace of sufficient capacity to cast a five or a ten ton gun would produce a much higher temperature than it was possible to attain in my small furnace, and also that a forced draft, obtained by closing in the ash-pit and forcing air into it, would also still further increase the temperature. That this forced draft was in my mind at the time, is shown by the fact that I took out a patent for the manufacture of cast-steel, dated Oct. 17, 1855; that is, about two months after the casting of the model gun; in this patent I fully described the forcing of air by a fan, into the closed ash-pits of furnaces employed in the manufacture of cast-steel; and it has often since occurred to me that, with the additional resources still untried, I did not act wisely in so suddenly abandoning these open-hearth experiments, in favor of an entirely different system, suggested to my mind by the incident before referred to. But with my impulsive nature and my intense desire to follow up every new problem which presented itself, I at once threw myself unreservedly into this new study, which seemed to open a way to the rapid production of bars, rails, and plates, of malleable metal direct from the blast furnace.

Before dismissing this subject it may be interesting even at this distant period to speculate on what would have been the natural outcome of the open-hearth furnace experiments, had I not been so suddenly diverted from their further pursuit.

Such a furnace, with a forced draft and a capacity of ten tons, would undoubtedly have melted malleable iron or steel in a bath of pig-iron, and have decarburized it to the desired extent, for I had, in fact, in this small furnace already fused steel in a bath of pig-iron, on the open hearth of a reverberatory furnace, and as far back as January, 1855, I had claimed in my patent "the fusion of steel in a bath of melted pig, or cast-iron in a reverberatory furnace, as herein described."

This was about ten years prior to the first patent taken out by M. Emile Martin, and now generally known as the Siemens-Martin process. This patent was obtained in England in the name of Emile Martin only, and is dated Aug. 18, 1865, or more than ten years after my patent of January 10, 1855. M. Emile Martin, in his patent, says: "The manufacture is effected upon the principle of fusion of iron or natural steel in a bath of cast-iron, maintained at a white heat, in a reverberatory furnace such as a Siemens gas-furnace."

I desire to say that I make no claim whatever to the prior invention of the Martin-Siemens process, nor do I for one moment assume that my patent of 1855 furnished any information which either of these gentlemen availed themselves of; but I think I am justified in saying that the fusion of steel in a bath of pig-iron, on the open hearth of a reverberatory furnace, which I had patented and successfully effected, was, to use a favorite expression of Mr. Gladstone, "approaching within measurable distance" of that now well-known and successful process.

On my return from the Ruelle gun foundry, I resumed my experiments with the open-hearth furnace, when the remarkable incident I have twice referred to, occurred in this way: Some pieces of pig-iron in one side of the bath attracted my attention by remaining unmelted despite the great heat of the furnace, and I turned on a little more air through the fire-bridge, with the intention of increasing the combustion; on again opening the furnace door after an interval of half an hour, these two pieces of pig still remained unfused. I then took an iron bar, with the intention of pushing them into the bath, when I discovered that they were merely thin shells of decarburized iron, as represented at Fig. 3, thus showing that atmospheric pressure alone was capable of wholly decarburizing gray pig-iron and converting it into malleable iron without puddling or any other manipulation. It was this which gave a new direction to my thoughts, and after due consideration I became convinced that if air could be brought in contact with a sufficiently extensive surface of molten crude iron the latter would rapidly be converted into malleable iron.

This, like all new problems, had a special interest for me, and I became impatient to test it by more than a laboratory experiment; without loss of time I had some fire-clay crucibles made with perforated covers, and also some fire-clay blow-pipes, which I joined to a 3-ft. length of 1-in. gas-pipe, the opposite end of which was attached by a piece of rubber tubing to a fixed blast-pipe. This elastic connection permitted the easy introduction and withdrawal of the blow-pipe into and out of the crucible, as shown at Fig. 4, which represents a vertical section of an air furnace. containing a crucible, which in this case represented the "converter." About 10 lbs. of molten gray pig-iron about half filled the crucible, and 30 minutes' blowing was found to convert 10 lbs. of this gray pig-iron into soft malleable iron. Here at least one great fact was elicited, viz.: the absolute decarburization of molten crude iron without any manipulation, but not without fuel; for had not a very high temperature been kept up in the air furnace all the time this quiet blowing for 30 minutes was going on, it would have resulted in the solidification of the metal in the crucible long before complete decarburation had been effected. Hence arose the all-important question: Can sufficient internal heat be produced by the introduction of atmospheric air to retain the fluidity of the metal until it is wholly decarburized in a vessel externally heated?

This I determined to try without delay. I fitted up a larger blast cylinder in connection with a 20 HP. engine which I had daily at work, and I also erected an ordinary foundry cupola capable of melting half a ton of pig-iron. Then came the question of the best form and size for the experimental "converter." I had very few data to guide me in this, as the crucible converter was hidden from view in the furnace during the blow. I, however, found that slag was produced during the blow and escaped through the holes in the lid; this fact guided me to the construction of a very simple form of cylindrical converter, about 4 ft. in height in the interior, which was sufficiently tall and capacious, as I believed to prevent anything but a few sparks and heated gases from escaping through a central hole made in the flat top of the vessel for that purpose, as shown in vertical section at Fig. 5. The converter had six horizontal tuyeres arranged around the lower part of it; these were connected by six adjustable branch pipes, deriving their supply of air from an annular rectangular chamber extending around the converter, as shown.

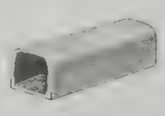


Fig.3.

Fig. 3.—Shell of Decarburized Pig Iron.

All being thus arranged, and a blast of 10 or 15 lbs. pressure turned on, about 7 cwt. of molten pig-iron was run into the hopper provided on one side of the converter for that purpose. All went on quietly for about ten minutes. Sparks, such as are commonly seen when tapping a cupola, accompanied by hot gases, ascended through the opening in the top of the converter, just as I supposed would be the case, but soon after a rapid change took place. In fact, the silicon had been quietly consumed, and the oxygen next uniting with the carbon, sent up an ever-increasing stream of sparks and a voluminous white flame; then followed a succession of mild explosions, throwing molten slags and splashes of metal high up into the air, the apparatus becoming a miniature volcano in a state of active eruption. No one can approach the converter to turn off the blast, and some low flat zinc-covered roofs close at hand were in danger of being set on fire by the shower of redhot matter falling on them. All this was a veritable revelation to me, as I had in no way anticipated such violent results. However, in ten minutes more the eruption had ceased, the flame died down, the process was complete, and on tapping the converter into a shallow pan or ladle, and forming it into an ingot, it was found to be wholly decarburized malleable iron.

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*A paper presented at the New York meeting (Dec., 1896) of the American Society of Mechanical Engineers. Another account by Sir Henry Bessemer of his great invention, communicated by him to the International Engineering Convention of 1890, was published in Engineering News, Oct. 18, 1890.

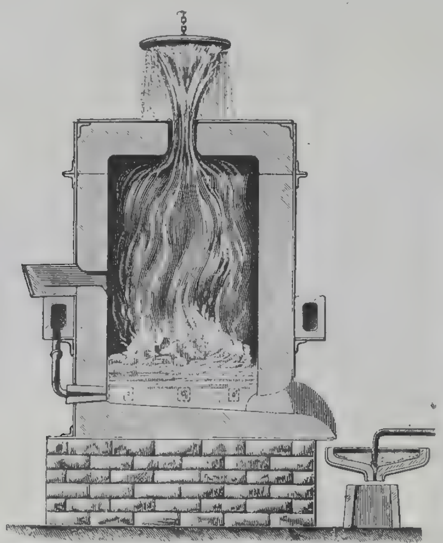

Fig. 5.

Fig. 5.—Bessemer's First Converter.

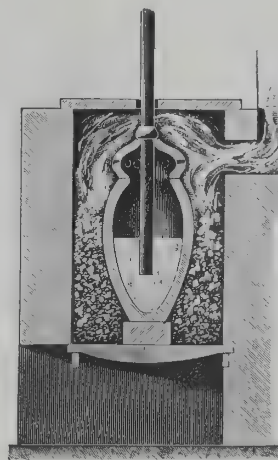

Fig. 4.

Fig. 4.—Bessemer's First Experiment—Decarburizing Iron in a Crucible.

Such were the conditions under which the first charge of pig-iron was converted into malleable iron in a vessel neither internally nor externally heated by fire.

I, however, desired to convert a second charge of pig-iron, which had been put into the cupola, and in order to prevent this dangerous projection upward of sparks and molten slags, a temporary expedient was resorted to which, however, failed in its object. I procured one of those circular chequered cast-iron plates so much used in the London pavements to allow coals to be put into the cellars below the pavement. This plate, which was about a foot in diameter, was suspended by a chain at a distance of 18 ins. above the central opening, in the top of the converter, as shown in Fig. 5.

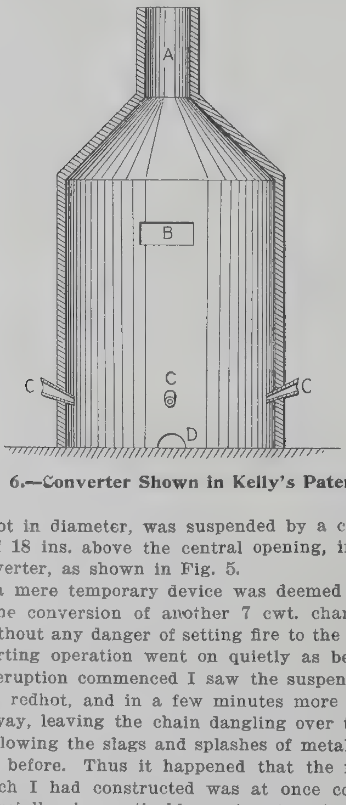

Fig. 6.—Converter Shown in Kelly's Patent.

This as a mere temporary device was deemed sufficient to allow the conversion of another 7 cwt. charge to be effected without any danger of setting fire to the premises. The converting operation went on quietly as before, but when the eruption commenced I saw the suspended plate get rapidly redhot, and in a few minutes more it melted and fell away, leaving the chain dangling over the opening, and allowing the slags and splashes of metal to shoot upward as before. Thus it happened that the first converter which I had constructed was at once condemned as commercially impracticable, owing to this vertical eruption of cinder, and for this reason only. All attempts to lessen the violence of the process by a reduction of the number of tuyeres, or by lessening the diameter of the tuyere pipe orifices, or by diminishing the pressure of the blast, cnly resulted in a reduction of the necessary temperature, and in preventing the conversion of the molten pig-iron into malleable iron. In one case the trial of a diminished area of tuyere opening, resulted in nearly the whole charge of metal, after more than an hour's blowing, being converted into a solid mass of brittle white iron similar to ordinary refiners' plate metal. Indeed, I may say that the results of all my early investigations proved to me, beyond the possibility of doubt, a fact which has since been confirmed in every Bessemer steel works throughout Europe and America, viz., that rapidity of action ending in a violent eruption are absolutely necessary conditions of success; and when we take into consideration the fact that the converted metal must be made to acquire an enormously high temperature, so that it may not be chilled in tapping, or pouring it out of the incandescent converter into a cold open ladle; that it be not chilled by the addition of a large quantity of much cooler metal employed to deoxidize it; that it does not chill and form a skull in the casting ladle during the comparatively long time required to form it into ingots; it is obvious that to carry out the Bessemer process successfully, a temperature must be obtained very considerably above the mere melting temperature of malleable iron. In order to obtain this temperature it is necessary to drive powerful streams of air into the metal, so as to divide it into innumerable fiery globules diffused throughout the whole body of metal under operation, which for the time being may be likened to a fluid sponge, with the active combustion of carbon with oxygen going on in every one of its myriads of ever-changing cavities.

It has been found that the union of carbon and oxygen takes place so rapidly at this high temperature as to produce a series of mild explosions, which are scarcely noticed in the large converters in common use which have a space for the violent expansions, of some 8 or 10 ft. in height above the normal level of the metal; in this space the violent action expends itself unseen, and is only partially recognized by a small additional quantity of slags leaping out of the mouth of the converter.

With these facts before us it must be self-evident that all attempts to produce malleable iron in a plain cylindrical vessel which has no top to it, and in which the metal rises to within a few inches of its open mouth, must utterly fail from two causes. First, because heat would fly off so freely that the temperature of molten malleable iron could never be reached, and, second, because nearly all the metal contained in such a shallow open-topped vessel would leap out of it, and be scattered in all directions when the explosive eruption takes place, without which no charge of molten pig-iron can be converted into fluid malleable iron. This violent eruption of slags, accompanied by an immense volume of flame which issues from the mouth of the converter, has surprised every one when witnessing the Bessemer process for the first time. Nor was I an exception to the rule, for I was as much astonished as others at this violent eruption, or most assuredly I should never have been so stupid as to design a converter so as to discharge a shower of slag vertically upwards, and thus insure its falling back on to and all around the converter. Till that time no one had ever seen a converter in operation, but no one who had once witnessed the conversion of fluid pig-iron into malleable iron by a blast of air, would ever propose to construct a converter with an opening at the top so as to direct this fiery stream vertically upwards. Later experience allows me fearlessly to assert that a charge of molten crude iron cannot be converted into fluid malleable iron or steel by forcing air through it, without this violent eruption taking place. Hence it is to me utterly inconceivable that any man who had once witnessed the violent eruption invariably accompanying the converting process, should, after such an experience, design and patent a converting vessel with a sloping top and a vertical outlet so admirably adapted to throw upward and discharge so large a proportion of its contents as that shown in Fig. 6, which is an exact reproduction of an authorized drawing of the converter of an American patentee who, it has been asserted, had successfully carried on this converting process many years prior to his taking out this patent in 1857. The original patent is headed: "W. Kelly, No. 505. Re-issued, Nov. 3, 1857."

I had no sooner condemned my first cylindrical converter than I commenced to remedy its defects. The most obvious and ready way of doing this would have been simply to make an opening near the top, on one side of it, and thus allow the escape of the ejected matter to take place horizontally, and direct the discharge against a wall, or allow it to fall into a pit, etc., but I desired to prevent the discharge of metal splashes as far as possible, so that I determined on constructing the new converter with an upper chamber having an arched roof and a conical sloping floor. This converter is represented at Fig. 7 in vertical section, and at Fig. 8 in horizontal cross-section, taken through the tuyeres. When a converter is so constructed the fluid matters which would otherwise pass vertically upward into the air are thrown against the arched roof, and any fluid metal which may be thrown up falls upon the sloping floor of the upper chamber, and again returns to the lower one, while the flame and a portion of the slags find their way out of the two square lateral openings provided for that purpose. This upper chamber serves also as a receptacle for heating up any metal intended to recarburize or alloy with the steel in course of being converted. The section Fig. 8 shows six well-burned fire-clay or plumbago tuyere pipes, fitted to openings left in the lining for that purpose. Their outer ends are made conical to facilitate the ramming in of loam around them, and which effectually holds them in position, and at the same time admits of their easy removal when worn out; a jointed piece of iron tube, with a catch to hold it in place, communicates the blast to each tuyere.

Another view of this converter, taken at right angles to Fig. 7, is represented in Fig. 9, showing in one side the hopper by which the molten iron is run in by a movable spout direct from the cupola. This view also shows the tapping hole open, and the spout which conducts the converted metal into a movable shallow pan or receiver supported by a long handle (not shown). A fire-brick plug, attached to a long handle, is fitted to a fire-brick ring or opening in the bottom of the pan, and prevents any debris from the tapping hole being carried into the mold.

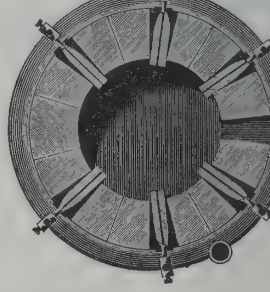

Fig. 8.

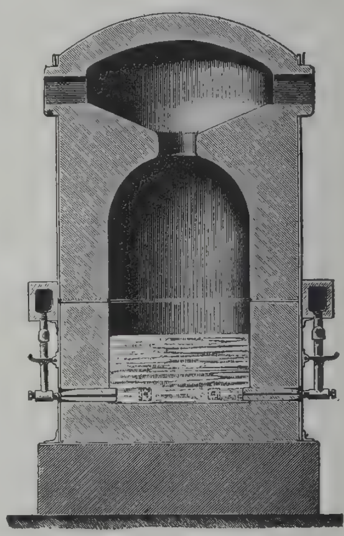

Fig. 7.

Figs. 7 and 8.—Bessemer's Second Converter.

As this apparatus was intended to exhibit the process, it was essential that an easy way should be provided for getting away the ingots and quickly repeating the process. This casting apparatus, constructed precisely as represented in Fig. 9, was erected at my bronze manufactory in London about two months prior to my reading the "Cheltenham Paper." It is represented in vertical section Fig. 9. The interior of the mold was 10 ins. square and about 3 ft. in length, and was made in two pieces planed quite parallel and then permanently bolted together. The mold had a massive square lower flange resting on four dwarf columns, which stood on the square upper flange of an hydraulic cylinder. Massive bolts passed through these dwarf columns and through the square flanges, and thus united the ingot mold and hydraulic cylinder, in which a ram or plunger was placed, having a movable square head which accurately fitted the mold and formed a closely fitting movable bottom to it. Both the ram and the external surface of the mold were kept cool by a water jacket provided with supply and waste pipes. Matters being thus arranged, the converted metal was allowed to fall in a vertical stream from the receiver on to the head of the ram. The receiver was then removed, and water under pressure was turned on to the hydraulic cylinder as soon as the steel was solidified, when a beautifully square ingot, 10 ins. square and weighing about seven hundredweight, steadily rose and stood on end ready for removal, the head of the ram rising one or two inches above the top of the mold. There are, no doubt, many persons still living who witnessed this combined converting and casting apparatus in successful operation at my bronze works in London.

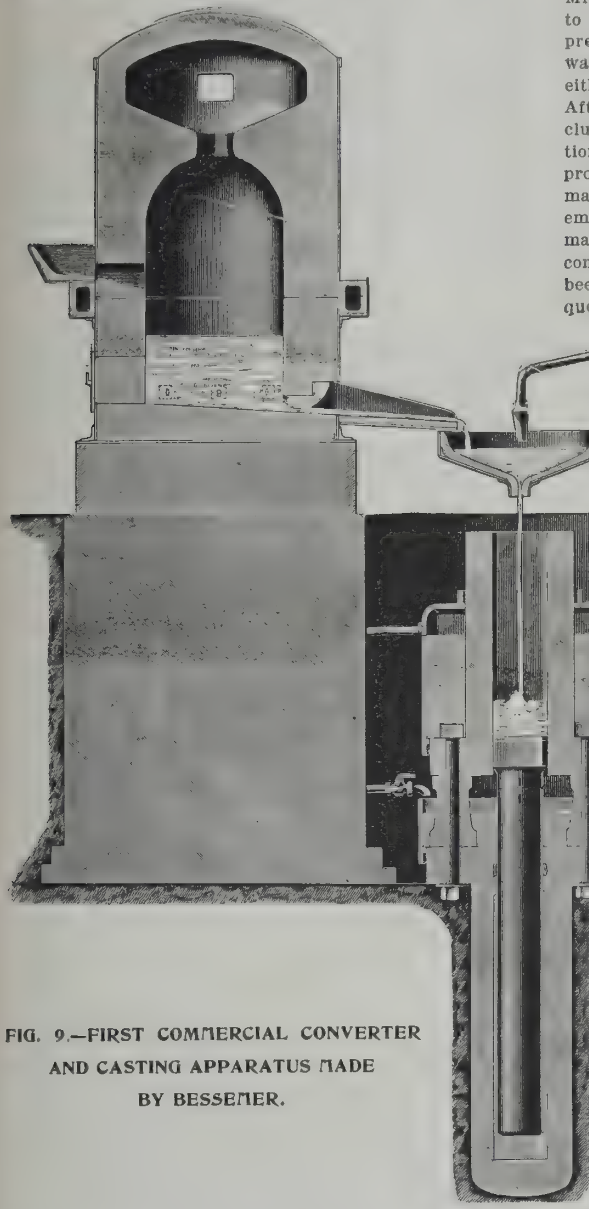

FIG. 9.—FIRST COMMERCIAL CONVERTER AND CASTING APPARATUS MADE BY BESSEMER.

Two ten-inch square ingots made with this apparatus were sent to the Dowlais Iron Works in Wales, and without hammering, were rolled into two flat-footed rails, on Aug. 26, 1856—that is, thirteen days after the reading of the "Cheltenham Paper." They were rolled under the personal superintendence of Mr. Edward Williams, Past-President of the Iron and Steel Institute, where two pieces of these rails are still kept as examples of the early working of my process in London.

I may here call attention to the fact that in my patent, dated Oct. 17, 1855, I described how the state of carburation of the converted metal might be regulated by the addition of molten pig-iron after the blow had taken place; and as this patent was dated eleven months prior to Mr. Mushet's patent, claiming to recarburize the converted metal with the German pig-iron known as spiegeleisen, Mr. Mushet could not prevent my use of that, or any other pig-iron, to recarburize the converted metal after the blow. There was also another absolute bar to Mr. Mushet's claims to the exclusive use of manganese in my process besides its public use in all countries by cast-steel manufacturers, for in another patent of mine, dated May 31, 1856—that is, 16 weeks prior to either of Mr. Mushet's three manganese patents—I gave the right to the public to alloy steel in my process with any metals previously used to alloy cast-steel, by showing various ways in which these alloys might be made in my process, either by fluid or solid metals, or by metallic oxides. After this description I entered a disclaimer to their exclusive use, by means of which disclaimer and publication, all alloys of steel might be made in my converting process which had hitherto been made by other cast-steel manufacturers; so that the three patents of Mr. Mushet, embracing, as they did, every known means of employing manganese, and which were intended to corner me and control my patent, utterly broke down simply by having been anticipated in my two former patents. In consequence of this, Mr. Mushet did not think it worth while even to give me notice that in using spiegeleisen for recarburizing I was infringing his patents, nor did he make any attempt legally or otherwise to prevent me and all my English licensees from the free use of manganese; and I could never understand why American steel manufacturers paid a roylty for the use of these invalid patents.

In this same patent of May 31, 1856, I anticipated the invention of Sir Joseph Whitworth for casting steel under great pressure in order to render the ingots or castings more sound. I stated that

> "I have observed that the cellular condition of cast-steel, and more especially malleable-iron castings, is more or less owing to the spontaneous disengagement of gaseous matter in the interior of the fluid mass. Now, it is well known that substances capable of vaporizing, or of evolving gaseous matters, do so with greater difficulty if surrounded by a dense atmosphere. I therefore make use of this peculiar property of matter in order to increase the soundness of ingots or other articles formed by casting in fluid malleable iron or steel."

Then follow details of apparatus both for casting under gaseous pressure and also by the direct action of an hydraulic plunger acting on the fluid steel during its solidification. I have no doubt whatever but that when Sir Joseph Whitworth applied for his patent for casting steel under the pressure of an hydraulic plunger, he was wholly unaware of what I had patented nine years previously, and it is only due to Sir Joseph to say that immediately on his patent agent pointing out this fact to him, he came to me and took a license under my patent, paying me a royalty on all the compressed steel made at his works up to that date at which my patent ceased to exist. That his special mechanical arrangements were an original invention I have never had any doubt whatever, and he had the additional merit of successfully carrying them out.

Before concluding this brief sketch of the more salient points connected with the many forms of apparatus designed by me to facilitate or improve my process, I must revert to the difficulties inseparable from a fixed converter, for in this form of apparatus much heat is dissipated by the necessity of blowing before running in the metal, and—what is still worse—the necessity of continuing the blast after the metal is converted and during the whole time of its discharge. Then there is the uncertainty as to the time employed in tapping, during which time the blowing must be continued, and there is also the difficulty of stopping the process, if anything goes wrong with the blast engine, or if a tuyere gives way.

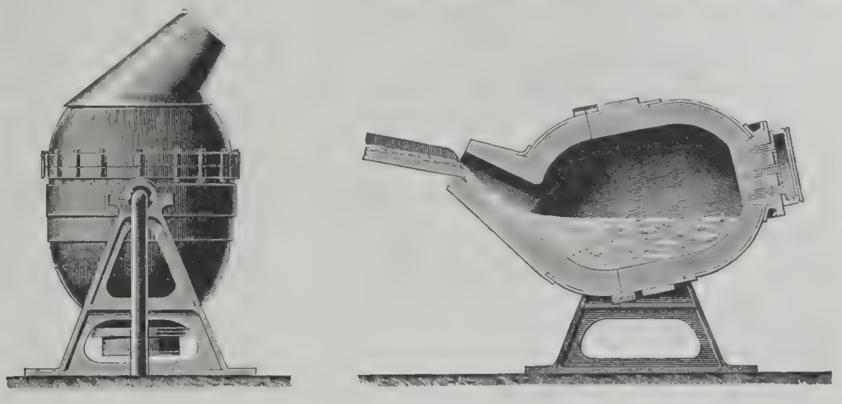

Fig. 10. Fig. 11.

FIGS. 10 and 11.—BESSEMER'S IMPROVED CONVERTER.

These difficulties and many others caused me to search diligently for a remedy for these grave defects, which at that time appeared impossible to overcome, until the happy idea occurred to me of moving the converter on axes, so as to be able to keep the tuyeres above the metal until a charge of molten iron was run in, and which permitted the whole charge to be commenced at one and the same time, and admitted also of the cessation of blowing during its discharge. This movement of the converter also permitted a stoppage of the process to take place at any time for the removal of a worn-out tuyere if necessary, and afforded great facilities for working the process. The peculiar form of the movable converter was a matter of great importance, as there were several necessary requirements to provide for. First, in order to make the heavy lining secure when turned upside down, a more or less arched shape in all directions was necessary, and a long oval form seemed best adapted to the purpose, as it allowed some eight or nine feet in height for the metal to throw itself about in, without leaving the converter. Then the large mouth or outlet pointing to one side was necessary to direct the sparks to be all discharged in a

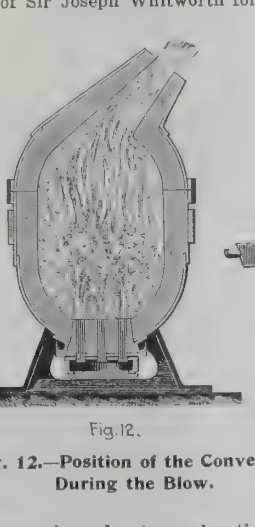

Fig. 12.

Fig. 12.—Position of the Converter During the Blow.

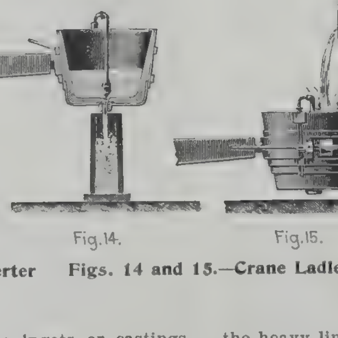

Fig. 14. Fig. 15.

Figs. 14 and 15.—Crane Ladle.

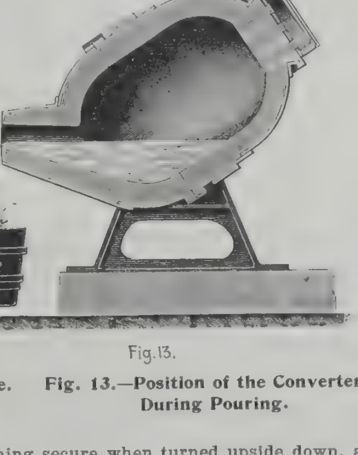

Fig. 13.

Fig. 13.—Position of the Converter During Pouring.

direction away from the casting pit. After much study the precise form arrived at is shown at Fig. 10, which is an external elevation, and of which Fig. 11 is a vertical section, in the position in which the vessel is retained during the running in of the metal; Fig. 12 shows the position it occupies during the blow; Fig. 13 shows the position is assumes during the discharge of the converted metal into a loamed-up casting ladle provided with a discharge valve at the bottom; the ladle can be moved from mold to mold by closing the valve during such movement, and on opening it a vertical stream descends into the mold, perfectly free from any admixture of slags. The advantage of this mode of filling the molds will be understood when it is borne in mind that the latter are necessarily narrow, upright iron vessels. Now, it is well known that a stream of molten metal, poured from the lip of a ladle, will describe a parabolic curve in its descent, and tends to strike the further side of the mold before reaching the bottom. The surface of the cast-iron mold so struck is instantly melted by the incandescent stream of steel, and the ingot and the mold thus become united, causing great inconvenience and destruction to the mold; nor is it easy in pouring the steel from a ladle to prevent some of the fluid slag floating on its surface from flowing over with the steel and spoiling the ingot. All of these difficulties are avoided by the valvular ladle discharging a vertical stream down the centre of the mold. the quantity and flow being regulated with great facility by the hand lever on the side of the ladle.

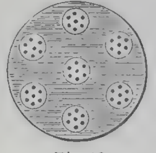

Fig.16.

Fig. 17.

Fig.18.

Fig. 16.—Arrangement of Tuyeres in the Converter Bottom.
Figs. 17 and 18.—Section and Bottom View of a Tuyere.

Many other mechanical contrivances were necessary to perfect the process; such, for instance, as a patent blast engine with noiseless self-acting valves; the hydraulic casting crane carrying the casting ladle over every mold in the semicircular casting pit, and capable of rising and falling to correspond to the descent of the mouth of the converter when filling the ladle for casting. Then there are the direct-acting ingot cranes which clear the pit and refill it with another set of molds rapidly and with little manual labor; then we have the elevated "valve stand," called in America, "the pulpit," from which safe position a single workman can overlook the whole converting apparatus, controlling all their movements, governing the blast, working the hydraulic cranes, etc.

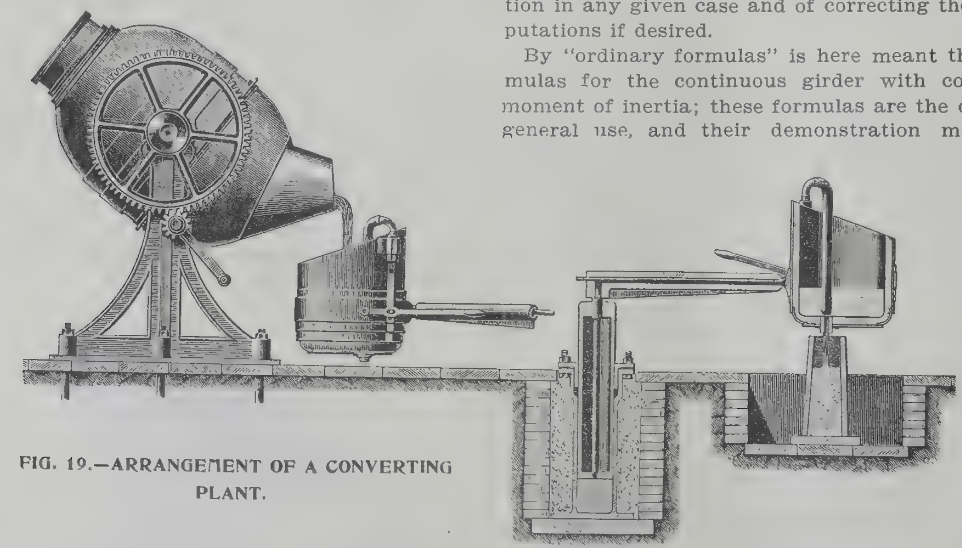

FIG. 19.—ARRANGEMENT OF A CONVERTING PLANT.

The mode of transmitting semi-rotary motion to the converter was another important question which I had to solve. I was of opinion that ordinary shafting and straps were out of the question in dealing with this fiery monster; five or ten tons of fluid metal had to be lifted in one direction, the load diminishing until the fluid running to the opposite end of the converter tended to drive the lifting gear in the reverse direction, so that if anything went wrong or slipped, the converter might swing itself round and discharge these five or ten tons of incandescent steel on to the floor or among the workpeople. This determined me to adopt the hydraulic apparatus now universally employed for governing the motions of the converter, for with this simple and reliable apparatus, a lad at safe distance can start it in motion or stop it instantly, can alter its speed of motion, and control the pouring out of ten tons of incandescent steel as easily as a lady pours out a cup of tea.

The first movable converter was erected at my steel works in Sheffield, and was moved by hand gearing, because at that early date I had not invented the hydraulic apparatus just described. This early converting apparatus did good work at Sheffield, and was constructed precisely as represented in Fig. 19, which shows also the first modification of the hydraulic casting crane, afterwards elaborated and rendered suitable for casting heavy charges of steel.

In conclusion, permit me to say that I have great pleasure in bringing before the many eminent engineers of which this society is composed a brief sketch of the early days of this invention, and although many interesting details are necessarily omitted, I trust that I have said enough to show how the Bessemer process originated, and how, by constant study and practical research it was developed from a mere abstract theory, nearer and nearer to a degree of practical development at my bronze works in London till I was justified in erecting the Bessemer Steel Works in Sheffield, which still remain in active operation under the style of Henry Bessemer & Co., Limited. These works were established for commercial purposes and also to serve as a pioneer works or school, where the process was for several years exhibited to any iron or steel manufacturers who desired to take a license to manufacture under my patents; during that time all who desired to do so were allowed to bring their own pig-iron, and personally, or by their managers, see it converted prior to taking a license.

And now, when I contemplate the great steel trade of Europe and America, with an annual production of 10,000,000 tons of Bessemer steel, I may be pardoned if I express some pride and satisfaction when I find that, notwithstanding the keen competition of rival manufacturers and the ceaseless activity and inventive talents of mechanical engineers, my original invention has not been swept away, but still exists in active operation in every steel-making country in the world, intact in all its main features and in almost every detail as it left my hands forty years ago.

* * *

THE ACCURACY OF THE ORDINARY FORMULAS FOR SWING BRIDGES.

By. F. E. Turneaure.*

In view of the statements which are occasionally seen, to the effect that perhaps our ordinary formulas for swing bridges may some day be replaced by more accurate and desirable ones, and of various remarks concerning the accuracy of these formulas, it may not be amiss to examine into their accuracy and to point out an easy method of determining the degree of approximation in any given case and of correcting the computations if desired.

By "ordinary formulas" is here meant the formulas for the continuous girder with constant moment of inertia; these formulas are the ones in general use, and their demonstration may be found in any modern work on bridges. Furthermore, in this discussion, truss bridges only will be considered.

The method of computation to be explained assumes that the stresses have been determined by some approximate method (preferably by the use of the ordinary formulas) and the sections of the members computed. By this proposed method we may then determine the true reactions and if it is found that those determined by the approximate methods are largely in error the stresses and cross-sections can be corrected accordingly. This would change the reactions to some extent and therefore, in turn, the stresses, but it will be found that the computations need never be repeated for any swing bridge as the second approximation will be abundantly accurate. In fact, it will be shown that the usual formulas are sufficiently accurate in all ordinary cases.

We will consider first a bridge of two equal spans. It will usually be sufficient to make the computations for one case only—that is, for a uniform load covering both spans, bridge acting as a continuous girder. The reactions for this case are determined as follows:

Assume first the bridge loaded with the given load and supported only at the center, both arms deflecting equally. Determine the deflection of the end point by the formula†

$$D = \Sigma \, \frac{P\,u\,l}{E\,a}, \tag{1}$$

in which

D = deflection of the end point,
P = stress in any member due to the assumed load,
u = stress in the same member due to a load of 1 lb. applied at the end,
l = length of the member,
E = modulus of elasticity, and
a = area of the cross-section of the member.

Now find in the same way the upward deflection of the end point due to a load of 1 lb. applied upwards at the end, The stress in each member due to this load, and which corresponds to P in the above formula, will be u, the value of which is already known. This upward deflection will then be

$$d = \Sigma \, \frac{u^2\,l}{E\,a}. \tag{2}$$

The necessary reaction to produce an upward deflection equal to D, or to bring the end back to normal position, will be

$$R = \frac{D}{d}. \tag{3}$$

The stresses "P" can be quickly found from a single stress diagram and if the dead load is taken as a uniform load, they will be proportional to the dead load stresses for bridge open. Stresses "u" can also be found from a single diagram, while all other quantities are known. A convenient form for computation will readily suggest itself.

For a symmetrical truss symmetrically loaded it is necessary to sum the terms $\frac{P\,u\,l}{E\,a}$ and $\frac{u^2\,l}{E\,a}$ for one-half the truss only. For symmetrical trusses unsymmetrically loaded we can first assume symmetrical loads and determine the corresponding reactions; then from these get the reactions for the unsymmetrical loading by use of the principle that the moment at the center due to a load on one span is one-half the moment due to two such loads symmetrically placed. Thus, for the case where the first span is fully loaded and the second span has no load, we find in this way the value of the left reaction,

$$R' = \frac{R + \dfrac{\Sigma\,P\,a}{L}}{2}, \tag{4}$$

in which R is found from (3), L = span length, and Σ Pa = summation of the moments of the loads about the center support.

Since equation (4) holds true when R and R′ are determined by formula, and since Σ Pa is independent of R, it follows that the discrepancy between the values of R′ as determined by deflections and by the ordinary formula is one-half the discrepancy between the values of R. That is, the error in reaction due to the use of the formula is twice as great for bridge fully loaded as for one span only loaded. As these two cases determine the maixmum stresses in nearly all the members, it will not usually be necessary to determine true reactions for other partial loads. However, if thought desirable, the reactions can be found for each panel load and the results combined. The additional labor involved is not so great as would seem to be the case, for many of the terms involving P disappear.

---

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†For a demonstration of this formula see Johnson's "Framed Structures," p. 220. The method here explained is essentially the same as that used by Prof. Swain in his discussion of the general case of the continuous girder in the Journal of the Franklin Institute, Vol. CXV, 1883.

For a bridge of unequal spans it is necessary to sum the terms $\Sigma \frac{P\,u\,l}{E\,a}$ and $\Sigma \frac{u^2\,l}{E\,a}$ for all members of the bridge. In this case it is convenient to assume the truss supported at the center and at one end and determine the deflections and reaction at the other.

The foregoing method is applicable not only to a two-span bridge but also to a three-span bridge in which the web members are omitted in the center span or panel; for, assuming such a truss supported at the center, or at the center and at one end, the stresses due to any load are fully determinate.

To get some notion of the accuracy of the ordinary formulas, reactions have been computed for several cases by the above method and also by the use of the formulas; the results are given below. In every case a load of unity per lineal foot extending over the entire bridge has been assumed. The following bridges have been treated:

(a) The Winona Bridge, a description of which will be found in Engineering News, vol. XXVI., 1891, p. 370. A sketch of this bridge is given in Fig. 1.

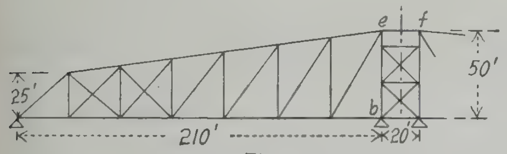

Fig.1.

(b) A series of designs with the half-truss containing 6, 5, 4, 3 and 2 panels successively. The general dimensions of these truses were chosen by taking a corresponding number of panels of the Winona Bridge. Cross-sections of members were properly determined from stresses due to certain assumed dead and live loads. In each of these cases computations were made for trusses with and without a central panel.

(c) Another bridge of a form similar to the Winona Bridge, but with five 18-ft. panels, a central panel of 18 ft., a center height of 32 ft. and end height of 25 ft.

(d) The Milwaukee drawbridge of the C., M. & St. P. Ry., which is described in the "Engineering and Building Record," vol. XVI., 1887, p. 747. Fig. 2 is a sketch of this bridge.

(e) The Sabula swing bridge as shown in Fig. 3.

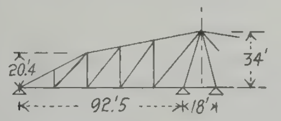

Fig.2.

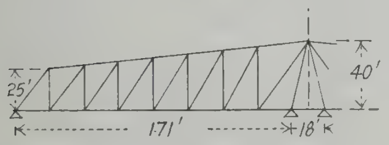

Fig.3.

This truss is analyzed by Prof. M. A. Howe in his book entitled "The Continuous Girder," p. 72, form which the dimensions of the truss and of the chord sections have been taken. The cross-sections of the web members not being at hand, the required sections have been obtained by computation, making reasonable assumptions as to loads.

The results of these computations are given in the following table:

Truss.	Reaction True. (a_1)	 True. (b_1)	 By form. (a_2)	 By form. (b_2)	 From chords.
a.	64.3	65.9	64.3	67.4	52.9
b. 6 panels	55.7	57.7	53.1	56.3	44.1
b. 5 "	45.8	47.0	42.0	44.7	34.7
b. 4 "	35.2	36.1	30.9	33.1	25.3
b. 3 "	24.3	25.2	20.0	22.1	14.7
b. 2 "	11.8	11.9	9.4	11.0	8.5
c.	36.8	38.2	34.2	36.7	31.3
d.	44.5	....	47.5	....	39.2
e.	56.6	....	58.1	....	50.9

Columns headed (a) are the reactions for the several trusses with the central panel omitted, while columns headed (b) are the reactions for the trusses having this panel.[*] The column headed "Reactions from Chords" contains the reactions as determined by deflections, but in the computation of which the chord members are alone considered. These have been figured for trusses without center panel only, and should therefore be compared with columns (a). These reactions are the same as would be found by the use of formulas which take strict account of the variation of the moment of inertia of the truss.

The principal points brought out by this table are: First, the comparatively close agreement between the true reactions and those found by formula, much closer than the writer had supposed would be the case; second, the fact that the formula taking account of the central panel gives results usually more accurate for these cases than the formula neglecting this panel—compare columns (a_2) and (b_2) with (b_1); third, that the reactions found by treating chords only are in every case much more in error than those found by the ordinary formula.

There are in the ordinary formulas two sources of error, one due to assuming the moment of inertia constant, and the other due to neglecting the distortion due to the web members. A decrease of moment of inertia towards the end of the truss tends to decrease the reactions while the effect of the web members is the reverse. This is clearly brought out by the table. The resultant effect is, however, small, at least in the examples given, and the statement appears to be warranted that the ordinary formula will give more accurate results than a formula involving variable moment of inertia, and that in most cases the results given by the former are sufficiently accurate. If it is desired to know the error in any case it can be readily found by the method here explained and corrections made accordingly.

The neglect of web distortion gives rise also to very erroneous conclusions in regard to the action of diagonals in the center panel of a three-span swingbridge. We will find our previously computed deflections of assistance in discussing this question.

Take for example the Winona Bridge and let us see what will be the effect of unsymmetrical loads on the bracing of the center panel, assuming this bracing to be attached at points e and f instead of lower down. The maximum distortion, or horizontal movement of the point e, will occur when the first span only is loaded. Assuming a uniform load of 3,000 lbs. per ft. on this span, the right reaction is found to be —19,000 lbs. Referring now to Fig. 4, let the full line a b c represent the axis of the bridge before the load is applied, the dotted line a b c the axis afterwards, and b c′ the tangent to this line at b. The horizontal movement, x, is evidently equal to $D' \times \frac{h}{L}$. The deflection D′, will be equal to the reaction R_2 multiplied by the deflection d (due to 1 lb.) as previously found. Or, in this example, d having been found equal to .0000334-in., we have

$$x = .0000334 \times 19{,}000 \times \frac{50}{210} = .15\text{-in.}$$

The vertical movement of the point e is that due to the stress in the member e b. This stress being 154,000 lbs. and the area of the section of the member 33 sq. ins., the vertical movement

$$= \frac{154{,}000 \times 50 \times 12}{30{,}000{,}000 \times 33} = .093\text{-in.}$$

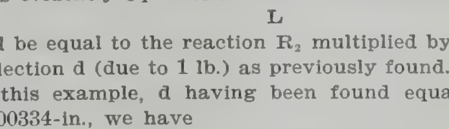

Fig.4.

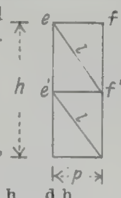

Fig.5.

In Fig. 5 is represented the center panel. The length of the diagonal is l, and the panel length, p. Differentiating the equation

$$l^2 = p^2 + \left(\frac{h}{2}\right)^2$$

with respect to both p and h, we have

$$2\,l\,d\,l = 2\,p\,d\,p + 2\,\frac{h}{2}\,.\,\frac{d\,h}{2},$$

whence

$$\frac{d\,l}{l} = \frac{p\,d\,p + \frac{h}{2}\,.\,\frac{d\,h}{2}}{l^2}, \qquad (5)$$

that is, applying this equation to the lower panel, the elongation per unit length of the diagonal

$$= (p \times \text{horizontal movement of } e' + \frac{h}{2} \times \text{vertical movement of } e') \div l^2,$$

in which an upward movement of e′ is positive. In the present case, both horizontal and vertical movements of e′ being one-half those of e, we have

$$\frac{d\,l}{l} = \frac{20 \times 12 \times \frac{.15}{2} - 25 \times 12 \times \frac{.093}{2}}{(20 \times 12)^2 + (25 \times 12)^2}$$

Multiplying this by 30,000,000, the modulus of elasticity assumed in the other computations, we have finally the unit stress in the diagonal = 830 lbs. per sq. in., tension, a result independent of the size of the member. The stress in the upper diagonal will be somewhat less since the point f′ does not move downwards as much as e′. If h were 64 ft. instead of 50 ft. there would be no stress in the diagonals. In many cases the diagonals are much more inclined to the horizontal than in this case and the stresses are correspondingly small or even compressive. This is true in several of the trusses described in this article.

It has usually been assumed that heavy diagonals in the center panel cause the bridge to act as a beam would act when resting on four supports, or at least that such diagonals seriously interfere with the use of the formula for a two-span bridge. The results so far obtained by the method here given would seem to show that as large diagonals may be used as is thought necessary and then entirely neglected in the computations. If the diagonals are stressed, then the horizontal and vertical movements will be slightly modified thereby, which in turn will decrease the stresses in the diagonals. Hence the stresses found as above are greater than those actually occurring.

A very important question, and one of especial significance when discussing accuracy of formulas, is that of the effect of a variation of temperature between different members of a swing-bridge. The effect on reactions of any given difference of temperature can very quickly be found from our previous computations.

Let

t = change of temperature of any member,
c = coefficient of expansion, = .0000065 per 1° F.,
l = length of member.

Then c t l = total change of length of any member. The deflection of the end of the truss due to the change of length of this member will be u c t l, where u is the same as in our previous work, and for a change of temperature of any number of members the deflection,

$$D_t = \Sigma\,u\,c\,t\,l. \qquad (6)$$

The reaction necessary to produce a like deflection, or the reaction produced by the assumed temperature changes will be

$$R = \frac{D_t}{d}, \qquad (7)$$

in which d = deflection due to a one-pound load, as before. For example, suppose the lower chord of the Winona bridge to drop in temperature 1° F. In this case c t l for each member = .00234 and $\Sigma\,u = 20$, whence

$$D^t = .047 \text{ and } R^t = \frac{.047}{.0000334} = 1{,}400 \text{ lbs.},$$

a very large amount for a change of temperature of only 1°. Considering a possible difference of temperature of 30° or even more, the great effect of this element can be appreciated. The effect is so great as to evidently render much refinement in calculation entirely useless and to support the statement previously made that the ordinary formulas are accurate enough for all ordinary cases.

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[*] The formula used for column (b) will be found demonstrated in Johnson's "Framed Structures," second and succeeding editions, p. 194, and in Engineering News, vol. XXXIV., 1895, p. 150.

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In view of the annual convention of the American Society of Irrigation Engineers to be held at Denver next week, and the National Irrigation Congress to be held in the week following at Phoenix, Arizona, we this week devote an unusually large proportion of our space to papers on irrigation engineering, and in order to do this without encroaching on the space allotted to other departments of engineering, we have added eight extra pages to this issue. The tables by Mr. Pope, for the flow of water over weirs, which are given in this number, will be found useful, we believe, by hydraulic engineers generally as well as by those who desire to measure water for irrigation purposes. For the benefit of any of our readers who may desire to have these tables in a shape more handy for use, we would say that they are to be published by the author very shortly in a convenient pocketbook form.

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In our correspondence column this week we publish a letter from Mr. Josiah Pierce, Jr., concerning the topographical survey of the City of Baltimore, and we ask the careful attention of our readers to its contents. This letter was written in reply to one stating the grounds upon which we made our recent comments on the work of this survey, and it should be read in connection with the statements made in the expert's report in our issue of Nov. 12. Our criticism in that issue upon the methods of obtaining data for the detail maps, was based upon information gleaned from the official proceedings of an investigating committee appointed by the City Council of Baltimore. These proceedings stated that Mr. Pierce, as acting chief of the survey, and other officers of the survey had been before the committee in their own defence; and that reputable expert witnesses, like Major N. H. Hutton and Mr. O. H. Tittman, the latter of the U. S. Coast and Geodetic Survey, had testified in support of the report of the committee. We assumed that the investigation was fairly and honestly conducted and criticised the reported results accordingly.

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From the letter of Mr. Pierce, and from other recent information furnished us, it would now seem that the manner and methods of this investigation are themselves open to criticism, and that the whole subject is to be submitted to another board of experts, of such professional experience and reputation as to leave no doubt as to the accuracy and honesty of the verdict to be rendered. We regret that the nature of the evidence previously submitted should have placed us in the position of possibly doing an injustice to engineers who have certainly done exceptionally good work in a great part of this survey. And under the newly developed conditions we can only ask our readers to await the more exhaustive report referred to before passing final judgment upon the work of those in charge of the Baltimore topographical survey.

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The paper by Sir Henry Bessemer, presented at the meeting of the American Society of Mechanical Engineers, which we print in full on another page, is one which will be found of great interest, as being probably the clearest account of the details of the work done by the eminent inventor which has ever been published. We regret, however, that Sir Henry has seen fit to include in the paper some matter which is outside of the description of his own work, and which tends to detract from the credit which should justly be given to other inventors in this field, especially Heath, Kelly and Mushet. For the sake of the truth of history it is desirable that the work of these men should not be allowed to fall into oblivion and their credit be hidden by the overshadowing fame and honor which Bessemer has deservedly obtained. Some of the history of the origin of the Bessemer and open hearth process has for many years been a matter of controversy, and it seems only fair for us to give in connection with Bessemer's account a statement of some of the evidence which tends to show that while Bessemer is justly entitled to the credit he has received, some credit also is due to others, which he seems inclined in his paper to withhold.

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The first statement to which we would call attention, relates to Bessemer's connection with the open hearth process. Sir Henry says:

> As far back as January, 1855, I had claimed in my patent the fusion of steel in a bath of melted pig or cast-iron in a reverberatory furnace, as herein described. * * I think I am justified in saying that the fusion of steel in a bath of pig iron, on the open hearth of a reverberatory furnace, which I had patented and successfully effected, was, to use a favorite expression of Mr. Gladstone, "approaching within measurable distance" of that now well-known and successful process.

The fact is that the fusion of steel in a bath of cast iron on the bed of a reverberatory furnace had been practised in England and described long before 1855. In Hasenfratz's "La Siderotechnie," Paris, 1812, Vol. IV., pp. 93-99, there is described the method of manufacturing two varieties of steel, known in England as Marschall and Huntzmann steels. It is stated that

> A mixture of gray and white cast iron is made. Sometimes also there is mixed either with the gray cast-iron alone or with the mixture of these two cast irons, clippings of iron, old bar iron, scales and even clippings of steel. The mixture described to make the second kind of steel is melted in ordinary reverberating furnaces in which one has prepared a sort of crucible in the lowest position. As soon as the cast iron begins to refine itself the principal workman introduces a small spoon into the bath. He continues to take out tests until that which he withdraws can be forged; then he examines the grain of the steel; if it is too soft the workman throws into the bath bars of steel too much cemented, which gives it carbon without altering its refining. If it is too hard he throws into it clippings of iron—sometimes even of bar iron—to diffuse the carbon through a larger mass or to burn a portion of it; then he withdraws the slags; he runs the cast-steel into the molds and it is afterwards forged to be sent forth into commerce. The facility which they have in England of procuring scraps to melt for steel gives to the inhabitants of that island a considerable advantage over all the other nations of Europe.

In the "Dictionnaire des Arts et Manufactures," Paris, 1845, A-F., p. 48, it is stated that

> M. Breant has proposed two different processes for directly manufacturing cast steel. In the second process one oxidizes on the hearth of a reverberatory furnace a certain quantity of good pig iron to which one mixes subsequently an equal quantity of the same nature, but not oxidized. On stirring well the materials the whole soon goes into fusion and furnishes a steel of good quality.

Josiah Marshall Heath, English Patent No. 10,798, of 1845, describes a process for the manufacture of cast steel on the bed of a reverberatory furnace, and states that the furnace may be heated by gas formed in a separate gas producer.

> The interior of the furnace should be kept at the highest temperature that can be produced. A bath of cast iron is formed on the bed of the furnace and it is refined by the addition to it of malleable iron in scraps or in any convenient form, or of iron which has been made from iron ore by cementing it with carbonaceous matter at a red heat in a close vessel.

It is thus seen that the fusion of steel with pig iron on the bed of a reverberatory furnace, for the purpose of making cast steel was known at least as early as 1812; that the fusion of pig iron, together with oxidized pig iron (that is, wrought iron), on the bed of a reverberatory furnace for the purpose of making steel was described in Paris in 1845; that Heath's process for making cast steel differs in no respect from that described by Bessemer, except that it states "the addition of malleable iron," instead of steel. But steel was used in a bath of cast iron, as already stated, as early as 1812.

All the early attempts to make steel on a reverberatory furnace by the mixture of cast iron and of wrought iron or steel seemed to have failed commercially prior to 1855 for three reasons:

(1) The lack of the Siemens regenerative furnace, (invented by Frederick Siemens, brother of Charles William Siemens, in 1856), or of any furnace which could produce and steadily maintain the temperature necessary to hold in fusion iron low in carbon.

(2) The want of knowledge how to overcome red-shortness, which was not known until Mushet described the use of spiegeleisen, in 1856.

(3) The lack of knowledge of the chemical composition of pig iron required to make good steel.

Bessemer, therefore, in 1855, was not "within measurable distance" of the modern open hearth process any more than Heath was, who anticipated him in date by nearly 10 years.

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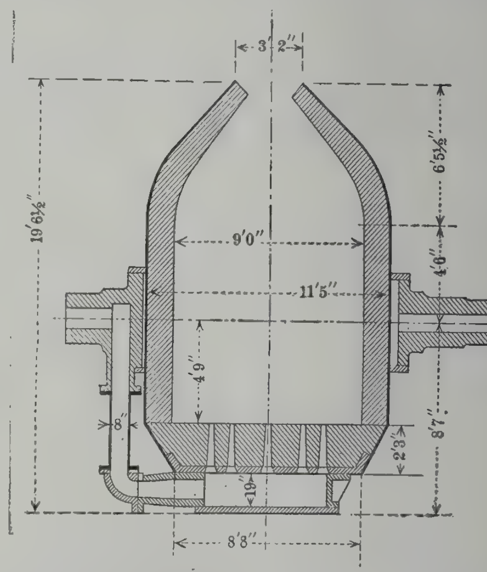
The next point raised by Sir Henry Bessemer which is open to criticism relates to the converter of Kelly, and to Kelly's claim to priority of invention of the pneumatic process. He says:

> No one who had once witnessed the conversion of fluid pig-iron into malleable iron by a blast of air, would ever propose to construct a converter with an opening at the top so as to direct this fiery stream upwards. It is to me utterly inconceivable that any man who had once witnessed the violent eruption accompanying the converting process should, after such an experienoce, design and patent a converting vessel with a sloping top and a vertical outlet so admirably adapted to throw upward and discharge so large a proportion of its contents as that shown in Fig. 6.

It appears that the converter now used in the most modern American works is exactly of this description; it has a sloping top and a vertical outlet admirably adapted to throw up and discharge its contents. On p. 63 of Mr. Harry Huse Campbell's recent work on "Structural Steel," is shown a sectional view (which we reproduce herewith) of an 18-ton converter, used in the works of the Maryland Steel Co., at Sparrows Point, Md., which has the sloping top and the vertical outlet.



18-Ton Converter in Use by The Maryland Steel Co., 1896.

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Referring to the claims made on behalf of Robert Mushet, Sir Henry states that he (Bessemer) described in his patent of Oct. 17, 1855, how the state of carburation of the converted metal might be regulated by the addition of molten pig iron after the blow had taken place, and as this patent was dated 11 months prior to Mr. Mushet's patent, claiming to recarburize the converted metal with the German metal, known as spiegeleisen, Mr.

Mushet could not prevent the use of that or any other pig iron to recarburize the converted metal after the blow.

But the fact is that Mr. Mushet's patent of Sept. 22, 1856, clearly shows that the effect of the addition of spiegeleisen was not merely a recarburizing but also a deoxidizing of the bath. Mushet says in his provisional specification:

> When cast-iron has been purified or decarbonized by blowing air through it when in the metal state, it is difficult to convert it into malleable iron or steel. I have discovered that by combining such purified iron in a heated state with a triple compound consisting of or containing iron, manganese and carbon, also in a heated state, I can obtain malleable iron or steel.

In his complete specification he describes at length the difficulty referred to and describes the product of simple decarburizing as "red short" or "hot short," and says the ingots so made are also generally porous or cellular in structure. He says further:

> To the purified cast iron when it has become wholly decarburized or nearly so by the action of air forced into or among its particles whilst it is in a molten or fluid state, I add a triple compound alloy or material of or consisting of iron, carbon and manganese, which mixture I effect in any suitable furnace, vessel or ladle. * * * I prefer to use the white crystalline cast-iron metal thus obtained and known in Prussia as spiegeleisen—and I prefer to use such varieties of this white crystalline cast-iron metal as are found to contain a large alloy of manganese.

Mushet further states:

> As the triple compound of or containing iron, carbon and manganese parts with a portion of its manganese every time it is remelted, I prefer to use that which has not been previously remelted and I avoid as much as possible any repeated remelting of it.

Mushet's claim is "the addition of a triple compound or material of or containing iron, carbon and manganese to cast iron which has been purified and decarburized by the action of air whilst in a molten or fluid state, or in any convenient manner."

Sir Henry Bessemer classes "the German pig-iron, known as spiegeleisen," as being simply a particular kind of pig iron. It is, nevertheless, as different a material from what is ordinarily called pig iron in commerce as ordinary pig iron is different from tool steel, or tool steel from wrought iron, in appearance, in chemical constitution and in physical properties; and spiegeleisen moreover differs wholly from pig iron in containing metallic manganese, which has the peculiar property of overcoming the red-shortness of steel. Sir Henry further says: "I never could understand why American steel manufacturers paid royalty for the use of these invalid patents" (that is the Mushet patents). The fact is the Mushet patents were not invalid in America, and it is very doubtful if they or the Kelly patents could have been made invalid by litigation. In 1865 the Kelly Process Co., owning the U. S. patents of Kelly and Mushet, and Winslow, Griswold & Holley, owners of the American Bessemer and Holley patents, concluded that it would be better to combine their interests than to enter into expensive litigation, and a combination was effected on the basis of 70% of the royalties going to the owners of the Bessemer and Holley patents and 30% to the owners of the Kelly and Mushet patents. (See Robert W. Hunt's "History of the Bessemer Manufacture in America," Trans. Am. Inst. M. E., Vol. 5). The owners of the American patents granted to Bessemer and Holley in 1865, no doubt considered there were strong reasons for believing the Kelly and Mushet patents to be valid, or they would not have entered into such an agreement.

THE OWNERSHIP AND CONTROL OF WATER IN THE IRRIGABLE WEST.

The saying, WATER IS KING, is as popular and well-warranted in the Irrigable West to-day as was ever the same ascription to cotton in the South. In fact it has more complete sovereignty, and that over a far more extended area, than was ever true of cotton; for at best cotton shared its rule with sugar, rice, corn and tobacco, as well as minor crops, while upon water, artificially applied, depend all crops in the West, and thus to a large extent all material progress. To carry the idea of the kingship of water a little further, it may be said that the monarchy is a limited rather than an absolute one, operating under both written and unwritten constitutions which are determined by the real and higher sovereigns, the people. This brings us directly to the question which it is the purpose of this article to discuss, the ownership and control of water in the Irrigable West. The region designated as the Irrigable West is meant to include all the Western States, where the culture of the land is dependent on irrigation, rather than the comparatively small areas which are actually irrigable. The question is many-sided and intricate. It will be possible for us to discuss only some of its broader phases which, governing the development of the country through the building of irrigation works, are intimately connected with the character of such works, and therefore deeply interest and affect engineers and contractors.

First, it may be said that as all cultivation of the land in many sections of the West is absolutely dependent on irrigation, ruin continually menaces agriculturalists unless they can be sure of an unfailing and ample supply of water at a reasonable price. Next, it should be noted that there is not enough water to supply all the arid land that is within reach of the streams, and hence the available supply must be most judiciously developed and conserved, and, equally important equitably distributed. Finally, economy demands that many or even most irrigation works be carried out on so large a scale as to make construction impossible except by large private companies or at public expense, while the sums of money thus involved are subjected to great risks unless a good market and sure pay can be obtained for the water developed.

The gist of the whole matter is, water and land must be wedded, each being well suited to the other, and having been once united never be divorced under any pretext, but always live amicably together with a due regard to economy of use and the rights of neighboring lands.

All this seems simple enough in the abstract, but the practical application of these principles sometimes bid fair to divide the irrigable territory aganst itself, while at least one of the problems involved, the public land question, may yet become the cause of a temporary bitter feeling between East and West. Certainly such feeling is likely to arise unless the East informs itself much more fully than it yet has regarding the various aspects of the question, and unless the West continually bears in mind that the remaining public lands are as much as ever a national possession, and not wholly of local interest and importance.

A few facts regarding the present status of both the public lands and the water problem may be given here. These points are some of many salient ones brought out by Mr. Elwood Mead, M. Am. Soc. C. E., State Engineer of Wyoming, in a paper to be read before the meeting, next week, of the American Society of Irrigation Engineers.

It will come as a surprise to many in the East to realize that the great bulk of the area west of the 100th meridian, is public land, owned by the United States, and not subject to taxation, therefore, by the states themselves. No less than 84% of the entire area of the nine states enumerated below is public land. Thus, these nine states as a whole have to maintain a law and order over a territory of which only 16%, on the average, is subject to taxation for either state or local purposes, or subject to the irrigation laws which the separate states may enact.

State.	Total area, sq. miles.	—Taxable area,— sq. miles.	per cent.
Montana	145,310	16,196	11.14
Idaho	84,290	5,708	6.77
Wyoming	97,575	6,051	6.20
Colorado	103,645	30,104	29.04
New Mexico	122,460	29,688	24.24
Arizona	112,920	6,634	5.87
Utah	82,190	7,812	9.51
Nevada	109,740	3,906	3.55
California	155,980	56,445	36.19
Total	1,014,110	162,544	16.03

These figures are very significant as showing the vast areas of the public domain in these nine states; the comparatively small area under settlement, taxation and state control generally, including irrigation matters; and the slow rate at which these conditions are changing.

By an act of 1894, each of these states may have transferred to it 1,000,000 acres of the public lands, under certain conditions looking to reclamation by irrigation. Five states have accepted the grant, but only one, Wyoming, has proceeded sufficiently far to select and secure the approval of the area donated, and none of this land has yet been transferred to actual settlers. Mr. Mead urges that the conditions of the grant are not conducive to the best results, and, while apparently welcoming the move as a step towards a proper solution of the problem, considers it as only a step. One condition of the grant he most heartily approves, and that is the making the right to the use of water inalienable from the land reclaimed by it.

Having extracted the above from Mr. Mead's paper a return may be made to the general subject under discussion.

The water problem has been solved, or left to a large extent unsolved, as each of the Western States has seen fit. In many of these states, if not all, the water has been considered as public property, but it has been subject to appropriation for use in irrigation under legislative enactments.

Such appropriation has the effect, to a greater or less extent, of making the water private property, and sometimes of giving it a speculative value, this speculative quality depending on the character of the appropriation laws and the manner in which they are administered. These statements do not apply to the water flowing through the public lands of the several states. The general government does not, and the state governments cannot, at present control such water supplies. Consequently water appropriations may be and are made with utter disregard to any interest but self interest, often to the great detriment of existing and future settlers. When the vast areas of public lands yet remaining are taken into account, the importance of establishing control over the water supplies pertaining to the public land becomes apparent. Of course only a small percentage of the public lands is irrigable, but the water rights on a far greater proportion of the land have a definite relation to the irrigable area, while, as Mr. Mead points out in the paper mentioned above, the condition of the forest areas vitally affects the water supply, and the administration of grazing lands has a direct bearing upon the prosperity of irrigators.

From the above, it is evident that the water question and the public land problem are most intimately connected. If all remaining public lands were to be turned over to the several states within which it is located, the water would go with it, and thus come under present state laws, unless the grant contained conditions to the contrary. If the national control of land is continued there will con- from many of those who believe in state control, over vast areas, unless a change of policy is inaugurated by Congress. Such a change would probably have to be sweeping to be of any effect and would meet with much opposition, notably from many of those who believe in state control as postponing that, and from those who have profited by the past and present let-alone principle.

To discuss adequately these great land and water questions would require a careful study of the history of our public land system, and of the water legislation of the several states, together with the practical working and results of each. This is, of course, far beyond the limits of the present article, and we may add that the magnitude and far-reaching importance of these questions is scarcely dreamed of by most of the people of the East, and fully appreciated by only a limited number in the West.

What we wish to do now is to call attention to this great Western problem and point out some of its main factors. This we have attempted to do above. We shall conclude by stating briefly the governing principles which seem most clearly established and freest from controversy, as follows:

(1) The agricultural products of the so-called arid region are its greatest source of wealth, and upon these all other industries and all progress are dependent.

(2) Irrigation is essential to agriculture in this region, and both depend for their success upon the wise solution of the great land and water questions.

(3) The public lands have long been regarded as the Nation's heritage and safety, but their value depends upon the public water supplies, so each

should be equally held in trust for the people and neither should become subject to speculative control for private profit.

(4) While speculative profit should be prevented, capital and labor must each have its legitimate reward.

(5) Economy of construction and operation demands that many irrigation works should be built on a large scale, to water great tracts. The volume of capital thus required renders the enterprises risky, and tends to the establishment of high water rates in order to produce returns commensurate with the risk, while at the same time the water company often controls the only available source of supply, and thus is tempted to demand high rates, whether or not the risks involved warrant them.

(6) As the uses to which land may be put, and thus its value, depend upon the amount of water available, and, moreover, as land without water is only a drug on the owner, the construction of irrigation works should precede, or at least accompany, the settlement of the land.

(7) As there is not enough water for all the land, the water should be conserved with the utmost care, and the land to be watered chosen with equal consideration. Water conservation includes the preservation of forest areas, the development of the greatest possible percentage of the rainfall, a minimum loss through evaporation and percolation, and a wise application to crops. It may even go farther in some cases and include the reclamation of the seepage water from irrigated areas.

(8) As the land and water are mutually dependent for value, and the water development comes first, and must be made to suit the land, evidently their development under joint ownership or some common regulation is desirable. This, we believe, has been done very advantageously in California under the Wright Irrigation District law, where the land owners build and own the irrigation works. The same plan has more recently been adopted by other states, and bids fair to gain in favor now that the U. S. Supreme Court has upheld the California statute.

In closing, attention must be called to one phase of the water problem of the public lands which seems to be almost wholly overlooked in the discussion of the subject, but which in many sections has not escaped investors, the value of natural water powers. . We cannot enlarge upon this subject at present, but throw out the question, should not the national government, or, if the lands are turned over to the states, the latter, retain control of the water powers, leasing the right to use them under proper conditions? The aggregate value of these rights is great. Does not the principle, all water should be held as public property, adopted by so many Western states, apply to water for power as well as for irrigation? Just now irrigation is uppermost in many sections, but the time will come when water power will be in great demand, a fact that should be borne in mind by all concerned.

LETTERS TO THE EDITOR.

Scherzer Rolling Bascule Bridge for Newtown Creek.

Sir: I desire to call your attention to some of the reasons why I found it impossible to present a complete design of a Scherzer rolling bascule bridge, adapted to the locality, within the 20 days limited by the joint committee on bridges of Kings and Queens counties, in their advertisement requesting designs for a new bridge to be built at Vernon Ave. across Newtown Creek.

The advertisement called for drawings showing the general design of the proposed structures with length of movable span or spans, and of stationaries, if any, width of clear waterway, width of roadway and of footways, loads proposed to be sustained and carried, dimensions of all the parts, and modes of construction and strain sheets showing the forms and construction of typical members with strains sustained. Also the metals proposed to be used, style of flooring and motive power, with sufficient detail to indicate the manner of the application and operation of the same, and a type-written description of the proposed structures. Each design to be in accordance with the regulation of the U. S. War Department.

The data given in the advertisement and that supplied upon application to the engineer designated was very inadequate, and I found it necessary to visit the site of the proposed bridge and there carefully study the situation, and the highway and water traffic to be accommodated. I also found it necessary to have a survey and map made of the vicinity of the bridge.

A careful study of the situation convinced me that any bridge at the level of the present swing structure would be a very poor solution of the problem, as the old bridge is opened from 100 to 200 times in 24 hours at the present time; and this large amount of navigation is constantly increasing. Such a low-level structure would be more expensive to operate, and would afford no accommodation to the large highway travel across the bridge, as it would have to be opened for every passing craft. If built it would at once necessitate the building of more new bridges to afford relief.

The low bridge would be in constant danger of being struck by the hulls of heavily loaded vessels, and greatly injured thereby, for the current caused by the tide is very strong in Newtown Creek, and vessels are frequently uncontrollable. Great delays and constant exposure to accidents would also result from the grade crossing of the Long Island R. R. tracks, which are about 200 ft. from the bridge, and form a very serious interruption to traffic.

Believing that the citizens and taxpayers who would have to pay for the new bridge wished to have the best structure to be obtained, I expended, gratuitously, a large amount of time and money to prepare the design which I submitted to the bridge committee. It required more than 20 days to prepare my design, and I believe that is one reason why it is especially worthy of consideration.

The design consists of: (1) A Scherzer rolling bascule bridge placed sufficiently high to allow about 70% of the water traffic to pass beneath without opening. (2) A viaduct which affords a safe and continuous overhead passage across the tracks of the Long Island R. R. The only objection to a viaduct would be that of a few abutting property-owners, but as the larger part of the abutting property is at present unimproved, the objection could not be serious, for many of the most prominent streets of Brooklyn are occupied by elevated railway structures, which are certainly more objectionable than a short viaduct in a less important street. However, should the viaduct be dispensed with, the bridge ought still to be elevated and be reached by short approaches. (3) The bridge is not an experiment, as it is similar to the two Scherzer rolling bascule bridges now in successful operation at Chicago, and also similar to the new Scherzer bascule bridge at North Halsted St., Chicago, rapidly nearing completion. The latter bridge is 50 ft. 2 ins. wide; has a clear opening between piers of 121 ft.; is designed to carry the heaviest electric car and highway traffic, and with the approaches is 327 ft. long. It cost complete, including approaches, machinery, and electric equipment, only $113,425, less than one-half as much as the Waddell lifting bridge, located upon the same street, upon the south branch of the Chicago River. (4) The large Scherzer bascule bridges are opened or closed in less than 30 seconds; and a similar Scherzer bridge across Newtown Creek would be operated in the same time. (5) The bridge requires no center supports or piers. It does not encroach upon valuable dock room; and when opened it closes the highway absolutely, thus preventing accidents. (6) It is economical in construction, as it only requires sufficient material to bridge the chasm, and dispenses with expensive towers, ropes, cables and movable counterweights. (7) It forms a very rigid, simple and artistic arched structure, adapted for the heaviest traffic, and wherever it has been tested it has given complete satisfaction. (8) It can be completed to work successfully in less than one year, and during its erection does not interfere with navigation.

I believe that a final decision has not yet been made, and hope that the ultimate decision will be solely upon the merits of the various designs. Yours very truly,

Albert H. Scherzer.

Chicago, Ill., Nov. 23, 1896.

The Topographical Survey of Baltimore.

Sir: In reply to your letter of the 20th inst., regarding the investigation of the topographical survey of the city of Baltimore, I am not surprised that you have been misled as well as others by the reports you have examined, as they contain statements which will not bear analysis.

I cannot make this point clearer than by calling your attention to the report of the survey, published January, 1895, in which you will find illustrations, upon a reduced scale, of property maps, upon which all dimensions are given in feet and decimals, based entirely upon locations of all details by transit observations and steel tape measurements. There exist about 150 such maps in the office and 100 note books containing the records of field measurements from which these maps were drawn, as well as innumerable notes and computations bearing upon the use of these notes in the problems involved in the analysis and adjustment of property and street lines.

There exists no evidence that the telemeter-rod has been used beyond its legitimate and economic use in topographical work, under well-known conditions and limitations, in spite of the assertions of Messrs. Sudler and Donn to the contrary, and the denial in their report of the existence of any such records as I have described.

It needs no expert examination of the published maps to show that they do not contain dimensions and lengths, "in feet and inches," etc., nor of the unpublished maps to show that they do contain the desired information and that they could not have been drawn and the dimensions given from telemeter readings.

The committee chose to disregard the requests made to examine the work as a whole and failed to verify the testimony given by the engineers of the survey, either by their own personal examination of the records and unpublished results, or by bringing this evidence to the attention of witnesses. It consequently lay in the power of this committee, by their presentation of their report to the city council without granting the opportunity which was requested for a defence to be made, and by withholding from examination the report of Messrs. Sudler and Donn, to very seriously influence public opinion, particularly by the publication of the latter report in the press before any of the testimony taken had been examined or officially acted upon by the commission authorized to conduct the topographical survey.

It is impossible for any fair-minded person to regard such reports as unbiased or expert when overwhelming evidence exists in the records of the survey to show that their foundation rests upon falsehood.

Major Hutton, Mr. Tittman and others, being unfamiliar with what had been done, with the problems involved, and with the progress made, and having upon no occasion examined the office work of the survey, were called upon to answer categorical questions, and were not called upon to discuss that section of the ordinance which provides for the publication of the topographical maps, nor the act of the State legislature, which gave the authority for their publication, consequently their testimony carries little weight.

It should be borne in mind that the work proceeded for 2½ years without interruption, with full authority for every step taken, and that complete records of all measurements, notes and drawings exist. In addition, during the current year, appropriations were granted for the continuation of the property work of the survey, designed for tax valuation and other purposes, outlined in the ordinances, including all of those details not carried in the topographical maps.

The latter maps were never intended to have street widths, etc., given upon them, because they were designed for use mainly in the annexed portion of the city, covering an area of 17 sq. miles, over the greater portion of which no streets exist; for the study of street lines and grades and their extension over the entire city, and their publication, before full information could be given on a larger scale of the details of the property work, was a necessary consequence of their requirement for the study of drainage. The charge that these maps are inaccurate and unreliable is untrue in view of their having fulfilled every requirement for which they were designed, and they are as free from mistakes and errors of appreciable magnitude as could possibly be expected with an average of 7,000 locations and elevations per sq. mile.

The investigation was first requested by Colonel Douglas before a board of competent experts, and the consent of the superintendent of the U. S. Coast and Geodetic Survey, the director of the U. S. Geological Survey and the Chief of Engineers of the U. S. Army, was obtained to appoint such a board, if called upon to do so officially, but the opportunity was denied. We have now demanded the right to present our statements before a competent board, and it is no longer our purpose to defend what we know to be right, but to show that the reports made are neither expert nor professional.

This will probably occur in a week or ten days, when a very full exposure of the entire matter will be given by Colonel Douglas, myself and others.

From a technical standpoint quite a number of important questions have arisen in this discussion, notably in the assumption of Mr. Donn that the principles of geodesy had been ignored by the adoption of a central meridian, and the computation of positions by rectangular coordinates with which he has shown his unfamiliarity.

He asserts that the instruments placed at his disposal for field tests were ineffective and not adapted for work of a critical character and also to the contrary that with these instruments we were able to detect errors of plotting as small as the 1-200th part of an inch. He has yet to prove that the graphical errors, which he asserts exist, were not largely of his own making, with one or two exceptions of evident mistakes—and he has not hesitated to assert without positive proof that these graphical errors were due to errors in location measurements of from 1 to 14 ft., and to carry his point has had the assurance to contradict the accuracy of my statements regarding the records of the office.

He asserts that upon the scale of 1-600 or 50 ft. to an inch, 2-10th of a ft. is discernible, or the 1-250th part of an inch, and 1 ft. on a scale of 1-2,400th, or the 1-200th part of an inch. This is not logical, and his argument is hypercritical. I leave it to your readers to decide what is an open question. Taking into account the processes required in drawing a topographical map from field notes, how close can a map be relied upon for scale measurements, allowing a reasonable amount of error to occur in every operation of plotting? Or, in other words, what is the accuracy of the location of a dot?

The errors due to the shrinkage of paper or the effect of the atmosphere, as well as those due to distortion in printing, far outweigh any errors made by the draftsmen in plotting maps. Yours very truly,

Josiah Pierce, Jr.,
Assoc. M. Inst. C. E.

921 Equitable Building, Baltimore, Md., Nov. 23, 1896.

(We have commented upon this letter upon our editorial page.—Ed.)

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Economy of Gas Engines using Gas made from Anthracite Culm.

Sir: I have received a marked copy of your issue of Nov. 12 calling my attention to a garbled extract from a paper recently read by me before the Scranton Board of Trade. The slur you cast at "the inventor" would deter me from giving the article any attention were it not for the request of the Secretary of the Board of Trade by whose solicitation the paper was prepared and read. Aside from some verbal corrections a portion of the extract should be corrected to read, "By actual measurement we produce and store from 118,000 cu. ft. to 120,000 cu. ft. of gas with one ton of fine waste from the washery." The "230 HP." you recognize as probably a misprint for 280."

Your assertion that "it would be interesting to know what kind of gas it is that can be obtained from anthracite culm in such large volume as 140,000 cu. ft. per ton" shows great lack of knowledge for a critic. The chemical analysis as made at the laboratory of the Lackawanna Iron and Steel Co. is:

C. O_2	3.80	C. H_4	0.66
O.	0.40	N.	46.49
C. O.	28.80		
H.	19.85		100.00

I should get about 170,000 cu. ft. of this gas from 2,000 pounds of coal. Notwithstanding many leaks, after washing and cooling I collect in the holder about 140,000 cu. ft. You can verify this by sending an agent to investigate—but, perhaps, if you will consult authorities on this subject you may think is unnecessary.

Mr. H. L. Gantt in "Cassier's Magazine," Nov., 1895, p. 48, tables 2, 3 and 4, give volume of anthracite gas from steam blown producer per 100 lbs. coal, varying from 7,580.15 cu. ft. to 8,114.0 cu. ft.

Mr. W. J. Taylor gives about 170,000 cu. ft. per ton of coal as his experience.

Now as to the allowance of 50 cu. ft. of gas per HP. per hour. There are responsible gas engine builders, who guarantee their engines not to consume more than 17 cu. ft. illuminating gas per HP. per hour. By reference to a long list of tests given in "tables of trials and tests of French and German gas engines, using lighting gas, 1885 to 1895," by Bryan Donkin, London, I find the consumption of gas, including ignition per brake HP. to be from 14.20 cu. ft. to 45 cu. ft. in different engines; 20 cu. ft. per HP. per hour being a fair allowance for average illuminating gas, and eliminating the 46% nitrogen as an inert quantity, in our producer gas, it would seem as if 50 cu. ft. per HP. per hour was a liberal allowance.

Now as to the quantity of culm consumed per HP. per hour. Culm is very pure carbon, the finer it is the freer of slate, and the gas we produce with it is higher in C. O. and H. and lower in N. than that from prepared coal.

The "Dowson gas" has become celebrated in Europe as a cheap power and fuel gas. It is made with anthracite coal or coke, and contains about 55% N. By reference to the table of "Trials and tests of gas engines, using power gas, 1881 to 1895, English, French and German," given by Mr. Donkin, I find that coal consumed per I. HP. per hour was from 0.76 lbs. to 1.45 lbs., and per B. HP. per hour was from 1.02 lbs. to 1.97 lbs. In test made by Prof. H. W. Spangler, of the University of Pennsylvania, and quoted by Mr. Gantt in the article before referred to, the results are stated as follows, viz.:

Coal used per I. HP. per hour............ = 0.9511 lbs.
Coal used per B. HP. per hour.............. = 1.315 "
Combustible per I. HP. per hour.......... = 0.8302 "
Combustible per B. HP. per hour.......... = 1.148 "

The engine was the Otto and the gas analyzed as follows, viz.:

C. O.	25.38	C. O_2	4.02
H.	4.51	N.	64.04
C. H_4	1.79		
O.	0.26		100.00

If you will compare this with the gas we are producing from culm you will not find my statements so very extravagant in the light of what has been before accomplished. In fact I expect to do considerably better, and if you will study up what has been accomplished in this line, you may be less sarcastic in your reference to the "inventor."

I remain, very respectfully,
J. Gardner Sanderson, C. E.,
M. Am. Soc. C. E.

Anthracite Gas Producer Co., Scranton, Pa.,
Nov. 18, 1896.

(Answering the first paragraph of our correspondent's letter, we would disclaim any intention to "cast a slur" at the inventor. It is our constant endeavor in the preparation for publication of notes concerning new inventions, etc., to point out briefly those features in which claims made seem to most need checking and verification. The "garbling" to which reference is made was not done by us. We reprinted the extract as we found it in the Scranton newspapers.

Taking up now the questions raised, it appears from Mr. Sanderson's letter that he makes even a larger claim than we supposed. We computed that he claimed a fuel economy of 0.8 lb. of culm per HP.-hour, on the basis that he allowed 2,240 lbs. to a ton. It appears from his letter above, however, that he referred to a ton of 2,000 lbs. in his estimate of a gas production of 140,000 cu. ft. per ton of culm. Hence we have 140,000 cu. ft. $\div 50 = 2{,}800$ HP.-hours. Then 2,000 lbs. $\div 2{,}800 = 0.714$ lbs. of culm per HP. per hour. If Mr. Sanderson were to reach a product of 170,000 cu. ft. of gas, as he says he ought to do, this remarkable efficiency would be still further reduced, and would become only 0.588 lbs. per HP.-hour.

We must still refuse to believe that so economical a figure for power generation by gas engines is feasible until it is verified by actual tests. The best results obtained by Prof. Spangler, which are cited above, were 0.951 lbs. of fuel per I. HP. The 0.714 lbs. claimed by Mr. Sanderson is 25% better than this.

It seems highly probable that the point in which Mr. Sanderson's estimates are defective is his assumption of 50 cu. ft. of his gas as sufficient for a horse-power hour. He calls this "a liberal allowance." We do not think it is at all liberal. Accepting this analysis of the gas given in his letter, although it is surprisingly high in hydrogen, we have computed its heating value per cubic foot, and find it to be 41.72 calories (=165.6 British thermal units), using the figures given in Butterfield's "Gas Manufacture" for the heating value of the constituent gases. Butterfield gives 37 calories for the heating power of Dowson gas, and 155 calories for London illuminating gas. The average heating value of New York city illuminating gas is 710 heat units (= 179 calories), according to Dr. E. G. Love. The average of these two figures for illuminating gas is 167 calories, or just four times that of Mr. Sanderson's gas. The consumption of illuminating gas per I. HP. being 20 cu. ft., which Mr. Sanderson says is a fair allowance, it would be reasonable, in the absence of direct evidence to the contrary, to say that the consumption of a gas of only one-fourth the heating value would be four times as great or 80 cu. ft., instead of 50 cu. ft., as he assumes. This would raise the consumption of culm per I. HP.-hour from 0.714 to 1.14 lbs. which we should consider reasonable.

Again, taking the above figures of 165.6 B. T. U., as the calorific value per cu. ft. of Mr. Sanderson's gas, we find that 50 cu. ft. would contain 8,280 B. T. U. In the table in Donkin's work of efficiencies of gas engines worked with illuminating gas, to which Mr. Sanderson refers, the British thermal units per I. HP. developed are given for each test, and the average is, we should judge, about 13,000 B. T. U. Still, again, the same authority gives the consumption per I. HP. of Dowson gas as 90 to 100 cu. ft. and over, and its calorific value is not very dissimilar to that which we have computed for Mr. Sanderson's gas.

It will be a surprise to most of our readers to learn that "culm is very pure carbon—the finer it is the freer from slate." We have always supposed the reverse. The late Eckley B. Coxe (Trans. Am. Inst. Mining Engrs., Vol. XIII., p. 706), gave the following percentages of ash in different sizes of anthracite coal shipped from one mine: Egg, 5.66; stove, 10.17, chestnut, 12.67; pea, 14.66; buckwheat, 16.62. In the article on Utilization of Anthracite Culm, published in our issue of Dec. 26, 1895, we gave the value of No. 1 culm as 78% and No. 2 as 70% of the value of egg coal, on the authority of Mr. Wm. McClave, of Scranton. The culm is apt to contain a greater quantity of moisture than the screened sizes and also a greater quantity of dirt. Further, if we are not misinformed, in the culm piles generally the pieces of slate from the breakers are mixed with the fine refuse.—Ed.)

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Notes and Queries.

C. H., Macomb, Ill., asks, "What is the angle or grade of repose of an ordinary four-wheeled wagon on a brick pavement?" It would doubtless vary within wide limits with the condition of the surface as respects mud, dust, smoothness, etc. If any of our readers have made any tests, however, we shall be pleased to print their results.

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HIGH BUILDINGS AND SAFE ELEVATORS.

We have received from a number of the principal makers of elevators, letters discussing the questions raised by the editorial in our last issue, and present herewith such portions of them as are of general interest.

Mr. L. S. Graves, President of the Graves Elevator Co., of Rochester, N. Y., presents what to us is an entirely new reason for limiting the height of buildings in proportion to the width of the streets on which they are built, as follows:

> You speak of the economical value of high buildings, which is probably true, but as a citizen I should say there was another very serious side to this question. If there is no legal limit to the height of buildings in New York or other large cities, how will Broadway (for instance) and the other streets of New York look in 50 or 100 years from now, lined on both sides with buildings twice as high as the width of the streets? But a more serious question is, how will the streets and sidewalks, and transportation facilities take care of the greatly increased number of people which can be accommodated for business and office uses in those high buildings, crowded as they are now, and no chance to increase their capacity. It seems to me curious that the papers have not taken up and discussed this subject before.
>
> I think the heights of buildings should be regulated by the width of streets. London and Paris, as you say, seldom have buildings more than five stories in height, and very few elevators to my knowledge. The tendency in this country is for buildings from 15 to 24 stories in height, but with our elevators and our Americanism, perhaps we could afford to double the height of buildings in the old country. A happy medium, it seems to me, would be from ten to twelve stories high.
>
> With our extremely high buildings, 700 ft. per minute for elevators may not be too high a speed for economy and convenience, but if buildings were limited to 12 stories and the speed of elevators limited to 500 ft. per minute, I think we should be in a much more sensible condition as to the question of safety and the future condition of streets and sidewalks.

The need of broad and unobstructed sidewalks, in an office building district, is already apparent, both in New York and Chicago, and we believe to some degree in the narrow streets of Boston and Philadelphia as well. The great trouble, however, is that the present sidewalks are constantly obstructed. The solution of the problem may, perhaps, be found in adding stories to the sidewalks as well as to the buildings.

A prominent New England elevator manufacturer sends the following discussion respecting elevator safety devices:

> We have read with great interest your article on safe elevators and high buildings, and believe you have reviewed the subject very thoroughly.
>
> There is one suggestion in your article that we think you lay too much stress upon; that is, that every elevator should be furnished with a brake under the control of the operator to suspend the car from the safety devices at every landing. There may be instances in which such an arrangement would be the cause of very serious trouble; especially on elevators where the motive power was other than hydraulic. Suppose a car to be suspended in this way in the downward trip, and for some reason the mechanism would keep on running, there would be nothing to indicate this to the operator in the car, and as he would be obliged to release his safeties before applying his power, the result would be that the moment the safeties were released the car would drop. We might cite several circumstances under which this same difficulty would arise.
>
> We note you refer to the infrequency with which safety appliances are inspected, and on this you touch a vital point. Few safety devices on elevator cars are inspected regularly, and a safety which is not kept in free working order is worse than no safety at all.
>
> Another point which we think you might emphasize is the tendency in elevator construction to increase the amount of mechanism between the operator in the car and the controlling valve of the hydraulic machine. We have, as you know, lever devices, wheels in the cars, and

> even electric buttons, and in each of these cases the mechanism between the operator and hydraulic valve is quite intricate. The simple method of passing a wire cable from the valve, passing directly through the car, and in control of the operator, removes many opportunities for breakages or disarrangement of fine mechanical parts.
>
> Another source of danger which you have failed to touch, and which has caused many accidents, especially on the direct plunger type of elevators, arises in this way: The elevator is built to raise a maximum load of say 2,000 lbs.; on special occasions the elevator may be loaded beyond this point, with the result that the car will fail to ascend, the load in the car overbalancing the pressure on the hydraulic piston. Before ascertaining that the car is overloaded the operator has been obliged to open his hydraulic valve, and quite often will start to lighten his load by asking his passengers to step out of the car without reversing the valve; but as soon as the load comes below the maximum the car will immediately start, and a number of people have been killed by being caught in the act of stepping from the car.

We may best answer the objection raised above by explaining more in detail our suggestion for the safety attachments of an elevator car as follows:

Let safety clutches be arranged to automatically grip the guides either when the elevator reaches a certain speed, or when the rope supporting the car breaks or is slackened. Let either these safety clutches or a separate and independent pair of safety clutches be placed under control of the operator and so interlocked with his operating lever and with the gates, that he must apply these clutches whenever he brings his elevator to a stop before he can let off passengers, and must release them before he can move his operating lever from the stop position.

Now, suppose that at some stop the machinery goes on moving while the elevator car stands at the floor. If the car were on its way down, the suspending rope would slacken. This would at once lock the safety clutches, and the operator, if he attempted to start the car down, would find it impossible to do so, for the safety clutches would be held fast by the slackening of the suspending rope.

On the other hand, suppose the car is on its way up. It stops at a floor, and while it stands there by some accident the machinery starts up again; but the operator's safety clutches being locked fast the machine is stalled, and the car cannot start until the passengers are on and the operator releases the safety clutches.

It may be remarked here that the most fruitful cause of accidents in connection with elevators is not failure or defects of the apparatus by any means, but carelessness on the part of the operators. There is a constant tendency to hurry-up things in the average office building elevator service, and there is always a certain amount of risk that a green or nervous operator will start his car a little too soon and catch a passenger in the door.

Every owner of a building in which an elevator is operated is liable to damage suits from accidents of this sort, and every elevator manufacturer has to subject his reputation to a certain extent to risks of this class. The value of a mechanical check to prevent such accidents ought to be clear.

We may note that the very class of accidents referred to in the last paragraph of the letter above would be prevented by the apparatus we have suggested. An operator with an overloaded car would be obliged to move his lever to the stop position and apply his safety clutches before he could open the gate to let passengers off.

The Crane Elevator Co. of Chicago writes us as follows:

> Agreeing with you thoroughly as to the comfort, convenience and business necessity of the high office building, we may as well also agree that that type of building has come to stay. It would seem to us, from what we have heard of it, that this accident at the American Tract Society Building occurred primarily from there not being a sufficiently large factor of safety in that part of the elevator equipment which gave way. What should and must be thoroughly understood by elevator builders is that it is far more necessary to exceed in strength in every part of the elevator plant than by safety devices to guard against possible weaknesses. While it is true that the latter duty should be deeply and thoroughly considered, still that is secondary to the first duty of providing a very large factor of safety. First, decide what that factor of safety will be, erring if anything on the side of extreme precaution, then make the most thorough and rigid tests of the entire plant, in position, to such an extent as will be far beyond anything that we know it is possible to put upon the plant in actual service. After this is done every means may be considered of avoiding unforeseen accidents or latent defects which have not shown up in tests.
>
> While the height of a building has nothing to do with the safety of its elevator, yet it must always be borne in mind that the farther you fall the harder you hit, and that in extremely high buildings the requirements of the elevator service are much more exacting than in the ordinary six to ten-story building. In providing against all possible weakness in elevator service, the same rule prevails as in all other lines of manufacturing business, namely, that long experience is an absolute necessity for arriving at the best results. This is emphasized strongly by the very accident that has called forth your editorial. In this case a manufacturer of long experience, admirable equipment, engineering talent, and every facility for giving first-class work, is yet confronted with an accident which evidently had not been provided against. In considering the matter of safety in elevators, it must be remembered that accidents involving the risk of loss of life or actual injury to passengers are extremely rare on first-class elevators, when the enormous travel in this line is taken into consideration; indeed, it is probable that a hundred times more people are killed by falling down stairs than by falling with elevators, and the scarcity of such accidents cannot but reflect credit on those manufacturers who have for so many years supplied the public with this class of machinery.
>
> We agree with you that the statement that the cause of the accident at the American Tract Society was the high pressure upon the system, is not correct. A high pressure, such as was sustained at this building (about 900 lbs.) is as perfectly safe as the ordinary pressure of say 125 lbs. All that is requisite is that the proper factor of safety should enter into every detail of the construction of the plant, and then there is not one particle more danger in the 900 lbs. pressure than there is in the 125 lbs. We think you are correct in ascribing the cause of such an accident as the one under discussion largely to the severe requirements as regards speed which are now imposed upon elevator builders, by architects and owners of these high office buildings. We think you are in error, however, in one or two points on this particular subject. A speed, such as that you mention, of 700 ft. per minute, is not absolutely requisite for first-class elevator service in office buildings even of 16 to 25 stories, except on elevators which are used as "express" elevators; that is to say, running from the first to the eighth or tenth story without stop. During this through run the speed of 700 ft. per minute, or even more, may be desirable or may be attained without any inconvenience or risk; but when stops are made at every floor, say every 12 ft. or so, a speed exceeding 500 ft. per minute is unnecessary, undesirable, and practically impossible; that is to say, if between the throwing a lever on the "up" and the centering of that lever for a "stop" a speed of 700 ft. per minute had been attained in 12 ft., the stop cannot be nearly as good as if the speed were only 500 ft. per minute, and consequently the results, so far as time is concerned, are not as good as if the lower rate of speed were adhered to.
>
> As regards safeties, few or none of the modern elevator builders construct an elevator without an automatic safety device which is intended to be thrown in when the car attains an excessive speed. The trouble, as you rightly say, is that elevator builders are now required to construct their work so that the cars will come down, even with light loads, at such a high rate of speed that the safeties must be set to throw in at such a rate of travel that passengers may be injured by the descent of a car less quickly than the figure at which the safeties are set to act. At 200 ft. normal speed the safeties will generally be set to throw in at about 400 ft. per minute, and at 500 ft. normal speed at about 800 ft. per minute. It can readily be seen then that in the case of such an accident as has happened at the Tract Society Building, if the normal speed were 500 ft. the car might come down at a speed of 700 ft. per minute without throwing the safeties, although we know that the landing of the passengers at the bottom of the shaft at such a rate of speed as this involves an absolutely serious risk. There is no good reason, as you say, why a device should not be put in the elevator car which would enable the operator to throw the safeties in and hold the car at any point in the hatchway. It must be remembered, however, that such a device would only be good if the operator preserved his coolness and presence of mind, still it is a step in the right direction, and will undoubtedly be used in connection with the high speed elevators which have necessitated it. Another element of safety which should always be present, is that every elevator plant should be in charge of a first-class engineer thoroughly competent and versed in the proper methods of caring for elevator machinery. Too often owners of buildings seem to think that elevator machinery and its care needs no skilful attention, and they are willing to entrust one of the most vital points of their building, and one on which the lives of their tenants and others are trusted every day, to the care of a man who has not the capacity or experience necessary for such a task.
>
> In conclusion, we can but reiterate that the main elements in a safe elevator service are:
>
> First, a very large factor of safety. Second, the testing of all the machinery in place rigorously and carefully. Third, the providing of every approved device against unforeseen accidents; and lastly, a most intelligent and careful maintenance of the entire plant in every particular.

In our last week's issue we referred to the fall of an elevator in the Manufactures Building at Chicago in 1893. Fuller details of this accident are sent us by a correspondent as follows:

> Sir: In your issue of Nov. 26 you mention the accident which happened to one of the elevators in the Manufactures Building at the Columbian Exposition. As I happened to see the car drop, I will give an account of it.
>
> The accident happened on the night of Oct. 21, 1893, to one of a group of four electric elevators (not hydraulic elevators, as you say). Without any warning, one of the outside cars, which had just started to go down, filled with passengers, began to drop with a series of lurches in its descent, and was finally stopped by becoming jammed between the guide posts, about 60 ft. from the ground. The outside guide post was a stick of timber about 12 ins. square, which was forced out of line by the automatic clutches under the car. This allowed the car to list to one side and become jammed between the guides. The timber broke when the car came to a stop. Fortunately, it did not give way entirely, but held the car in its distorted position until a fire company brought ladders and released the passengers from their perilous position. If the guide post had broken, so as to allow the car to drop entirely out of its guides, every one in the car would have been killed. The lesson is a valuable one, as the lack of rigidity in the guide posts is a defect which can be seen in some of our modern elevators.
>
> Yours truly,
>
> J. W. Schaub, M. Am. Soc. C. E.,
> Chief Engineer and Manager Hamilton Bridge Works.
> Hamilton, Canada, Nov. 30, 1896.

Besides the above correspondence, several elevator builders have favored us with their opinions in personal interviews. One of these gentlemen makes some interesting comments upon the city inspection of elevators. He says that this official inspection is, as a rule, either a farce or a piece of blackmail. The inspectors are not expert elevator mechanics, and as a result their investigation is superficial and of no account. The "defects" which they find are, as a rule, not real defects at all; but are either trivial things of no importance, or else they condemn parts of the machinery which are actually in perfect condition. The cases taken to court are, in practically every case, instances where the long-suffering owner refuses to submit to downright imposition or blackmail, and prefers to fight the case in court. It will be readily understood that most owners will prefer to submit to a good deal of loss rather than go to law, for the mere fact that fault had been found with an elevator, justly or unjustly, which is made public by an action at law, would be sufficient to prejudice tenants against a building.

On the other hand the systematic inspection of elevators which is made by elevator builders and by companies insuring against elevator accidents, is exceedingly valuable. These companies employ elevator constructors of thorough experience, and as they have a financial interest at stake, careful and intelligent work is assured.

It will be remembered that in our editorial last week, we ourselves pointed out that to rely on a municipal inspection for safety was leaning on a broken reed. The above opinions lend additional force to what we then said. Whether the charges made are true or not, it is clear enough that under political conditions which may at any time obtain in any city, they may become true. It may indeed be that a certain amount of municipal inspection is a necessity to check dangers in the cheapest class of buildings, where a cheap elevator is put in charge of a cheap engineer and is left to take care of itself; but as we recently said with respect to municipal building inspection, we hold it to be a mistake to so greatly magnify this work, that owners and builders will begin to rely on such inspection instead of on the watchfulness of their own architects and engineers for good and safe construction.

METHOD OF DETERMINING THE WORK DONE DAILY BY A REFRIGERATING PLANT AND ITS COST.*

By Francis H. Boyer, M. Am. Soc. M. E.**

The refrigerating plant in the Abattoir of John P Squire & Co., East Cambridge, Mass., was installed by the De La Vergne Refrigerating Machine Co., during the winter and spring of 1890 and 1891. It is composed of two machines rated by the builders as 150 tons ice-melting capacity each daily or a combined capacity of 300 tons, this to be accomplished by running 24 hours daily with a return pressure of 26 lbs. above atmosphere, a condition of 40.7 lbs. pressure absolute, running at 40 revs. per minute. The size of the gas compressing cylinders were 16 ins. in diameter and 32 ins. stroke, being double acting, four gas cylinders all told.

The condition and amount of work being done is indicated by the back or return pressure of the gas—this condition being maintained by the speed of the gas pump—the engines being directly connected and constructed to allow of a variation of speed from 15 to 75 or more revs. per minute.

It became desirable to establish a method to obtain the amount of work accomplished daily in order to arrive at the expense of operation, and to make comparison with results of other departments of the abattoir. By taking the cubic displacement of the compressors with a given amount of return pressure the amount was obtained easily.

The accompanying table is a copy of the Engineer's log for July 18, 1896:

ENGINEER'S DAILY REPORT.

JOHN P. SQUIRE & CO. CORP., East Cambridge, Mass. Department 24. Date, *July* 18, 1896.

	Engine Room.									Refrigerator Temperatures.																Beef House.				Water Condenser.			Weather.		Remarks.
	D. P.	R. P.	Revolutions.				Salt Water Column.	Steam.	Vacuum.	1	2	3	Ham Room.	4	Rib Room.	Hanging Room.				6	7	Steam Lard.	Leaf Lard.	Oil Room.	Oil Cellar.	1	2	3	4	I	C.	F.	Temp.	Conditions.	
			No. 1.	No. 2.	No. 3.	No. 4.										1	2	3	4																
7 A.M.	165	13	45	45	..	..	110	80	24¼	41	41	41	33	39	33	38	36	33	33	42	38	51	47	..	42	39	35	33	33	67	76	102	68	Clear.	Turn gas on water tank 8 A.M.—*G. M. D.*
8 "	170	13	45	45	..	..	100	80	24	..	..	..	....	..	..	39	36	34	33	..	..	..	..	..	..	..	..	..	..	67	77	105	70	......	
9 "	170	13	45	45	..	..	100	80	24	42	42	41	33	40	35	39	36	35	33	43	38	53	49	..	43	40	35	35	33	67	77	108	70	......	
10 "	170	14	45	45	..	..	100	80	24	..	..	..	....	..	..	39	36	36	33	..	..	..	..	..	..	..	..	..	..	67	77	116	78	......	Keep ham room normal.—*J. Crowley.*
11 "	180	14	45	45	..	..	95	75	24	..	..	..	....	..	..	40	36	36	34	..	..	..	..	..	..	..	..	..	..	71	77	115	78	......	
12 "	180	15	45	45	..	80	95	80	23¼	42	42	41	35	40	35	42	87	36	36	43	38	54	49	..	43	38	35	35	33	72	77	115	76	......	No. 3 room closed blower on temperature 48 degrees.
1 P.M.	180	15	45	45	..	..	95	80	23	..	..	..	....	..	..	42	37	36	26	..	..	..	..	..	..	..	..	..	..	73	77	114	75	......	
2 "	180	15	45	45	..	..	95	80	24	..	..	..	....	..	..	42	37	36	36	..	..	..	..	..	..	..	..	..	..	71	78	114	75	......	Fire alarm test O.K. 8.30 A.M.
3 "	180	15	45	45	..	..	95	80	24	42	42	41	36	40	37	42	37	36	36	43	38	54	49	..	43	36	34	34	33	72	79	117	73	......	" " " " 12 noon.
4 "	180	14	45	45	..	..	95	80	24	..	..	..	....	..	..	40	37	36	36	..	..	..	..	..	..	..	..	..	..	70	81	121	72	......	Fire box 21 Somerville alarm 8.30 A.M., and out 8.45 A.M.
5 "	175	13	45	45	..	..	95	80	24	..	..	..	....	..	..	40	36	36	36	..	..	..	..	..	..	..	..	..	..	68	80	115	72	......	
6 "	175	13	45	45	..	..	95	80	24¼	42	42	42	34	40	36	39	36	36	36	43	38	55	51	..	44	36	34	31	34	67	78	112	72	......	(Signed) JAMES HIGGINS, *Engineer.*
7 "	170	12	45	45	..	..	100	80	25	..	..	..	....	..	..	39	36	36	37	..	..	..	..	..	..	..	..	..	..	67	78	113	71	......	
8 "	170	11	45	45	..	80	100	80	25	..	..	..	....	..	..	39	36	36	37	..	..	..	..	..	..	..	..	..	..	67	78	114	69	......	Start both coils in rib room Sunday 12 P.M.—*W. Lincoln.*
9 "	165	10	45	45	..	80	95	80	25	..	..	..	....	..	..	39	36	36	37	..	..	..	..	..	..	..	..	..	..	67	78	115	68	......	
10 "	165	10	36	36	..	80	95	80	25	41	41	42	34	40	36	38	36	36	37	42	38	54	50	..	43	34	34	33	33	67	78	114	67	......	
11 "	165	10	36	36	..	80	95	80	25	..	..	..	....	..	..	38	35	35	36	..	..	..	..	..	..	..	..	..	..	68	78	115	66	......	
12 "	170	9	36	36	..	80	95	80	25	..	..	..	....	..	..	38	35	35	36	..	..	..	..	..	..	..	..	..	..	69	79	114	65	......	
1 A.M.	170	9	36	36	..	80	95	80	25	..	..	..	....	..	..	37	35	35	36	..	..	..	..	..	..	..	..	..	..	70	79	113	64	......	
2 "	170	11	36	36	..	80	95	80	25	42	42	42	34	40	36	37	35	35	35	42	38	50	46	..	43	34	32	32	32	70	80	118	62	......	
3 "	170	12	36	36	..	80	95	80	25	..	..	..	....	..	..	36	34	34	34	..	..	..	..	..	..	..	..	..	..	70	80	117	61	......	
4 "	165	12	36	36	..	80	90	80	25	..	..	..	..	..	..	36	34	34	34	..	..	..	..	..	..	..	..	..	..	69	79	116	60	......	
5 "	165	13	36	36	..	80	90	80	25	..	..	..	....	..	..	36	34	34	34	..	..	..	..	..	..	..	..	..	..	69	78	117	59	......	(Signed) PAT FOLEY, *Engineer.*
6 "	165	13	36	36	..	.	95	80	25	..	..	..	....	..	..	35	34	34	34	..	..	..	..	..	..	..	..	..	..	68	78	116	63	......	

Engines Hours Run.				Boilers Hours Run.				Coal Receipts.	Daily Tons Refrigeration.	Salt Water Counter.		Gallons to date.
No. 1.	27,339	24	27,363	No. 1.	25,778		25,778	Pocahontas.	$\frac{48}{24} \times \frac{40\frac{6}{10}}{40} \times \frac{12\frac{4}{10}}{26} \times \frac{150}{1} = 145\frac{2}{10}$ tons.	No. 1.	603,484	1,357,600 } to-day.
" 2.	27,935	24	27,959	" 2.	21,739	24	21,763	9,110 pounds.		" 2.	237,642	964,300 }
" 3.				" 3.	21,644	24	21,668	9,480 "				2,321,900 "
" 4.	9,593	10	9,603	" 4.	21,269		21,269	9,800 "				32,634,300 to date for July.
" 5.	1,068		1,068	" 5.	24,024	24	24,048	8,490 "				34,956,200 total for 18 days in July.
				" 6.	22,542	24	22,542					
				" 7.	16,044	24	16,648	36,880 pounds.				
				" 8.	23,523		23,523					

"P. D." indicates direct pressure or pressure at which the ammonia gas is being liquefied.

"R. P." indicates return or suction pressure—all pressures starting at atmosphere.

Engines Nos. 1 and 2 are refrigerating engines. Engine No. 4 is a 200 HP. electric light engine. Engine No. 5 is an air compressor for testing car-brakes.

"Salt-water column" is expressed in feet of hydrostatic pressure. It is pumped 1,800 ft. through a 12-in. cast-iron pipe, steam being conducted under the ground. Water is taken from the bay, and is therefore salt water. The water is first used to condense ammonia, and finally to condense the steam in a Wheeler 1,000 HP. surface condenser.

In "Water Condenser" columns, "I" is initial temperature to ammonia condensers; "C" is temperature of water on entering steam condenser; "F" is final temperature of water leaving steam condenser.

"Engine Hours run" indicate the number of hours the engine has run from the time they started. This I find quite an important item as engine drivers are apt to become prejudiced against one or the other engine where one engine remains idle, as it does in this case during the cold winter days.

"Remarks" come in shape of instructions from Department Superintendents—test and fire alarms.

The engine had run from 7 a. m. to 10 p. m. at 45 revs. per minute, during which time between 2,000 and 3,000 hogs had been slaughtered and placed in the "hanging-rooms" for cooling, which has a floor space of about one acre, or to be exact 42,240 sq. ft. Rooms No. 1-2-3-4-6 and 7 have the same floor area. The temperature of the hanging-room increased from 38° to 33° at 7 a. m. to 42°—36° F. at 2 p. m. At this time the most severe work was being done by the machinery. This is shown by the return pressure of the gas being at 15 lbs., and the direct pressure at 180 lbs. per sq. in. As the temperature in the hanging-room decreases so does the work on the engines. Reference will be made only to the hanging-room, as there is where most of the work comes from. Rooms No. 1-2-3-4-6 and 7 are used for curing and storage purposes, and work coming from there comes from heat radiating from workmen, from lights, from decomposition in process of curing, and from imperfect insulation. From the last source there is but little trouble as the building has few windows, no hallway or elevators, no communication between floors, and brick walls 48 ins. thick.

As the coils circulating the ammonia becomes cold, and the unexpanded liquid returns to the engine, the attendant reduces the supply. This first makes its appearance from 7 to 9 o'clock p. m., and at 10 p. m. the volume of return pressure of gas has become so low that the attendant has slowed down the machines from 45 to 36 revs. per minute, and at this condition the work is kept up until 7 a. m. the following morning. At 2 a. m. there is an increase of a return pressure, which continues until 7 a. m.; this is caused by a gang of about 100 workmen beginning at 1 a. m.

A little story is told in the Water Condenser column in the initial column marked "I."

At 7.00 a. m.	the temperature	was	....	67 degrees.
" 1.00 p. m.	"	"	....	73 "
" 8.00 p. m.	"	"	....	67 "
" 2.00 a. m.	"	"	....	70 "
" 6.00 a. m.	"	"	....	67 "

This is due to the condition of the tides, the coldest water coming at high water and warm at low water. Here we find that our thermometer gives us a correct reading of conditions of the tides, clearly defining high and low water.

The object of this paper, which is to ascertain the amount of work done daily under these varying conditions under the heading of "Daily Tons of Refrigeration" is the following:

$$\frac{48}{24} \times \frac{40.6}{40} \times \frac{12.4}{26} \times \frac{150}{1} = 145.2 \text{ tons},$$

$\frac{48}{24}$ being the number of hours which the engines have done service.

40.6 is the average number of revolutions for the day, 40 being a fixed number of revolutions necessary to establish a given result of effort.

12.4 is the average return pressure of the gas from the refrigerator.

Twenty-six lbs. per sq. in. is the fixed pressure for a given result, 150 being the rated capacity of the machines when the fixed conditions are maintained, or we should have as a fixed formula:

Hours. Revolutions. Return Pressure. Tons Refrigerating.

$$\frac{\quad}{24} \times \frac{\quad}{40} \times \frac{\quad}{26} \times \frac{150}{1}$$

Average varying being daily entered.

To prove the statement is an easy matter by taking the weight of the condensing water from the ammonia condensers, also the oil cooler, and multiplying by the heat units will establish the amount of heat being given. I will not attempt to go into detail, as this is already on record in the Society Transactions, in the able paper on "Refrigerating Machinery," by Professor Denton, Vol. X., p. 792.

In determining the cost of operating, several tests had been made on the boiler and engine plant, which showed an average of 10.4 lbs. of water vaporized per pound of coal consumed, Pocahontas coal from Virginia being used, and with an efficiency of 16.44 lbs. of steam per hour per HP., or 1.56 lbs. of coal per hour per HP. From this data is established the amount to be charged to electric light and car department for the air compressor for testing air-brakes.

The total amount of expense for operating is taken monthly from the store-room accounts; from the year 1894 we have the following:

Tons of refrigerating produced	48,466½
Cost of maintaining refrigerating department, including annual repairs	$28,471.03
Average cost per ton for refrigeration for 1894.	58.7 cts.

An interesting feature of the monthly production and cost per ton of refrigerating is shown as follows:

1894.	Tons.	Cost per ton.
January	1,816	85 cents.
February	1,423	86 "
March	1,538.3	33 "
April	2,821.7	73 "
May	4,747.3	46 "
June	5,491.7	38 "
July	6,736.4	31 "
August	7,596.6	27 "
September	6,283.4	24 "
October	5,419.5	52 "
November	2,647.5	78 "
December	1,945.1	82 "

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*A paper presented at the New York meeting of the American Society of Mechanical Engineers.

**Chief Engineer, John P. Squire & Co., East Cambridge, Mass.

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ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The annual meeting of the American Society of Mechanical Engineers, which is being held at its house in New York city this week, promises to be the largest meeting ever held by the society. Over 300 members and guests were registered before the close of the first session on Tuesday evening, and the list was enlarged by Wednesday noon to 394. One of the features of the meetings of this society, which contributes largely to facilitating the making of acquaintances, is the wearing by each member and guest of a badge with a number in figures, which may easily be read a few feet distant, and the printing once or twice a day of the complete members registered with the badge number adjacent to each name. This system is especially valuable to those who have an imperfect memory of names and faces.

The opening session on Tuesday evening consisted first of an informal gathering of the members and guests, among whom were many ladies, in the rooms, both up and down stairs, which lasted till 9 p. m., when those who could find seating or standing room crowded into the auditorium to listen to the address of the retiring president, Mr. John Fritz. We postpone the publication of this to our next issue.

It is not the usual custom to discuss the address of the president, but Lieut. W. H. Jacques, U. S. N., who is a member of the society, made a brief response, in which he told something of the history of the beginning of armor plate and heavy gun forgings in this country, and of the work of the Naval Advisory Board of which he was a member, which led to the starting of the new manufacture at the Bethlehem Steel Works. He was followed by Mr. Andrew Carnegie, who, in a most happy speech, paid tribute to Mr. Fritz and to the other metallurgical and mechanical engineers who had done so much for the iron and steel industries. Historical reminiscences of the steel men being in order, Messrs. Robert W. Hunt and Robert Forsyth were called on to speak on behalf of the Bessemer steel manufacture, and Mr. Samuel T. Wellman on the open-hearth process. After the speechmaking, the informal reception was continued, and lasted till midnight.

On Wednesday morning, the session began with formal business, consisting of reading of the reports of the council, of the tellers of election, and of the chairmen of several committees.

The Report of the Council.

The report of the council opened with a tribute to the late Mr. J. F. Holloway, Past-President of the Society. The membership of the society is now 1,762, of which 104 are Associate Members, 300 Junior Members and 16 Honorary Members. The society has been officially represented upon the commission for revising the New York Building laws by Messrs. Henry R. Towne, C. W. Hunt and S. W. Baldwin. A delegate to the National Conference on Standard Electrical Rules was appointed in the person of Mr. C. J. H. Woodbury. The council presented a memorial to Congress respecting the position of the naval engineers; but refused a request that the influence of the society be excited in favor of the bills proposing the wholesale establishment of engineering experiment stations. The council has appointed Messrs. Coleman Sellers, John E. Sweet, Chas. T. Porter, Geo. M. Bond and Coleman Sellers, Jr., a committee to prepare material to be used in opposition to proposed Congressional legislation to make the metric system compulsory. Invitations were received from Nashville and Milwaukee, urging that those cities be selected for holding the spring meeting of 1897, but the council has practically fixed on Hartford, Conn., for this meeting. The tellers reported the result of the election of officers for the ensuing year as follows:

President, Worcester R. Warner, Cleveland; Vice-Presidents, Edwin S. Cramp, S. T. Wellman, W. F. Durfee; Treasurer, Wm. H. Wiley; Managers, H. S. Haines, G. C. Herring, A. W. Robinson. A letter from the secretary of the American Association of Steel Manufacturers was read, informing the society that the association had adopted the "Decimal Gage" for measuring materials. This is the system of measuring sizes such as thickness of sheets and plates, and diameters of wires, rods, etc., in thousandths of an inch instead of by the ancient wire and sheet metal gages.

Reports of progress were read by the chairmen of committees on a standard method of testing boilers, and on standard methods of testing materials of construction. The business meeting being concluded, the presentation and discussion of professional papers was then begun. Under the admirable rules of the society all of these papers were printed and distributed in advance to those members who signified their intention to attend the meeting, so that those who wished had ample time to study them and prepare written discussions. The first paper was one by Sir Henry Bessemer, honorary member of the society, entitled "History and Technical Sketch of the Origin of the Bessemer Process." It was read in abstract by Prof. R. H. Thurston. This paper we present in full in this issue, and comment on it in our editorial columns. Mr. Wm. F. Durfee, who is the only surviving representative of the owners of the Kelly process patent of 1857, read a discussion of the paper in which he pointed out the relations of Kelly and Mushet to the Bessemer process. He was followed by Mr. Allan Stirling, who read an encomium upon Mr. Bessemer and upon the value of his services to the world. Mr. Robert W. Hunt and Mr. William Kent continued the discussion, both expressing their regrets that Mr. Bessemer had not seen fit to give due credit to the other inventors of the process which bears his name.

"Ancient Pompeiian Boilers" was the subject of the next paper. It was presented by Mr. W. T. Bonner, and illustrates and describes some bronze relics of Pompeii which are preserved in the National Museum at Naples. They are vessels for heating water, and show a remarkable analogy to the water-leg, water-grate, and water-tube boilers of to-day. The grate bars are tubes made from sheet bronze, rolled, and soldered or brazed. They open at both ends into the bottom of the water jacket, thus forming water-tubes through which traversed the water as it circulated in the boiler. "Method of Determining the Work Done Daily by a Refrigerating Plant and its Cost," by Francis H. Boyer, was the next paper. This paper we print in full in this issue. "The Promise and Potency of High Pressure Steam," by Prof. R. H. Thurston, of Cornell University, was then presented by its author. We shall print an abstract of the paper at an early date.

Wednesday afternoon was left free to the members, without any formal session. Invitations were received from many industrial establishments and other places of interest, and parties were formed for visiting these, while others of the members remained in the rooms and attended a meeting in honor of the memory of the late J. T. Holloway, past president of the society, at which addresses were made by some of his numerous friends.

The remainder of the report of the meeting will be given in next week's issue.

THE NEW ENGLISH MOTOR-CAR REGULATIONS.

The Local Government Board has issued to the County Councils and certain other local authorities of England and Wales, regulations with respect to the use of light locomotives on highways, their construction and the condition under which they can be used. These regulations went into effect on Nov. 14, 1896, and are practically as follows:

The expression "light locomotive," means a vehicle propelled by mechanical power, which is under 3 tons in weight unloaded, and it can only draw one other vehicle, with a weight for both not exceeding 4 tons, unloaded. The locomotive must be so built as not to emit smoke or visible vapor, except from temporary or accidental cause. The conditions imposed for a locomotive, exceeding 5 cwt. in weight, are that it shall be capable of traveling backward or forward; that it shall not exceed 6½ ft. in extreme width; that the tire shall be smooth, and 2½ ins. wide, up to 1 ton in weight of vehicle; 3 ins. wide for a locomotive weighing between 1 and 2 tons, and not less than 4 ins. for any weight exceeding 2 tons. In case a pneumatic or other soft and elastic tire is used, it may be rounded and provided with bosses or projections of the same soft material as is used in the tire. In this case the width of tire is measured when the tire is not under pressure.

The light locomotive must have two independent and efficient brakes; and the vehicle must be so constructed as to be always under control without causing undue interference with ordinary traffic. The weight of a light locomotive exceeding 1½ tons, and of a car hauled, must be conspicuously painted on such vehicles; the weight, not including that of the water, fuel or accumulators used. The name of the owner and the place of his abode or business must also be similarly displayed in letters not less than 1 in. high.

The person in charge must be competent to control and direct its movements, and lights must be lit between sunset and sunrise, with a red lamp in front and a white light in the rear. This latter regulation does not apply to any bicycle or trycicle provided for under the act of 1888. The maximum speed permitted is 12 miles per hour. If the light locomotive weighs between 1½ and 2 tons, the speed is limited to 8 miles per hour, and to 5 miles if the weight exceeds 2 tons. If any light locomotive is used on any highway to draw another vehicle the maximum speed is 6 miles per hour.

Various other minor regulations follow. The Secretary of the Local Government Board calls attention to the fact that light locomotives which are carriages or hackney carriages, under the definition of the Inland Revenue Act of 1888, must pay an additional excise duty at the following rate: £2 2s. if the weight exceeds 1 ton but is under 2 tons, unladen; and £3 3s. if the weight exceeds 2 tons.

PURIFICATION OF THE SEWAGE OF WATERbury, Conn., is recommended in a report just made by Mr. Rudolph Hering, M. Am. Soc. C. E. Two plans are reported as feasible: Intermittent filtration on 100 acres of land, nine miles from the city, or combined chemical precipitation and filtration, using for the latter 33 acres of land 1.4 miles distant. In either case a 40-in. outlet sewer would be required for an estimated daily flow of 17,000,000 gallons. This allows about 85 gallons of sewage per day for 75,000 people, together with a considerable amount of surface water. The filtration plans calls for a present outlay of $609,730 and yearly charges of $28,489; a final outlay of $767,580 and yearly charges of $40,000; the average yearly charges being $34,246. The combined precipitation and filtration plan could be carried out for an initial outlay of only $138,380, and at an ultimate cost of $336,270; the yearly charges would range from $21,335 at the outset to $59,569 at the finish, with an average of $40,452. The low first cost of construction and operation under the second plan is due to the possibility of entirely omitting filtration for a time.

A 59-STORY BUILDING was announced to be under contemplation by the New York "Evening World" of Nov. 27. This veracious sheet went so far as to publish an elevation and plan of the structure, and stated that "the plans have been prepared by the firm of Chadwick & Wilbert, of the Bennett Building." A visit of a member of the staff of Engineering News to the Bennett Building showed that no such firm had offices there, and their names do not appear in the city directory. The description in "The World" stated that the building was to have seven sub-cellars; the outside was to be "of sheet-iron sheathed with brownstone," and the interior "furnished in Italian marble and brass." This charming structure was to be located at the corner of Tenth Ave. and 25th St., a locality where even an ordinary skyscraper would be absurd from the investors' point of view. We feel like begging our readers' pardon for paying any attention to this fake story in our columns, but we are aware that in many parts of the country, where "the new journalism" is not yet fully understood, people sometimes believe such newspaper fictions as the above.

A WATERFALL 1,600 FT. HIGH is reported as having been found in Venezuela by Mr. Donald Grant, of the Orinoco Company. A letter written from Santa Catalina, Venezuela, by S. A. Thompson, C. E., of Duluth, says that during the explorations of a concession to this company, in the Imataca Mountains, a large river was discovered cutting diagonally through an almost perpendicular cliff, estimated as being 1,600 ft. high. The water breaks into a dozen different streams, and spreads out in "fanlike expansions." This is at least interesting—if true.

WAR ON BRITISH DREDGES has been declared by some of the leading dredging companies of the United States. These companies have filed protests at Washington against permitting dredges from Canada working upon the government contract in Delaware River and Bay. The dredge lately towed from Montreal has been seized by the Philadelphia custom officials for violating the customs laws of the United States. Other dredges are on their way from Canada. A transfer to American owners is now being examined by the authorities, the new owners claiming that they thus have the right to use the plant in American waters. At the bottom of this trouble lies a row between rival American dredging companies and contractors for dredging.

AN AMERICAN PAPER-MAKING MACHINE is to be set up in the "Daily Chronicle" paper mill, at Sittingbourne, England. The machine is furnished with all the latest improvements and is said to be the first paper machine ever sent to England.

THE TOTAL JAPANESE RAILWAY MILEAGE, on March 1, 1896, was 2,290 miles, says Consul Uchida. At the same time 1,368 miles more were under construction and charters have been applied for covering an additional 655 miles. A ship-canal, from Osaka, across to the west coast of the island, is also under discussion. The actual cutting would be about 22 miles, and the river Uji and 9 miles of Lake Biwa would be included in the route. The Japan Mail Steamship Company, which recently opened a line to Seattle, has established a monthly service between Yokohama and Sidney and other Australian ports, and another Australian line is projected. The annual report of the Japanese Bureau of Merchant Marine shows that Japan has registered for foreign trade 109 iron and steel steamships, of 231,139 gross tons. Since 1890 twenty shipyards have been established in Japan, and 40 were started in the previous decade. The stone dry-dock at Nagasaki is 438 ft. long and 26 ft. deep. The Japanese subsidy law, which went into effect last October, gives shipbuilders a bounty of $10 per gross ton on steel vessels over 1,000 tons, and grants also $2.50 per horse-power.

THE CHINESE-RUSSIAN TREATY, reported as lately confirmed, grants important railway and other concessions to Russia, permitting that government to build its Trans-Siberian railway across Chinese territory, in Manchuria; to guard the railway with troops; to build other railways for China, terminating at Port Arthur, and to mine and transact other business. The representatives of other nations are inclined to publicly minimize the import of these concessions. Some of the lines of railways referred to will not be completed for two years, and others are only projected. They say that while the treaty gives Russia power to station troops in Chinese territory, it is not believed that this will be done except in urgent cases as such action would be regarded by other powers as a dangerous menace to their interests. But the same powers practically admit that Russia now politically dominates all China; though they say that England still holds the commercial supremacy.

GOVERNMENT CONTROL OF RAILWAYS has been mainly unsuccessful from an economic point of view in South America, and it is said that the Brazilian Congress will lease the Brazilian Central Ry. (operating 500 miles) to a foreign syndicate, the price being $90,000,000 for a 90-year lease. Under the imperial government this line was styled the Don Pedro Segundo Ry. It is charged that employment on the road has been given as a reward for political activity, the partisans of one party succeeding each other with the various changes of administration. In many cases the salaries were largely disproportionate to the character of the service performed, while in nearly every case except where experts were employed the appointees were unfit for their places. The debates in the Congress, which disclosed these facts, also showed conclusively that the road, instead of being a paying investment, is steadily losing money at the rate of $2,000,000 a year.

THE PACIFIC CABLE BILL, advocated by the Pacific Cable Company, is to be pushed in the next Congress. This bill would authorize the Postmaster General to contract to pay $100,000 per year for 20 years, for the construction and operation of an electric submarine cable connecting San Francisco and Honolulu, and such places on the coasts of Japan and China as the company may select, with the approval of this government. The company is to deposit $100,000 in U. S. bonds, to be forfeited in case of nonfulfilment of contract. This contract would require the company to complete the line to Honolulu before Jan. 1, 1898, so that it be capable of transmitting not less than 15 words per minute; within one year thereafter the line to China and Japan must be built. The company may establish landing stations on the Midway Islands, between Hawaii and Japan, and belonging to the United States. U. S. government messages are to be transmitted free forever and to have preference, and the rate for ordinary messages between the United States and Japan and China shall not exceed $1.25 per word, and 35 cts. per word to Honolulu. Press rates shall not exceed one-fourth of the cost of private messages. The House Committee has reported favorably upon this bill. The length of the cable route would be 2,097 miles to Honolulu, and 6,500 miles to Japan; and with 16% of slack the cable itself would be about 7,500 nautical miles long. The cost of the cable and the necessary repair ship is estimated at $7,500,000. This would be the longest cable in the world, and the deepest soundings show 3,185 fathoms. The Pacific Cable Company is a New York State corporation, with $10,000,000 capital.

WIRES UNDERGROUND AT ST. LOUIS seems to be the order of the day, 14 applications for permits to put in conduit systems having been filed recently by light, telephone and other companies.

THE MEASUREMENT OF WATER FOR IRRIGATION.*

By J. B. Pope, C. E.

Introductory.

The question is often asked, what is a miner's inch? and the answer often given is, that "quantity of water which will flow through an aperture 1 in. square under a 4-in. pressure." Frequently the "authority" will call it a 6-in. pressure and sometimes the pressure-head is measured from the center of the aperture, or the top or bottom. Seldom is it stated whether the discharge is through a thin or thick plate, although this condition is a very important factor.

An attempt will be made in the following pages to demonstrate the importance of abolishing the "miner's inch," and adopting cubic feet per second as a unit of measurement for all water systems. Irrigating water will then assume a value according to quantity.

The principles of making distributions and constructing adjustable measuring weirs are original, and, as submitted, represent a considerable expenditure for testing and experimenting. The tables were carefully calculated and checked over, and their correctness demonstrated by many crucial tests.

Tables I. and II.

Table I. is simply a reduction of the California miner's inch, and the Colorado miner's inch, to cubic feet and acre feet for irrigating seasons of 3, 4, 5, 6 and 7 months, and every ten days thereof.

The Colorado miner's inch is equal to a flow of 1.56 cu. ft. per min., or .026 cu. ft. per sec., and 1 cu. ft. per sec. equals 38.46 Colorado miner's inches. (See report of State Engineer to Governor of Colorado for 1883 and 1884, page 60.)

The California miner's inch is equal to a flow of 1.2 cu. ft. per min., or .02 cu. ft. per sec., and 1 cu. ft. per sec. is equal to 50 California miner's inches. (See Irrigation in California, Wm. Ham. Hall, Part II., p. 27.)

The California miner's inch seems to be in greatest favor, possibly by reason of its convenience as a mathematical factor. In a few localities other values are adopted and called "miner's inches," but not to an extent worthy of notice.

The first left hand column of Table I. gives the number of days for irrigating seasons from 90 up to 210 days, or from 3 to 7 months. Opposite each irrigating season the double lines in the second column gives the quantity or value of a California miner's inch, flowing continuously for that length of time in the lower line, and the value of a Colorado miner's inch, flowing continuously for the same length of time is given in the upper line of the second column.

For example, one Colorado miner's inch flowing continuously for five months, or 150 days, equals 336,960 cu. ft., and one California miner's inch flowing continuously for five months, or 150 days, equals 259,200 cu. ft.

The other columns to the right give the values in acre feet for Colorado miner's inches above, and California miner's inches below, for the respective irrigation seasons, and continuous flow. Thus, with an irrigating season of six months, or 180 days, and a water right of one Colorado miner's inch continuous flow, we find in the first column six months, 180 days; opposite this, in the second column and above, we find 404,352, the quantity in cubic feet for that period of time; in the third column and above, we find its value 9,283 acre feet for one acre, or in the seventh column, which is headed 5A, we find 1.857, its value in acre feet for five acres, i. e., the depth in feet which one Colorado miner's inch, flowing continuously for 180 days, will cover one acre, or five acres, as the case may be. Opposite 180 days, in the column headed five acres, and on the lower line, we find 1.628, or the value in acre feet for one California miner's inch, flowing continuously for 180 days.

Table II. gives the required flow in cubic feet per second to cover one acre a given depth in one hour's time, or with from 1 to 30 irrigations of one hour each. The first column gives the number of irrigations during the entire season; the top line of figures gives the value of the water right in acre feet for the entire season, and the quantities below give the flow in cubic feet per second required to supply this water right, or any portion of it, in one hour of time. For example, with a water right of 1 acre foot, and an irrigation season of 180 days, it is desired to irrigate every nine days, allowing one hour constant flow for each acre, required the flow in cubic feet per second; we thus have 20 irrigations. Reading down the first column to the number 20, then to the right along this line to the column headed "1 acre foot," we find 0.605, the flow in cubic feet per second that will cover one acre 0.20-ft. deep in one hour of time.

Again, with a water right of 1.6 acre feet and ten irrigations during the entire season, required the flow in cubic feet per second for each irrigation to irrigate one acre in one hour of time. Find 10 in the first column opposite, and in column headed "1.6 acre feet" appear the figures 1.936, the flow in cubic feet per second required to cover one acre 0.16-ft. deep in one hour of time.

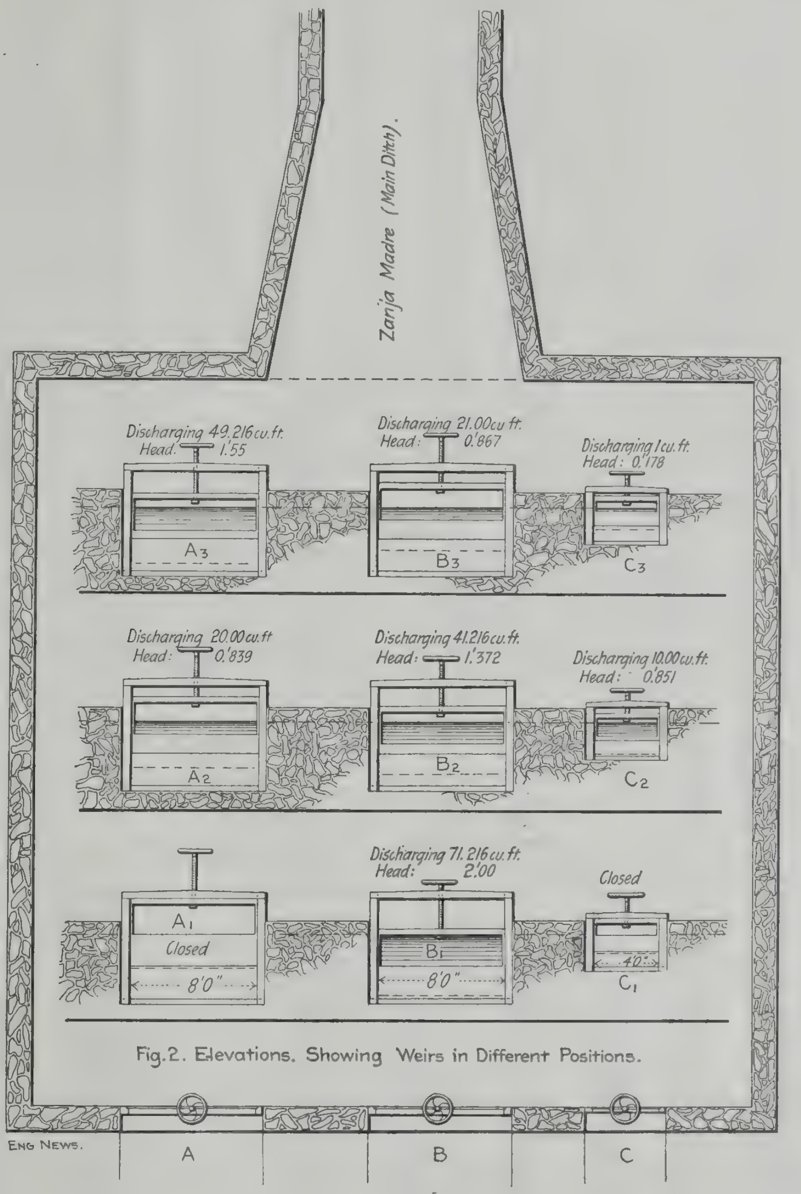

Fig. 2. Elevations. Showing Weirs in Different Positions.

Fig. 1. General Plan.

ELEVATION AND PLAN OF ADJUSTABLE DISTRIBUTING WEIRS.

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With Tables I. and II. we can readily reduce water rights quoted in Colorado or California miner's inches per acre to acre feet.

For example: With a water right of one Colorado miner's inch to eight acres during an irrigating season of five months, or 150 days, by Table I. we find that the total flow is 336,960 cu. ft., and that the value of the water right in acre feet is 0.967, which may be called 1 acre-ft. for all practical purposes, and with the aid of Table II. may be successfully delivered in any desired number of irrigations at the rate of one acre per hour, or any fraction or multiple thereof. The same is true with the California miner's inch. The water right being quoted in miner's inches per acre, we have only to follow the explanations given to find the tables applicable and sufficient for all ordinary cases.

The advantage of measuring and distributing irrigation water in cubic feet per second and in acre feet is obvious when compared with the troublesome and ambiguous "miner's inch" method. At present the policy of the irrigator is to irrigate as often and freely as possible, seldom admitting that the supply is sufficient. Little effort is made to determine the actual quantity of water required during an irrigating season to produce the best results for different crops and soils under cultivation. With water rights in acre feet, and the several distributions made in cubic feet per second, the user will, in the course of time, be enabled to determine many economical questions, such as the actual quantity of water required, number and time of deliveries for each crop, etc. There are few systems in operation at present that do not waste at least 40% of the supply, owing to ineffectual distributions and misleading measurements.

To make a practical and accurate distribution of the water flowing in a main irrigating canal so that one or more lateral canals will be supplied with certain quantities, while the remainder continues through the main canal, the maximum flow of main and laterals must first be determined, and the following requisite conditions complied with:

For a short distance immediately above the distribution box the cross-section of the main canal must be enlarged, and the grade flattened, so that the velocity will not exceed 1 ft. per sec. where it enters the distribution box. This box should be

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square, as shown in Fig. 1, with the sides equal to four times the length of the longest weir required. The depth should equal the length of the longest weir measuring down from its crest. Should the water carry a perceptible amount of silt the depth should be increased. Let the spillway equal twice the maximum head of its respective weir, measuring down from the crest. This will allow a free discharge. The weirs may be placed in the wall opposite the inflow, with small weirs on either side of the greater.

Great care must be exercised in placing the weirs, the crest of each being exactly its maximum head below the surface of the intake during a maximum flow. This done, there will be no material acceleration of flow from the intake through the weir box to the discharging weirs. A datum point must then be established on the working surface of the box, on the level of the water at the intake and working head of the weirs, and should be located at the middle of either side of the weir box. This point is the hydraulic head of all of the weirs when the requisite conditions have been attained in the weir box, which then becomes a still pond.

TABLE I.—Values of California and Colorado Miner's Inches in Cubic Feet and Acre-Feet for Various Periods.

		Value of mnr's ins. in cu. ft.*	Values of Colorado and California miner's inches in acre-feet														
Acres			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
90 days	Colorado	202,176	4.641	2.320	1.547	1.160	0.928	0.774	0.663	0.580	0.516	0.464	0.422	0.387	0.357	0.332	0.309
90 "	California	155,520	3.570	1.785	1.190	0.892	0.714	0.595	0.510	0.446	0.397	0.357	0.325	0.297	0.275	0.255	0.238
100 "	Colorado	224,640	5.157	2.578	1.719	1.289	1.031	0.860	0.737	0.645	0.573	0.516	0.469	0.430	0.397	0.368	0.344
100 "	California	172,800	3.967	1.983	1.322	0.991	0.793	0.662	0.567	0.496	0.441	0.397	0.361	0.331	0.305	0.283	0.264
110 "	Colorado	247,104	5.673	2.836	1.891	1.418	1.135	0.946	0.810	0.709	0.630	0.567	0.516	0.473	0.436	0.406	0.378
110 "	California	190,080	4.364	2.182	1.454	1.091	0.873	0.727	0.623	0.545	0.485	0.436	0.397	0.364	0.336	0.312	0.291
120 "	Colorado	269,568	6.188	3.094	2.063	1.547	1.238	1.031	0.884	0.773	0.688	0.619	0.563	0.516	0.476	0.442	0.413
120 "	California	207,360	4.760	2.380	1.587	1.190	0.952	0.793	0.680	0.595	0.529	0.476	0.433	0.397	0.366	0.340	0.317
130 "	Colorado	292,032	6.704	3.352	2.235	1.676	1.341	1.117	0.958	0.837	0.745	0.670	0.610	0.506	0.516	0.479	0.447
130 "	California	224,640	5.157	2.578	1.719	1.289	1.031	0.859	0.737	0.645	0.573	0.516	0.469	0.430	0.397	0.368	0.344
140 "	Colorado	314,496	7.220	3.610	2.407	1.805	1.444	1.203	1.031	0.903	0.802	0.722	0.656	0.602	0.555	0.516	0.481
140 "	California	241,920	5.554	2.777	1.851	1.388	1.111	0.926	0.793	0.694	0.617	0.555	0.505	0.463	0.426	0.397	0.370
150 "	Colorado	336,960	7.735	3.867	2.578	1.934	1.547	1.290	1.105	0.967	0.860	0.774	0.703	0.645	0.595	0.552	0.516
150 "	California	259,200	5.950	2.975	1.983	1.488	1.190	0.991	0.850	0.743	0.661	0.595	0.541	0.496	0.458	0.425	0.397
160 "	Colorado	359,424	8.251	4.125	2.750	2.063	1.650	1.376	1.179	1.031	0.917	0.825	0.750	0.688	0.635	0.589	0.550
160 "	California	276,480	6.347	3.173	2.116	1.587	1.269	1.059	0.907	0.793	0.705	0.635	0.577	0.529	0.488	0.453	0.423
170 "	Colorado	381,888	8.767	4.383	2.922	2.192	1.753	1.461	1.253	1.096	0.974	0.878	0.797	0.731	0.675	0.626	0.585
170 "	California	293,760	6.744	3.372	2.248	1.686	1.349	1.124	0.963	0.843	0.749	0.674	0.613	0.562	0.519	0.482	0.450
180 "	Colorado	404,352	9.283	4.641	3.094	2.321	1.857	1.547	1.326	1.160	1.031	0.928	0.844	0.774	0.714	0.663	0.619
180 "	California	311,040	7.140	3.570	2.380	1.785	1.428	1.190	1.020	0.892	0.793	0.714	0.649	0.595	0.549	0.510	0.476
190 "	Colorado	426,816	9.798	4.899	3.266	2.450	1.960	1.634	1.400	1.225	1.089	0.980	0.890	0.817	0.754	0.700	0.653
190 "	California	328,320	7.537	3.769	2.512	1.884	1.507	1.256	1.077	0.942	0.837	0.754	0.685	0.628	0.580	0.538	0.502
200 "	Colorado	449,280	10.314	5.157	3.438	2.578	2.063	1.719	1.473	1.289	1.146	1.031	0.938	0.860	0.794	0.737	0.688
200 "	California	345,600	7.934	3.967	2.645	1.983	1.587	1.322	1.133	0.992	0.881	0.793	0.721	0.661	0.610	0.567	0.529
210 "	Colorado	471,744	10.830	5.415	3.610	2.707	2.166	1.806	1.547	1.353	1.203	1.083	0.984	0.903	0.833	0.774	0.722
210 "	California	362,880	8.331	4.165	2.777	2.083	1.666	1.388	1.190	1.041	0.926	0.833	0.757	0.694	0.641	0.595	0.555

*A continuous flow of 1 in. for the period named in the first column.

The writer has designed and tested a very satisfactory weir, consisting of a rectangular weir-plate that is raised and lowered by means of a screw. The water in the division box presses the weir-plate against the frame and fixed plate, making water-tight bearings. The weir-plate is flush with the inside wall of the division box; the uprights of the fixed frame are channeled to receive the beveled edge and uprights of the weir-plate. The length of the crest should be even feet.

TABLE II.—Required Flow in Cubic Feet per Second to Cover One Acre a Given Depth in from 1 to 30 Hours.

Total hours.*	Depth in acre-feet for irrigating season.															
	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
	Flow in cubic feet per second to cover one acre a given depth in one hour of time.															
1	6.050	7.260	8.470	9.680	10.890	12.100	13.310	14.520	15.730	16.940	18.150	19.360	20.570	21.780	22.990	24.200
2	3.025	3.630	4.235	4.840	5.445	6.050	6.655	7.260	7.865	8.470	9.075	9.680	10.285	10.890	11.495	12.100
3	2.017	2.420	2.823	3.227	3.630	4.033	4.437	4.840	5.243	5.647	6.050	6.453	6.857	7.260	7.663	8.066
4	1.512	1.815	2.117	2.420	2.722	3.025	3.327	3.630	3.932	4.235	4.537	4.840	5.142	5.445	5.747	6.050
5	1.210	1.452	1.694	1.936	2.178	2.420	2.662	2.904	3.146	3.388	3.630	3.872	4.114	4.354	4.598	4.840
6	1.010	1.210	1.411	1.613	1.815	2.016	2.218	2.420	2.622	2.823	3.025	3.227	3.428	3.630	3.831	4.033
7	0.864	1.037	1.210	1.383	1.556	1.728	1.901	2.074	2.247	2.420	2.593	2.766	2.938	3.111	3.284	3.457
8	0.756	0.907	1.059	1.210	1.361	1.512	1.664	1.815	1.966	2.117	2.269	2.420	2.571	2.722	2.874	3.025
9	0.672	0.806	0.941	1.076	1.210	1.344	1.479	1.613	1.748	1.882	2.017	2.151	2.285	2.420	2.554	2.689
10	0.605	0.726	0.847	0.968	1.089	1.210	1.331	1.452	1.573	1.694	1.815	1.936	2.057	2.178	2.299	2.420
11	0.550	0.660	0.770	0.880	0.990	1.100	1.210	1.320	1.430	1.540	1.650	1.760	1.870	1.980	2.090	2.200
12	0.504	0.605	0.706	0.807	9.908	1.008	1.109	1.210	1.311	1.412	1.512	1.613	1.714	1.815	1.916	2.017
13	0.465	0.558	0.651	0.745	0.838	0.931	1.024	1.117	1.210	1.303	1.396	1.489	1.582	1.675	1.768	1.860
14	0.432	0.519	0.605	0.691	0.778	0.864	0.951	1.030	1.124	1.210	1.296	1.383	1.470	1.556	1.642	1.728
16	0.378	0.454	0.529	0.605	0.681	0.756	0.832	0.907	0.983	1.059	1.134	1.210	1.286	1.361	1.436	1.513
18	0.336	0.403	0.471	0.538	0.605	0.672	0.739	0.807	0.874	0.941	1.008	1.076	1.143	1.210	1.277	1.344
20	0.302	0.363	0.423	0.484	0.544	0.605	0.665	0.726	0.786	0.847	0.907	0.968	1.028	1.089	1.149	1.210
22	0.229	0.330	0.382	0.440	0.495	0.550	0.605	0.660	0.715	0.770	0.825	0.880	0.935	0.990	1.045	1.100
24	0.252	0.302	0.353	0.403	0.454	0.504	0.554	0.605	0.655	0.706	0.756	0.807	0.857	0.908	0.958	1.008
26	0.232	0.279	0.326	0.372	0.419	0.465	0.512	0.558	0.605	0.651	0.698	0.745	0.791	0.838	0.884	0.931
28	0.216	0.259	0.302	0.345	0.389	0.432	0.475	0.519	0.562	0.605	0.648	0.691	0.734	0.778	0.821	0.864
30	0.202	0.242	0.282	0.323	0.363	0.403	0.443	0.484	0.524	0.565	0.605	0.645	0.686	0.726	0.766	0.807

*Or the number of irrigations during the season.

A graduated scale of a special design should then be placed on one or both of the fixed uprights, the vernier for the scale being fixed on the upright of the movable weir-plate. The lower end of the screw acts as a swivel in the horizontal member that carries the weir-plate. The upper horizontal member of the frame is fixed firmly, and is threaded to carry the screw which governs the weir-plate. A datum point with graduated scale and vernier is then set in the division box on a level with the crest of the weir when it is closed up, and its scale reading zero.

We are then ready for

Table III.

This table gives the discharge in cubic feet per second for rectangular weirs of several lengths, with end contractions, for heads of every .001 ft. from .01 up to one-fourth the length of the weir. It is based upon the well-known weir formula of the late J. B. Francis, i. e.: Discharge in cubic feet per second $= 3.33 \times \left|\begin{array}{c}\text{length of weir,}\\ \text{minus 1-5th head}\end{array}\right| \times$ $\sqrt{\text{cube}}$ of head, special notice being taken of his statement that "where more than common accuracy is aimed at, we may take co-efficients between 3.41 and 3.33 for heads betwen ½-in. and 5 ins., and 3.3 instead of 3.33 for heads greater than 2 ft. (Trautwine, 13th ed., p. 265.)

The coefficients used in calculating the table were obtained by interpolation in accordance with the above suggestion.

The correctness of this method the writer demonstrated to his satisfaction by placing a number of weirs of various lengths continuously one upstream above the other in a cemented canal. The weirs were so placed that all requisite conditions regarding still water and spillways were obtained. The respective heads were determined with needle-point gages, on the plan of hook gages. These experiments were often repeated during the summer of 1894, and always with satisfactory results. Thus encouraged, the task of completing the table was cheerfully resumed. Figures for 1, 1½, 2, 3, 4, 5, 6, 8 and 10-ft. weirs are given.

(To reduce the weir discharge given in the tables to California miner's inches, we have only to multiply the quantity given by the constant 50. Multiplying by 38.46 the result will be in Colorado miner's inches.)

Fig. 2 shows three of these weirs in a division box, two 8 and one 4-ft. A1 and C1 are closed. B1 is discharging 71.216 cu. ft. per sec. The scale on the upright reads 2 ft. even. The line indicating the surface, or hydraulic head, is at zero, the datum point. In the second series, A2 has been lowered by means of the screw until its graduated scale reads 0.839, and is discharging 20 cu. ft. per sec. B2 has been raised, its scale reading 1.372, and is discharging 41.216, according to the part of the table for 8-ft. weirs. C2 is now discharging 10 cu. ft. per sec., its scale reading 0.851 nearly, according to the part of the table for 4-ft. weirs. The datum line, or hydraulic head, is unchanged.

A third distribution is shown by A3, B3 and C3, the hydraulic head remaining unchanged. A3 discharges 49.216 cu. ft. per sec., with a head of 1.55 nearly. B3 discharges 21 cu. ft. per sec., under a head of 0.867, and C3 discharges 1 cu. ft. per sec., with a head of 0.178. The scale in all cases gives the head, feet and decimal parts thereof, the first column giving feet and hundredths thereof, the thousandths being indicated at the top.

The graduated scale attached to the zero point, which is the hydraulic head, is used only when an increase in the flow occurs unexpectedly. When this happens, it is only necessary to measure up by means of this scale. This increased head is added to the head of each of the weirs, the several flows noted and corrected by adjusting one of the weirs, so that it will take the surplus in addition to its previous flow. This done the others carry their required volumes, and the hydraulic head soon settles back to its proper place. When a deficiency occurs, it but remains to raise whichever weir is to lose it, according to the amount of the deficiency, then the hydraulic head is quickly resumed. Thus it is seen that there is no limit to the relative proportion of distributions that may be made with this method.

The first cost does not exceed very materially that of less satisfactory division boxes. The weirs are durable, and can be made of wood, or iron, or brass. The graduated scales can be obtained at very reasonable figures from Mr. J. C. Sala, 429 Montgomery St., San Francisco, Cal. The author will supply plans and specifications, or furnish weirs of all sizes, place and test them, guaranteeing satisfactory results.

TABLE III.—DISCHARGE IN CUBIC FEET PER SECOND FOR WEIRS WITH END CONTRACTIONS FOR LENGTHS OF FROM 1 TO 10 FT., AND HEADS OF FROM 0.010 TO ONE-FOURTH THE LENGTH OF THE WEIRS.

1-Ft. Weir.

Head in ft.	0	1	2	3	4	5	6	7	8	9
.01..	.003	.004	.004	.005	.006	.006	.007	.008	.009	.099
.02..	.010	.011	.011	.012	.013	.013	.014	.015	.016	.016
.03..	.017	.018	.019	.020	.021	.022	.023	.024	.025	.026
.04..	.027	.028	.029	.030	.031	.032	.033	.034	.035	.036
.05..	.037	.038	.039	.041	.042	.044	.045	.046	.047	.048
.06..	.049	.050	.052	.053	.054	.055	.057	.058	.059	.060
.07..	.062	.063	.065	.066	.067	.068	.070	.071	.073	.074
.08..	.075	.076	.078	.079	.081	.082	.084	.085	.087	.088
.09..	.090	.091	.093	.094	.096	.097	.099	.100	.102	.103
.10..	.105	.106	.108	.110	.111	.113	.115	.116	.118	.119
.11..	.121	.123	.124	.126	.127	.129	.131	.132	.134	.135
.12..	.137	.139	.140	.142	.144	.145	.147	.149	.151	.152
.13..	.154	.156	.157	.159	.161	.163	.165	.167	.168	.170
.14..	.172	.174	.176	.177	.179	.181	.183	.185	.186	.188
.15..	.190	.193	.195	.196	.198	.200	.202	.204	.205	.207
.16..	.209	.211	.213	.215	.217	.218	.220	.222	.224	.226
.17..	.228	.230	.232	.234	.236	.238	.240	.242	.244	.246
.18..	.248	.250	.252	.254	.256	.258	.261	.263	.265	.267
.19..	.269	.271	.273	.275	.277	.279	.282	.284	.286	.288
.20..	.290	.292	.294	.296	.298	.300	.302	.304	.306	.308
.21..	.311	.313	.315	.317	.319	.321	.324	.326	.328	.330
.22..	.332	.334	.336	.338	.341	.343	.345	.347	.350	.352
.23..	.354	.356	.358	.361	.363	.365	.367	.369	.372	.374
.24..	.376	.378	.381	.383	.385	.387	.390	.392	.394	.397
.25..	.400	.402	.405	.407	.410	.412	.414	.417	.419	.422

TABLE III.—(Continued.)

1½-Ft. Weir.

Head in ft.	0	1	2	3	4	5	6	7	8	9
.01..	.005	.006	.007	.008	.009	.009	.010	.011	.012	.013
.02..	.014	.015	.016	.018	.019	.020	.021	.022	.024	.025
.03..	.026	.027	.029	.030	.031	.033	.034	.036	.037	.039
.04..	.040	.042	.043	.045	.047	.048	.050	.052	.054	.055
.05..	.057	.059	.060	.062	.064	.065	.067	.069	.071	.072
.06..	.074	.076	.078	.080	.082	.083	.085	.087	.089	.091
.07..	.093	.095	.097	.099	.101	.103	.106	.108	.110	.112
.08..	.114	.116	.118	.121	.123	.125	.127	.129	.132	.134
.09..	.136	.138	.141	.143	.145	.147	.150	.152	.154	.157
.10..	.159	.161	.164	.166	.169	.171	.173	.176	.178	.181
.11..	.183	.185	.188	.190	.193	.195	.198	.200	.203	.205
.12..	.208	.211	.213	.216	.218	.221	.224	.226	.229	.231
.13..	.234	.237	.239	.242	.245	.247	.250	.253	.256	.258
.14..	.261	.264	.267	.269	.272	.275	.278	.281	.283	.286
.15..	.289	.292	.295	.297	.300	.303	.306	.309	.311	.314
.16..	.317	.320	.323	.326	.329	.332	.335	.338	.341	.344
.17..	.347	.350	.353	.356	.359	.362	.365	.368	.371	.374
.18..	.377	.380	.383	.386	.389	.392	.395	.398	.401	.404
.19..	.408	.411	.414	.418	.421	.424	.427	.430	.434	.437
.20..	.440	.443	.446	.449	.453	.456	.459	.463	.466	.469
.21..	.473	.476	.480	.483	.486	.489	.493	.496	.499	.503
.22..	.506	.509	.513	.516	.520	.523	.526	.530	.533	.537
.23..	.540	.543	.547	.550	.554	.557	.560	.564	.567	.571
.24..	.574	.577	.581	.584	.588	.591	.595	.598	.602	.605
.25..	.609	.613	.616	.620	.623	.627	.631	.634	.638	.641
.26..	.645	.649	.652	.656	.659	.663	.667	.670	.674	.677
.27..	.681	.685	.688	.692	.696	.699	.703	.707	.711	.714
.28..	.718	.722	.725	.729	.733	.736	.740	.744	.748	.751
.29..	.755	.759	.763	.766	.770	.774	.778	.782	.785	.789
.30..	.793	.797	.801	.804	.808	.812	.816	.820	.823	.827
.31..	.831	.835	.839	.843	.847	.850	.854	.858	.862	.866
.32..	.870	.874	.878	.882	.886	.889	.893	.897	.901	.905
.33..	.909	.913	.917	.921	.925	.929	.933	.937	.941	.945
.34..	.949	.953	.957	.961	.965	.969	.973	.977	.981	.985
.35..	.989	.993	.997	1.001	1.005	1.009	1.013	1.017	1.021	1.025
.36..	1.030	1.034	1.038	1.042	1.046	1.050	1.055	1.059	1.063	1.067
.37..	1.071	1.075	1.079	1.084	1.088	1.092	1.096	1.100	1.105	1.109
.38..	1.113	1.117	1.121	1.126	1.130	1.134	1.139	1.142	1.147	1.151
.39..	1.115	1.159	1.163	1.168	1.172	1.176	1.180	1.184	1.189	1.193
.40..	1.197	1.201	1.206	1.210	1.214	1.218	1.223	1.227	1.231	1.236

TABLE III.—(Continued.)

2-Ft. Weir.

Head in ft.	0	1	2	3	4	5	6	7	8	9
.01..	.007	.008	.009	.011	.012	.013	.014	.015	.017	.018
.02..	.019	.021	.022	.024	.025	.027	.029	.030	.032	.033
.03..	.035	.037	.039	.041	.043	.044	.046	.048	.050	.052
.04..	.054	.056	.058	.060	.062	.064	.067	.069	.071	.073
.05..	.075	.077	.080	.082	.085	.087	.089	.092	.094	.097
.06..	.099	.102	.104	.107	.109	.112	.115	.117	.120	.122
.07..	.125	.128	.130	.133	.136	.138	.141	.144	.147	.149
.08..	.152	.155	.158	.161	.164	.167	.170	.173	,176	.179
.09..	.182	.185	.188	.191	.194	.197	.200	.203	.206	.209
.10..	.212	.215	.219	.222	.225	.228	.232	.235	.238	.242
.11..	.245	.248	.252	.255	.258	.262	.265	.268	.272	.275
.12..	.278	.281	.285	.288	.292	.295	.299	.302	.305	.309
.13..	.313	.317	.320	.324	.328	.331	.335	.339	.343	.346
.14..	.350	.354	.357	.361	.365	.368	.372	.376	.380	.383
.15..	.387	.391	.395	.398	.402	.406	.410	.414	.417	.421
.16..	.425	.429	.433	.437	.441	.445	.449	.453	.457	.461
.17..	.465	.469	.473	.477	.481	.485	.490	.494	.498	.502
.18..	.506	.510	.514	.519	.523	.527	.531	.535	.540	.544
.19..	.548	.552	.557	.561	.565	.569	.574	.578	.582	.587
.20..	.591	.595	.600	.604	.609	.613	.617	.622	.626	.631
.21..	.635	.639	.644	.648	.653	.657	.662	.666	.671	.675
.22..	.680	.684	.689	.693	.698	.702	.707	.711	.716	.720
.23..	.725	.730	.734	.739	.744	.748	.753	.758	.763	.767
.24..	.772	.777	.782	.786	.791	.796	.801	.806	.810	.815
.25..	.820	.825	.830	.834	.839	.844	.849	.854	.858	.863
.26..	.868	.873	.878	.883	.888	.892	.897	.902	.907	.912
.27..	.917	.922	.927	.932	.937	.942	.947	.952	.957	.962
.28..	.967	.972	.977	.982	.987	.992	.997	1.002	1.007	1.012
.29..	1.017	1.022	1.027	1.033	1.038	1.043	1.048	1.053	1.059	1.064
.30..	1.069	1.074	1.079	1.085	1.090	1.095	1.100	1.105	1.111	1.116
.31..	1.121	1.126	1.132	1.137	1.142	1.147	1.153	1.158	1.163	1.169
.32..	1.174	1.179	1.185	1.190	1.195	1.200	1.206	1.211	1.216	1.222
.33..	1.227	1.232	1.238	1.243	1.249	1.254	1.259	1.265	1.270	1.276
.34..	1.281	1.286	1.292	1.297	1.303	1.308	1.314	1.319	1.325	1.330
.35..	1.336	1.341	1.347	1.352	1.358	1.363	1.369	1.374	1.380	1.385
.36..	1.391	1.396	1.402	1.408	1.413	1.419	1.425	1.430	1.436	1.441
.37..	1.447	1.453	1.458	1.464	1.469	1.475	1.481	1.486	1.492	1.497
.38..	1.503	1.509	1.515	1.520	1.526	1.532	1.538	1.544	1.549	1.555
.39..	1.561	1.567	1.573	1.578	1.584	1.590	1.596	1.602	1.607	1.613
.40..	1.619	1.625	1.631	1.637	1.643	1.648	1.654	1.660	1.667	1.672
.41..	1.678	1.684	1.690	1.696	1.702	1.707	1.713	1.719	1.725	1.731
.42..	1.737	1.743	1.749	1.755	1.761	1.767	1.773	1.779	1.785	1.791
.43..	1.797	1.803	1.809	1.815	1.821	1.827	1.833	1.840	1.846	1.852
.44..	1.858	1.864	1.870	1.876	1.882	1.888	1.895	1.901	1.907	1.913
.45..	1.919	1.925	1.932	1.938	1.994	1.950	1.957	1.963	1.969	1.976
.46..	1.982	1.988	1.995	2.001	2.007	2.013	2.020	2.026	2.032	2.039
.47..	2.045	2.051	2.058	2.064	2.070	2.076	2.083	2.089	2.095	2.102
.48..	2.108	2.114	2.121	2.127	2.134	2.140	2.146	2.153	2.159	2.166
.49..	2.172	2.178	2.185	2.191	2.198	2.204	2.210	2.217	2.223	2.230
.50..	2.236	2.242	2.249	2.255	2.262	2.268	2.274	2.281	2.287	2.294

TABLE III.—(Continued.)

3-Ft. Weir.

Head in ft.	0	1	2	3	4	5	6	7	8	9
.01..	.010	.012	.013	.015	.017	.018	.020	.022	.024	.025
.02..	.027	.029	.032	.034	.037	.039	.041	.044	.046	.049
.03..	.051	.054	.057	.060	.063	.066	.069	.072	.075	.078
.04..	.081	.084	.087	.091	.094	.097	.100	.103	.107	.110
.05..	.113	.117	.120	.124	.127	.131	.135	.138	.142	.145
.06..	.149	.153	.157	.161	.165	.168	.172	.176	.180	.184
.07..	.188	.192	.196	.200	.204	.208	.213	.217	.221	.225
.08..	.229	.233	.238	.242	.247	.251	.255	.260	.264	.269
.09..	.273	.278	.282	.287	,292	.296	.301	.306	.311	.315
.10..	.320	.325	.330	.334	.339	.344	.349	.354	.358	.363
.11..	.368	.373	.378	.383	.388	.393	.399	.404	.409	.414
.12..	.419	.424	.430	.435	.440	.445	.451	.456	.461	.467
.13..	.472	.477	.483	.488	.494	.499	.505	.510	.516	.521
.14..	.527	.533	.538	.544	.549	.555	.561	.566	.572	.577
.15..	.583	.589	.595	.601	.607	.612	.618	.624	.630	.636
.16..	.642	.648	.654	.660	.666	.672	.678	.684	.690	.696
.17..	.702	.708	.714	.720	.727	.733	.739	.745	.752	.758
.18..	.764	.770	.777	.783	.789	.795	.802	.808	.815	.821
.19..	.827	.833	.840	.846	.853	.859	.866	.872	.879	.885
.20..	.892	.899	.905	.912	.918	.925	.932	.938	.945	.951
.21..	.958	.965	.972	.979	.986	.992	.999	1.006	1.013	1.020
.22..	1.027	1.034	1.041	1.048	1.055	1.062	1.069	1.076	1.083	1.090
.23..	1.097	1.104	1.111	1.118	1.125	1.132	1.139	1.146	1.153	1.160
.24..	1.167	1.174	1.182	1.189	1.196	1.203	1.211	1.218	1.225	1.233
.25..	1.240	1.247	1.255	1.262	1.269	1.276	1.284	1.291	1.298	1.306
.26..	1.313	1.320	1.328	1.335	1.343	1.350	1.358	1.365	1.373	1.380
.27..	1.388	1.396	1.403	1.411	1.418	1.426	1.434	1.441	1.449	1.456
.28..	1.464	1.472	1.479	1.487	1.495	1.502	1.510	1.518	1.526	1.533
.29..	1.541	1.549	1.557	1.564	1.572	1.580	1.588	1.596	1.603	1.611
.30..	1.619	1.627	1.635	1.643	1.651	1.659	1.667	1.675	1.683	1.691
.31..	1.699	1.707	1.715	1.723	1.731	1.739	1.747	1.755	1.763	1.771
.32..	1.779	1.787	1.795	1.804	1.812	1.820	1.828	1.836	1.845	1.853
.33..	1.861	1.869	1.877	1.886	1.894	1.902	1.910	1.918	1.927	1.935
.34..	1.943	1.951	1.960	1.968	1.977	1.985	1.993	2.002	2.010	2.019
.35..	2.027	2.035	2.044	2.052	2.061	2.069	2.078	2.086	2.095	2.103
.36..	2.112	2.121	2.129	2.138	2.146	2.155	2.164	2.172	2.181	2.189
.37..	2.198	2.207	2.215	2.224	2.233	2,241	2.250	2.259	2.268	2.276
.38..	2.285	2.294	2.303	2.311	2.320	2.329	2.338	2.347	2.355	2.364
.39..	2.373	2.382	2.391	2.399	2.408	2.417	2.426	2.435	2.443	2.452
.40..	2.461	2.470	2.479	2.488	2.497	2.506	2.515	2.524	2.533	2.542
.41..	2.552	2.560	2.569	2.578	2.588	2.597	2.606	2.615	2.624	2.634
.42..	2.643	2.652	2.662	2.671	2.680	2.689	2.699	2.708	2.717	2.727
.43..	2.736	2.745	2.755	2.764	2.773	2.783	2.792	2.802	2.811	2.826
.44..	2.830	2.839	2.849	2.858	2.868	2.877	2.887	2.896	2.906	2.915
.45..	2.925	2.934	2.944	2.953	2.963	2.972	2.982	2.991	3.001	3.010
.46..	3.020	3.030	3.039	3.049	3.059	3.068	3.078	3.088	3.098	3.107
.47..	3.117	3.127	3.137	3.146	3.156	3.166	3.176	3.186	3.195	3.205
.48..	3.215	3.225	3.235	3.245	3.255	3.264	3.274	3.284	3.294	3.304
.49..	3.314	3.324	3.334	3.344	3.354	3.363	3.373	3.383	3.393	3.403
.50..	3.413	3.423	3.433	3.443	3.453	3.463	3.473	3.483	3.493	3.503
.51..	3.513	3.523	3.533	3.543	3.553	3.563	3.574	3.584	3.594	3.604
.52..	3.614	3.624	3.634	3.645	3.655	3.665	3.675	3.685	3.696	3.706
.53..	3.716	3.726	3.737	3.747	3.757	3.767	3.778	3.788	3.798	3.809
.54..	3.819	3.829	3.840	3.850	3.860	3.870	3.881	3.891	3.901	3.912
.55..	3.922	3.932	3.943	3.953	3.964	3.974	3.985	3.995	4.006	4.016
.56..	4.027	4.037	4.048	4.058	4.069	4.079	4.090	4.100	4.111	4.121
.57..	4.132	4.142	4.153	4.164	4.174	4.185	4.196	4.206	4.217	4.227
.58..	4.238	4.249	4.259	4.270	4.281	4.291	4.302	4.313	4.324	4.334
.59..	4.345	4.356	4.367	4.377	4.388	4.399	4.410	4.421	4.431	4.442
.60..	4.453	4.464	4.475	4.486	4.497	4.507	4.518	4.529	4.540	4.551
.61..	4.562	4.573	4.584	4.595	4.606	4.616	4.627	4.638	4.649	4.660
.62..	4.671	4.682	4.693	4.704	4.715	4.726	4.737	4.748	4.759	4.770
.63..	4.781	4.792	4.803	4.814	4.825	4.836	4.848	4.859	4.870	4.881
.64..	4.892	4.903	4.914	4.925	4.936	4.947	4.959	4.970	4.981	4.992
.65..	5.003	5.014	5.025	5.036	5.047	5.058	5.070	5.081	5.092	5.103
.66..	5.114	5.125	5.137	5.148	5.160	5.171	5.182	5.194	5.205	5.216
.67..	5.228	5.239	5.251	5.262	5.274	5.285	5.296	5.308	5.319	5.326
.68..	5.342	5.353	5.365	5.376	5.388	5.399	5.410	5.422	5.433	5.446
.69..	5.456	5.467	5.479	5.490	5.502	5.513	5.525	5.536	5.548	5.559
.70..	5.571	5.583	5.594	5.606	5.617	5.629	5.641	5.652	5.664	5.675
.71..	5.687	5.699	5.710	5.722	5.733	5.745	5.757	5.768	5.780	5.791
.72..	5.803	5.815	5.826	5.838	5.850	5.861	5.873	5.885	5.897	5.908
.73..	5.920	5.932	5.944	5.955	5.967	5.979	5.991	6.003	6.014	6.026
.74..	6.038	6.050	6.062	6.073	6.085	6.097	6.109	6.121	6.132	6.144
75..	6.156	6.168	6.180	6.192	6.204	6.215	6.227	6.239	6.251	6.263

TABLE III.—(Continued.)

4-Ft. Weir.

Head in ft.	0	1	2	3	4	5	6	7	8	9
.01..	.013	.015	.018	.020	.023	.025	.028	.030	.033	.035
.02..	.038	.041	.045	.048	.051	.054	.058	.061	.064	.068
.03..	.071	.075	.079	.082	.086	.090	.094	.098	.100	.105
.04..	.109	.113	.118	.122	.126	.130	.135	.139	.143	.148
.05..	.152	.157	.161	.166	.171	.175	.180	.185	.190	.194
.06..	.199	.204	.209	.215	.220	.225	.230	.235	.240	.246
.07..	.251	.256	.262	.267	.273	.278	.284	.289	.295	.300
.08..	.306	.312	.318	.324	.330	.335	.341	.347	.353	.359
.09..	.365	.371	.377	.384	.390	.396	.402	.408	.415	.421
.10..	.427	.433	.440	.446	.453	.459	.466	.472	.479	.485
.11..	.492	.499	.506	.512	.519	.526	.533	.540	.546	.553
.12..	.560	.567	.574	.582	.589	.596	.603	.610	.618	.625
.13..	.632	.639	.646	.654	.661	.668	.675	.682	.690	.697
.14..	.704	.712	.719	.727	.734	.742	.750	.757	.765	.772
.15..	.780	.788	.796	.803	.811	.819	.827	.835	.842	.850
.16..	.858	.866	.874	.882	.890	.898	.907	.915	.923	.931
.17..	.939	.947	.956	.964	.972	.980	.989	.997	1.005	1.014
.18..	1.022	1.030	1.039	1.047	1.056	1.064	1.073	1.081	1.090	1.098
.19..	1.107	1.116	1.124	1.133	1.142	1.150	1.159	1.168	1.177	1.185
.20..	1.194	1.203	1.212	1.221	1.230	1.239	1.248	1.257	1.266	1.275
.21..	1.284	1.293	1.302	1.311	1.320	1.329	1.339	1.348	1.357	1.366
.22..	1.375	1.484	1.494	1.503	1.512	1.521	1.532	1.540	1.549	1.559
.23..	1.468	1.477	1.487	1.496	1.506	1.515	1.525	1.534	1.544	1.553
.24..	1.563	1.573	1.582	1.592	1.602	1.611	1.621	1.631	1.641	1.650
.25..	1.660	1.670	1.680	1.690	1.700	1.709	1.719	1.729	1.739	1.748
.26..	1.759	1.769	1.779	1.789	1.799	1.809	1.819	1.729	1.839	1.849
.27..	1.859	1.869	1.879	1.889	1.900	1.910	1.920	1.930	1.941	1.951
.28..	1.961	1.971	1.982	1.992	2.003	2.013	2.023	2.034	2.044	2.055
.29..	2.065	2.075	2.086	2.096	2.107	2.117	2.128	2.138	2.149	2.159
.30..	2.170	2.181	2.191	2.202	2.213	2.223	2.234	2.245	2.256	2.266
.31..	2.277	2.288	2.299	2.309	2.320	2.331	2.342	2.353	2.363	2.374
.32..	2,385	2.396	2.407	2.418	2.429	2.240	2.451	2.462	2.473	2.484
.33..	2.495	2.506	2.517	2.529	2.540	2.551	2.562	2.573	2.584	2.596
.34..	2.607	2.618	2.630	2.641	2.652	2.663	2.675	2.686	2.697	2.709
.35..	2.720	2.731	2.743	2.754	2.766	2.777	2.788	2.800	2.811	2.823
.36..	2.834	2.845	2.857	2.868	2.880	2.891	2.903	2.914	2.926	2.937
.37..	2.949	2.961	2.972	2.984	2.996	3.007	3.019	3.031	3.043	3.054
.38..	3.066	3.078	3.090	3.101	3.113	3.125	3.137	3.149	3.160	3.172
.39..	3.184	3.196	3.208	3.220	3.232	3.244	3.256	3.268	3.280	3.292
.40..	3.304	3.316	3.328	3.341	3.353	3.365	3.377	3.389	3.402	3.414
.41..	3.426	3.438	3.450	3.463	3.475	3.487	3.500	3.512	3.524	3.537
.42..	3.549	3.561	3.574	3.586	3.599	3.611	3.623	3.636	3.649	3.661
.43..	3.674	3.687	3.699	3.712	3.725	3.737	3.750	3.763	3.776	3.788
.44..	3.801	3.814	3.827	3.839	3.852	3.865	3.878	3.891	3.903	3.916
.45..	3.929	3.942	3.955	3.968	3.981	3.993	4.006	4.019	4.032	4.045
.46..	4.058	4.071	4.084	4.098	4.111	4.124	4.136	4.150	4.164	4.177
.47..	4.190	4.203	4.216	4.230	4.243	4.256	4.269	4.282	4.296	4.309
.48..	4.322	4.335	4.348	4.362	4.375	4.388	4.402	4.415	4.428	4.442

Head in ft.	0	1	2	3	4	5	6	7	8	9
.49..	4.455	4.468	4.482	4.495	4.509	4.522	4.535	4.549	4.562	4.576
.50..	4.589	4.603	4.616	4.630	4.643	4.657	4.676	4.684	4.698	4.711
.51..	4.725	4.739	4.752	4.766	4.780	4.793	4.807	4.821	4.835	4.848
.52..	4.862	4.876	4.890	4.903	4.917	4.931	4.945	4.959	4.972	4.986
.53..	5.000	5.014	5.028	5.042	5.056	5.069	5.083	5.097	5.111	5.125
.54..	5.139	5.053	5.167	5.181	5.195	5.209	5.223	5.237	5.251	5.265
.55..	5.279	5.293	5.307	5.322	5.336	5.350	5.364	5.378	5.393	5.407
.56..	5.421	5.435	5.450	5.464	5.478	5.492	5.507	5.521	5.535	5.507
.57..	5.564	5.578	5.593	5.607	5.622	5.636	5.650	5.665	5.679	5.694
.58..	5.708	5.722	5.737	5.751	5.766	5.780	5.795	5.810	5.824	5.839
.59..	5.853	5.868	5.882	5.897	5.911	5.926	5.941	5.955	5.970	5.984
.60..	5.999	6.014	6.029	6.043	6.058	6.073	6.088	6.103	6.117	6.132
.61..	6.145	6.160	6.175	6.189	6.204	6.219	6.234	6.249	6.263	6.278
.62..	6.293	6.308	6.325	6.338	6.353	6.368	6.383	6.398	6.413	6.428
.63..	6.443	6.458	6.473	6.488	6.503	6.519	6.534	6.549	6.564	6.579
.64..	6.594	6.609	6.624	6.640	6.655	6.670	6.685	6.700	6.716	6.731
.65..	6.746	6.761	6.777	6.792	6.807	6.822	6.838	6.853	6.868	6.884
.66..	6.899	6.914	6.930	6.945	6.960	6.975	6.991	7.006	7.021	7.037
.67..	7.052	7.067	7.083	7.098	7.114	7,129	7.145	7.160	7.176	7.191
.68..	7.207	7.222	7.238	7.253	7.269	7.284	7.300	7.315	7.331	7.346
.69..	7.362	7.378	7.393	7.409	7.424	7.440	7.455	7.471	7.497	7.502
.70..	7.518	7.534	7.550	7.565	7.581	7.597	7.613	7.629	7.644	7.660
.71..	7.676	7.692	7.708	7.724	7.740	7.755	7.771	7.787	7.803	7.819
.72..	7.835	7.851	7.867	7.883	7.899	7.914	7.930	7.946	7.962	7.978
.73..	7.994	8.010	8.026	8.042	8.058	8.074	8.090	8.106	8.122	8.138
.74..	8.154	8.170	8.186	8.202	8,218	8.234	8.251	8.267	8.283	8.299
.75..	8.315	8.331	8.348	8.365	8.380	8.396	8.413	8.429	8.445	8.462
.76..	8.478	8.494	8.511	8.527	8.543	8.559	8.576	8.592	8.608	8.625
.77..	8.641	8.657	8.674	8.690	8.706	8.723	8.739	8.756	8.772	8.788
.78..	8.805	8.821	8.839	8.854	8.871	8.887	8.904	8.920	8.937	8.953
.79..	8.970	8.987	9.003	9.020	9.036	9.053	9.070	9.086	9.103	9.119
.80..	9.136	9.153	9.169	9.186	9.202	9.219	9.236	9.252	9.269	9.285
.81..	9.302	9.319	9.336	9.352	9.369	9.386	9.403	9.420	9.436	9.453
.82..	9.470	9.487	9.504	9.520	9.538	9.554	9.571	9.588	9.605	9.622
.83..	9.639	9.656	9.673	9.690	9.707	9.723	9.740	9.757	9.774	9.791
.84..	9.808	9.825	9.842	9.859	9.876	9.893	9.910	9.927	9.944	9.961
.85..	9.978	9.995	10.012	10.029	10.046	10.063	10.081	10.098	10.115	10.132
.86..	10.149	10.166	10.184	10.201	10.218	10.235	10.253	10.270	10.287	10.304
.87..	10.322	10.339	10.356	10.374	10.391	10.408	10.426	10.443	10.460	10.477
.88..	10.495	10.512	10.530	10.547	10.563	10.581	10.599	10.616	10.633	10.651
.89..	10.668	10.685	10.703	10.719	10.737	10.754	10.771	10.789	10.806	10.824
.90..	10.841	10.858	10.876	10.893	10.911	10.923	10.946	10.963	10.981	10.998
.91..	11.016	11.034	11.051	11.069	11.086	11.104	11.122	11.139	11.157	11.174
.92..	11.192	11.210	11.227	11.245	11.263	11.280	11.298	11.316	11.334	11.351
.93..	11.369	11.387	11.404	11.422	11.440	11.457	11.475	11.493	11.511	11.528
.94..	11.546	11.564	11.582	11.600	11.617	11.635	11.653	11.671	11.689	11.707
.95..	11.725	11.743	11.761	11.779	11.797	11.814	11.832	11.850	11.868	11.886
.96..	11.904	11.922	11.940	11.958	11.976	11.994	12.012	12.030	12.048	12.066
.97..	12.084	12.102	12.120	12.138	12.156	12.174	12.192	12,210	12.228	12.246
.98..	12.264	12.282	12.300	12.318	12.336	12.354	12.372	12.391	12.409	12.427
.99..	12.445	12.463	12.482	12.500	12.518	12.536	12.554	12.572	12.591	12.608
1.00..	12.627	12.645	12.663	12.682	12.700	12.718	12.736	12.754	12.773	12.791

TABLE III.—(Continued.)

5-Ft. Weir.

Head in ft.	0	1	2	3	4	5	6	7	8	9
.01..	.017	.020	.023	.026	.029	.032	.036	.039	.042	.045
.02..	.048	.052	.056	.060	.064	.068	.072	.076	.080	.084
.03..	.088	.093	.098	.102	.107	.112	.117	.122	.126	.131
.04..	.136	.141	.147	.152	.158	.163	.168	.174	.179	.185
.05..	.190	.196	.202	.208	.214	.219	.225	.231	237	.243
.06..	.249	.255	.262	.268	.275	.281	.288	.294	.301	.307
.07..	.314	.321	.328	.335	.342	.348	.355	.362	.369	.376
.08..	.383	.390	.398	.405	.413	.420	.427	.435	.442	.450
.09..	.457	.464	.472	.480	.487	.495	.502	.510	.518	.525
.10..	.534	.542	.550	.558	.566	.574	.583	.591	.599	.607
.11..	.615	.624	.632	.641	.649	.658	.667	.675	.684	.692
.12..	.701	.710	.718	.727	.736	.745	.754	.762	.771	.780
.13..	.789	.798	.807	.817	.826	.835	.844	.853	.863	.872
.14..	.881	.890	.900	.909	.919	.928	.938	.947	.957	.966
.15..	.976	.986	.996	1.006	1.016	1.025	1.035	1.045	1.055	1.065
.16..	1.075	1.085	1.095	1.105	1.115	1.125	1.136	1.146	1.156	1.166
.17..	1.176	1.186	1.197	1,207	1.218	1.228	1.238	1.249	1.259	1.270
.18..	1.280	1.291	1.301	1.312	1.322	1.333	1.344	1.354	1.365	1.375
.19..	1.386	1.397	1.408	1.419	1.430	1.441	1.452	1.463	1.474	1.485
.20..	1.496	1.507	1.518	1.530	1.541	1.552	1.563	1.574	1.586	1.597
.21..	1.608	1.619	1.631	1.642	1.653	1.665	1.676	1.688	1.699	1.711
.22..	1.722	1.734	1.745	1.757	1.769	1.780	1.792	1.804	1.816	1.827
.23..	1.839	1.851	1.863	1.875	1.887	1.899	1.911	1.923	1.935	1.947
.24..	1.959	1.971	1.983	1.995	2.007	2.019	2.032	2.044	2.056	2.068
.25..	2.080	2.092	2.105	2.117	2.130	2.142	2.154	2.167	2.179	2.192
.26..	2.204	2.217	2.229	2.242	2.254	2.267	2.280	2.292	2.305	2.317
.27..	2.330	2.343	2.356	2.368	2.381	2.394	2.407	2.420	2.432	2.445
.28..	2.458	2.471	2.484	2.497	2.510	2.523	2.536	2.549	2.562	2.575
.29..	2.588	2.601	2.615	2.628	2.641	2.654	2.668	2.681	2.694	2.708
.30..	2.721	2.734	2.748	2.761	2.775	2.788	2.801	2.815	2.828	2.841
.31..	2.855	2.869	2.822	2.896	2.909	2.923	2.937	2.950	2.964	2.977
.32..	2.991	3.005	3.019	3.033	3.047	3.060	3.074	3.088	3.102	3.116
.33..	3.130	3.144	3.158	3.172	3.186	3.200	3.214	3.228	3.242	3.256
.34..	3.270	3.284	3.298	3.313	3.327	3.341	3.355	3.369	3.384	3.398
.35..	3.412	3.426	3.441	3.455	3.469	3.483	3.498	3.512	3.526	3.541
.36..	3.555	3.570	3.584	3.599	3.613	3.628	3.643	3.657	3.672	3.686
.37..	3.701	3.716	3.730	3.746	3.760	3.774	3.789	3.804	3.819	3.833
.38..	3.848	3.863	3.878	3.893	3.908	3.922	3.937	3.952	3.967	3.982
.39..	3.997	4.012	4.027	4.042	4.057	4.072	4.087	4.102	4.117	4.132
.40..	4.147	4.162	4.178	4.193	4.208	4.223	4.239	4.254	4.269	4.285
.41..	4.300	4.315	4.331	4.346	4.362	4.377	4.393	4.408	4.424	4.439
.42..	4.455	4.471	4.486	4.502	4.518	4.534	4.550	4.565	4.581	4.597
.43..	4.613	4.629	4.645	4.661	4.677	4.693	4.709	4.725	4.741	4.757
.44..	4.773	4.789	4.805	4.822	4.838	4.854	4.870	4.886	4.902	4.919
.45..	4.935	4.951	4.967	4.984	5.000	5.016	5.032	5.048	5.065	5.081
.46..	5.097	5.113	5.130	5.146	5.163	5.179	5.196	5.212	5.229	5.245
.47..	5.262	5.279	5.295	5.312	5.329	5.345	5.362	5.379	5.396	5.412
.48..	5.429	5.446	5.463	5.479	5.496	5.513	5.530	5.547	5.563	5.580
.49..	5.597	5.616	5.631	5.649	5.665	5.682	5.699	5.716	5.733	5.750
.50..	5.767	5.784	5.801	5.818	5.835	5.852	5.869	5.886	5.903	5.920
.51..	5.937	5.954	5.971	5.989	6.006	6.023	6.040	6.057	6.075	6.092
.52..	6.109	6.126	6.144	6.161	6.179	6.196	6.213	6.231	6.248	6.266
.53..	6.283	6.301	6.318	6.336	6.353	6.371	6.389	6.406	6.424	6.441
.54..	6.459	6.477	6.495	6.512	6.530	6.548	6.566	6.584	6.601	6.619
.55..	6.637	6.655	6.673	6.691	6.709	6.726	6.744	6.762	6.780	6.789
.56..	6.816	6.834	6.852	6.870	6.888	6.906	6.924	6.942	6.960	6.978
.57..	6.996	7.014	7.032	7.051	7.069	7.087	7.105	7.123	7.142	7.160
.58..	7.178	7.196	7.215	7.233	7.251	7.269	7.288	7.306	7.324	7.343
.59..	7.361	7.379	7.398	7.416	7.435	7.452	7.472	7.490	7.509	7.527
.60..	7.546	7.565	7.583	7.602	7.620	7.639	7.658	7.676	7.695	7.713
.61..	7.732	7.751	7.769	7.788	7.807	7.825	7.844	7.863	7.882	7.900
.62..	7.919	7.938	7.957	7.976	7.995	8.013	8.032	8.051	8.070	8.089
.63..	8.108	8.127	8.146	8.165	8.184	8.203	8.222	8.241	8.260	8.279
.64..	8.298	8.317	8.336	8.355	8.375	8.394	8.413	8.432	8.452	8.471
.65..	8.490	8.509	8.528	8.548	8.567	8.586	8.605	8.624	8.644	8.663
.66..	8.682	8.701	8.721	8.740	8.760	8.779	8.798	8.818	8.837	8.857
.67..	8.876	8.896	8.915	8.935	8.954	8.974	8.994	9.013	9.033	9.052
.68..	9.072	9.092	9.111	9.131	9.151	9.170	9.190	9.209	9.230	9.249
.69..	9.269	9.289	9.309	9.328	9.348	9.368	9.388	9.408	9.427	9.447
.70..	9.467	9.487	9.507	9.527	9.547	9.566	9.586	9.606	9.627	9.647
.71..	9.666	9.686	9.706	9.726	9.746	9.766	9.786	9.806	9.826	9.846
.72..	9.867	9.887	9.907	9.927	9.947	9.967	9.987	10.007	10.027	10.047
.73..	10.068	10.088	10.108	10.129	10.149	10.169	10.190	10.210	10.230	10.251
.74..	10.271	10.291	10.312	10.332	10.353	10.373	10.393	10.414	10.437	10.455
.75..	10.475	10.496	10.516	10.537	10.557	10.578	10.598	10.619	10.640	10.660
.76..	10.681	10.702	10.722	10.743	10.764	10.784	10,805	10.826	10.846	10.867

Head in ft.	0	1	2	3	4	5	6	7	8	9
.77..	10.888	10.909	10.930	10.950	10.971	10.992	11.013	11.034	11.054	11.075
.78..	11.096	11.117	11.138	11.159	11.180	11.200	11.221	11.242	11.263	11.284
.79..	11.305	11.326	11.347	11.368	11.389	11.410	11.431	11.452	11.473	11.494
.80..	11.515	11.536	11.557	11.578	11.599	11.620	11.642	11.663	11.684	11.705
.81..	11.726	11.747	11.769	11.790	11.811	11.832	11.854	11.875	11.896	11.918
.82..	11.939	11.960	11.982	12.003	12.025	12.046	12.067	12.089	12.110	12.131
.83..	12.153	12.174	12.196	12.217	12.239	12.260	12.281	12.303	12.324	12.345
.84..	12.367	12.389	12.410	12.432	12.453	12.475	12.497	12.518	12.540	12.561
.85..	12.583	12.605	12.627	12.648	12.670	12.692	12.714	12.736	12.757	12.779
.86..	12.801	12.823	12.845	12.866	12.888	12.910	12.932	12.954	12.975	12.997
.87..	13.019	13.041	13.063	13.085	13.107	13.128	13.150	13.172	13.194	13.216
.88..	13.238	13.260	13.282	13.304	13.326	13.348	13.371	13.393	13.415	13.437
.89..	13.459	13.481	13.503	13.525	13.547	13.569	13.592	13.614	13.636	13.658
.90..	13.680	13.702	13.725	13.747	13.769	13.791	13.814	13.836	13.858	13.881
.91..	13.903	13.925	13.948	13.970	13.992	14.014	14.037	14.059	14.081	14.014
.92..	14.126	14.148	14.171	14.193	14.216	14.238	14.261	14.283	14.306	14.328
.93..	14.351	14.373	14.396	14.418	14.441	14.463	14.486	14.508	14.531	14.553
.94..	14.576	14.599	14.621	14.644	14.666	14.689	14.712	14.734	14.757	14.779
.95..	14.802	14.825	14.847	14.870	14.893	14.915	14.938	14.961	14.984	15.006
.96..	15.029	15.052	15.075	15.098	15.121	15.143	15.166	15.189	15.212	15.235
.97..	15.258	15.281	15.304	15.327	15.350	15.373	15.396	15.419	15.442	15.465
.98..	15.488	15.511	15.534	15.557	15.580	15.603	15.626	15.649	15.672	15.695
.99..	15.718	15.741	15.764	15.787	15.811	15.834	15.857	15.880	15.904	15.927
1.00..	15.950	15.973	15.996	16.019	16.043	16.066	16.089	16.112	16.136	16.159
1.01..	16.182	16.205	16.229	16.252	16.276	16.299	16.322	16.346	16.369	16.392
1.02..	16.416	16.439	16.463	16.486	16.510	16.533	16.557	16.580	16.604	16.627
1.03..	16.651	16.675	16.698	16.722	16.745	16.769	16.792	16.816	16.840	16.863
1.04..	16.887	16.911	16.934	16.958	16.982	17.005	17.029	17.053	17.077	17.100
1.05..	17.124	17.148	17.171	17.195	17.219	17.242	17.266	17.290	17.314	17.337
1.06..	17.361	17.386	17.409	17.432	17.456	17.479	17.503	17.527	17.551	17.574
1.07..	17.599	17.623	17.647	17.671	17.694	17.718	17.742	17.766	17.790	17.814
1.08..	17.838	17.862	17.886	17.910	17.934	17.958	17.982	18.006	18.030	18.054
1.09..	18.078	18.102	18.126	18.150	18.174	18.198	18.223	18.247	18.271	18.295
1.10..	18.319	18.343	18.368	18.392	18.416	18.440	18.465	18.489	18.513	18.537
1.11..	18.562	18.586	18.610	18.635	18.659	18.683	18.708	18.732	18.756	18.781
1.12..	18.805	18.829	18.854	18.878	18.903	18.927	18.951	18.976	19.000	19.025
1.13..	19.049	19.073	19.098	19.122	19.147	19.171	19.196	19.220	19.245	19.269
1.14..	19.294	19.318	19.343	19.367	19.392	19.416	19.441	19.465	19.490	19.514
1.15..	19.539	19.564	19.588	19.613	19.637	19.662	19.687	19.711	19.736	19.760
1.16..	19.785	19.810	19.835	19.859	19.884	19.909	19.934	19.959	19.983	20.008
1.17..	20.033	20.058	20.083	20.107	20.132	20.157	20.182	20.207	20.231	20.259
1.18..	20.281	20.306	20.331	20.356	20.381	20.405	20.430	20.455	20.480	20.505
1.19..	20.530	20.555	20.580	20.605	20.630	20.655	20.680	20.705	20.730	20.755
1.20..	20.780	20.805	20.830	20.855	20.880	20.905	20.931	20.956	20.981	21.006
1.21..	21.031	21.056	21.081	21.106	21.132	21.157	21.182	21.207	21.233	21.258
1.22..	21.283	21.308	21.333	21.359	21.384	21.409	21.434	21.459	21.485	21.510
1.23..	21.535	21.560	21.585	21.611	21.637	21.663	21.687	21.713	21.738	21.764
1.24..	21.789	21.814	21.840	21.865	21.891	21.916	21.941	21.967	21.992	22.017
1.25..	22.043	22.068	22.094	22.119	22.145	22.170	22.196	22.221	22.247	22,272

TABLE III.—(Continued.)

6-Ft. Weir.

Head in ft.	0	1	2	3	4	5	6	7	8	9
.01..	.021	.025	.028	.032	.036	.039	.043	.047	.051	.054
.02..	.058	.063	.067	.072	.077	.082	.087	.092	.096	.101
.03..	.106	.112	.117	.123	.129	.134	.140	.146	.152	.157
.04..	.163	.169	.176	.182	.189	.195	.202	.208	.215	.221
.05..	.228	.235	.242	.249	.256	.263	.271	.278	.285	.292
.06..	.299	.307	.315	.322	.330	.338	.346	.354	.361	.369
.07..	.377	.385	.394	.402	.410	.418	.427	.435	.443	.452
.08..	.460	.469	.478	.486	.495	.504	.513	.522	.530	.539
.09..	.548	.557	.567	.576	.585	.594	.604	.613	.622	.632
.10..	.641	.651	.660	.670	.680	.689	.699	.709	.719	.728
.11..	.738	.748	.759	.769	.780	.790	.800	.811	.821	.832
.12..	.842	.853	.863	.874	.885	.895	.906	.917	.928	.938
.13..	.949	.960	.971	.982	.993	1.004	1.015	1.026	1.037	1.048
.14..	1.059	1.070	1.082	1.093	1.105	1.116	1.127	1.139	1.150	1.162
.15..	1.173	1.185	1.197	1.208	1.220	1.232	1.244	1.256	1.267	1.279
.16..	1.291	1.303	1.315	1.327	1.339	1.351	1.364	1.376	1.388	1.400
.17..	1.412	1.425	1.437	1.450	1.462	1.475	1.488	1.500	1.513	1.525
.18..	1.538	1.551	1.564	1.576	1.589	1.602	1.615	1.628	1.640	1.653
.19..	1.666	1.679	1.692	1.706	1.719	1.732	1.745	1.758	1.772	1.785
.20..	1.798	1.811	1.825	1.838	1.852	1.865	1.878	1.892	1.905	1.919
.21..	1.932	1.946	1.960	1.974	1.988	2.002	2.016	2.029	2.042	2.056
.22..	2.070	2.084	2.098	2.112	2.126	2.140	2.154	2.168	2.182	2.196
.23..	2.210	2.224	2.239	2.253	2.268	2.282	2.296	2.311	2.325	2.340
.24..	2.354	2.369	2.383	2.398	2.412	2.427	2.442	2.456	2.471	2.485
.25..	2.500	2.515	2.530	2.544	2.559	2.574	2.589	2.604	2.628	2.643
.26..	2.648	2.663	2.679	2.694	2.709	2.724	2.740	2.755	2.770	2.785
.27..	2.801	2.816	2.832	2.847	2.863	2.878	2.893	2.909	2.924	2.940
.28..	2.955	2.971	2.986	3.002	3.018	3.033	3.049	3.065	3.081	3.096
.29..	3.112	3.128	3.144	3.160	3.176	3.191	3.207	3.223	3.239	3.255
.30..	3.271	3.287	3.303	3.320	3.336	3.352	3.368	3.384	3.401	3.417
.31..	3.433	3.449	3.466	3.482	3.499	3.515	3.531	3.548	3.564	3.581
.32..	3.597	3.614	3.630	3.647	3.664	3.680	3.697	3.714	3.731	3.747
.33..	3.764	3.781	3.798	3.815	3.832	3.849	3.866	3.883	3.900	3.917
.34..	3.934	3.951	3.968	3.986	4.003	4.020	4.037	4.054	4.072	4.089
.35..	4.106	4.123	4.141	4.158	4.175	4.192	4.210	4.227	4.244	4.262
.36..	4.279	4.296	4.314	4.331	4.349	4.366	4.383	4.401	4.418	4.436
.37..	4.453	4.471	4.488	4.506	4.523	4.541	4.559	4.576	4.594	4.611
.38..	4.629	4.647	4.665	4.683	4.701	4.719	4.737	4.755	4.773	4.791
.39..	4.809	4.827	4.845	4.863	4.881	4.899	4.918	4.936	4.954	4.972
.40..	4.990	5.008	5.027	5.045	5.064	5.082	5.100	5.119	5.137	5.156
.41..	5.174	5.193	5.212	5.230	5.249	5.268	5.286	5.304	5.322	5.340
.42..	5.362	5.381	5.400	5.419	5.438	5.457	5.476	5.495	5.514	5.533
.43..	5.552	5.571	5.591	5.610	5.629	5.649	5.668	5.687	5.706	5.726
.44..	5.745	5.764	5.784	5.803	5.823	5.842	5.862	5.881	5.901	5.920
.45..	5.940	5.960	5.979	5.999	6.018	6.038	6.058	6.077	6.079	6.116
.46..	6.136	6.156	6.176	6.196	6.216	6.235	6.255	6.275	6.295	6.315
.47..	6.335	6.355	6.375	6.395	6.415	6.435	6.456	6.476	6.496	6.516
.48..	6.536	6.556	6.576	6.597	6.616	6.637	6.657	6.677	6.698	6.718
.49..	6.739	6.758	6.778	6.799	6.819	6.839	6.860	6.880	6.900	6.921
.50..	6.941	6.961	6.982	7.002	7.023	7.043	7.064	7.084	7.105	7.125
.51..	7.146	7.167	7.188	7.208	7.229	7.250	7.271	7.292	7.312	7.333
.52..	7.354	7.375	7.396	7.417	7.438	7.459	7.480	7.501	7.522	7.543
.53..	7.564	7.585	7.607	7.628	7.650	7.671	7.692	7.714	7.735	7.757
.54..	7.778	7.800	7.821	7.843	7.864	7.886	7.908	7.929	7.951	7.972
.55..	7.994	8.016	8.037	8.059	8.080	8.102	8.124	8.145	8.167	8.188
.56..	8.210	8.232	8.254	8.275	8.297	8.319	8.341	8.363	8.384	8.406
.57..	8.428	8.450	8.472	8.494	8.516	8.538	8.560	8.582	8.604	8.626
.58..	8.648	8.670	8.692	8.714	8.736	8.758	8.781	8.803	8.825	8.847
.59..	8.869	8.891	8.914	8.936	8.958	8.980	9.003	9.025	9.047	9.070
.60..	9.092	9.114	9.137	9.159	9.182	9.204	9.227	9.249	9.272	9.294
.61..	9.317	9.340	9.362	9.385	9.407	9.430	9.453	9.475	9.498	9.520
.62..	9.543	9.566	9.589	9.611	9.634	9.657	9.680	9.703	9.725	9.748
.63..	9.771	9.794	9.817	9.840	9.863	9.886	9.909	9.932	9.955	9.978
.64..	10.001	10.024	10.047	10.071	10.094	10.117	10.140	10.163	10.187	10.210
.65..	10.233	10.256	10.280	10.303	10.236	10.349	10.373	10.396	10.419	10.443
.66..	10.466	10.489	10.513	10.536	10.560	10.583	10.607	10.630	10.654	10.667
.67..	10.701	10.725	10.748	10.772	10.795	10.819	10.842	10.866	10.890	10.913
.68..	10.937	10.961	10.985	11.008	11.032	11.056	11.080	11.103	11,127	11.151
.69..	11.175	11.199	11.223	11.247	11.271	11.295	11.319	11.343	11.367	11.391
.70..	11.415	11.439	11.463	11.487	11.511	11.535	11.560	11.584	11.608	11.632
.71..	11.656	11.680	11.704	11.729	11.753	11.777	11.801	11.825	11.850	11.874
.72..	11.898	11.922	11.947	11.971	11.996	12.020	12.044	12.069	12.093	12.118
.73..	12.142	12.167	12.191	12.216	12.240	12.265	12.290	12.314	12.339	12.363
.74..	12.388	12.413	12.437	12.462	12.487	12.511	12.536	12.561	12.586	12.610
.75..	12.635	12.660	12.685	12.710	12.735	12.760	12.785	12.810	12.835	12.860
.76..	12.885	12.910	12.935	12.960	12.985	13.010	13.035	13.060	13.085	13.110
.77..	13.135	13.160	13.185	13.211	13.236	13.261	13.286	13.311	13.337	13.362
.78..	13.387	13.412	13.438	13.463	13.488	13.513	13.539	13.564	13.589	13.615

Head in ft.	0	1	2	3	4	5	6	7	8	9
.79	13.640	13.665	13.691	13.716	13.742	13.767	13.793	13.818	13.844	13.869
.80	13.895	13.920	13.946	13.971	13.997	14.022	14.048	14.073	14.099	14.124
.81	14.150	14.176	14.202	14.227	14.253	14.279	14.305	14.331	14.356	14.382
.82	14.408	14.434	14.460	14.486	14.512	14.537	14.563	14.589	14.615	14.641
.83	14.667	14.693	14.719	14.745	14.771	14.797	14.823	14.849	14.875	14.901
.84	14.927	14.953	14.979	15.006	15.032	15.058	15.084	15.110	15.137	15.163
.85	15.189	15.215	15.242	15.268	15.294	15.320	15.347	15.373	15.399	15.426
.86	15.452	15.478	15.505	15.531	15.558	15.584	15.610	15.637	15.663	15.690
.87	15.716	15.743	15.769	15.796	15.823	15.849	15.876	15.903	15.930	15.956
.88	15.983	16.010	16.036	16.063	16.090	16.116	16.143	16.170	16.197	16.223
.89	16.250	16.277	16.304	16.330	16.357	16.384	16.411	16.438	16.464	16.491
.90	16.518	16.545	16.572	16.599	16.626	16.652	16.679	16.706	16.733	16.760
.91	16.787	16.814	16.841	16.868	16.895	16.922	16.950	16.978	17.004	17.031
.92	17.058	17.085	17.112	17.140	17.167	17.194	17.221	17.248	17.276	17.303
.93	17.330	17.357	17.385	17.412	17.440	17.467	17.495	17.522	17.550	17.577
.94	17.605	17.632	17.660	17.687	17.715	17.742	17.770	17.797	17.825	17.852
.95	17.880	17.908	17.935	17.963	17.990	18.018	18.046	18.073	18.102	18.128
.96	18.156	18.184	18.212	18.239	18.267	18.295	18.323	18.351	18.378	18.406
.97	18.434	18.462	18.490	18.518	18.546	18.573	18.601	18.629	18.657	18.685
.98	18.713	18.741	18.769	18.797	18.825	18.852	18.880	18.908	18.936	18.964
.99	18.992	19.020	19.048	19.076	19.104	19.132	19.161	19.189	19.217	19.245
1.00	19.273	19.301	19.329	19.358	19.386	19.414	19.442	19.470	19.499	19.527
1.01	19.555	19.583	19.612	19.640	19.669	19.697	19.725	19.754	19.782	19.811
1.02	19.839	19.867	19.896	19.924	19.953	19.981	20.010	20.038	20.067	20.095
1.03	20.124	20.153	20.181	20.210	20.238	20.267	20.296	20.324	20.353	20.381
1.04	20.410	20.439	20.468	20.496	20.525	20.554	20.583	20.612	20.640	20.669
1.05	20.698	20.727	20.756	20.784	20.814	20.842	20.871	20.900	20.929	20.958
1.06	20.987	21.016	21.045	21.074	21.103	21.131	21.160	21.189	21.218	21.247
1.07	21.276	21.305	21.334	21.363	21.392	21.421	21.451	21.480	21.509	21.538
1.08	21.567	21.596	21.625	21.654	21.684	21.713	21.742	21.771	21.801	21.830
1.09	21.859	21.888	21.918	21.947	21.976	22.005	22.035	22.064	22.093	22.123
1.10	22.152	22.181	22.211	22.240	22.270	22.300	22.329	22.358	22.388	22.417
1.11	22.447	22.476	22.506	22.535	22.565	22.594	22.624	22.653	22.683	22.712
1.12	22.742	22.772	22.801	22.831	22.860	22.890	22.920	22.949	22.979	23.008
1.13	23.038	23.068	23.098	23.127	23.157	23.187	23.217	23.247	23.276	23.306
1.14	23.336	23.366	23.396	23.426	23.456	23.485	23.515	23.545	23.575	23.605
1.15	23.635	23.665	23.695	23.725	23.755	23.785	23.815	23.845	23.875	23.905
1.16	23.935	23.965	23.995	24.025	24.055	24.085	24.116	24.146	24.176	24.206
1.17	24.236	24.266	24.296	24.327	24.357	24.387	24.417	24.447	24.478	24.508
1.18	24.538	24.568	24.599	24.629	24.660	24.690	24.720	24.751	24.781	24.812
1.19	24.842	24.872	24.903	24.933	24.964	24.994	25.024	25.055	25.085	25.116
1.20	25.146	25.176	25.207	25.237	25.268	25.298	25.329	25.359	25.390	25.420
1.21	24.451	25.482	25.512	25.543	25.573	25.604	25.635	25.665	25.696	25.726
1.22	25.757	25.788	25.819	25.849	25.880	25.911	25.942	25.973	26.003	26.034
1.23	26.065	26.096	26.127	26.157	26.188	26.219	26.250	26.281	26.311	26.342
1.24	26.373	26.404	26.435	26.466	26.491	26.528	26.559	26.590	26.621	26.652
1.25	26.683	26.714	26.745	26.776	26.807	26.838	26.869	26.900	26.931	26.962
1.26	26.993	27.024	27.055	27.087	27.118	27.149	27.180	27.211	27.243	27.274
1.27	27.305	27.336	27.368	27.399	27.430	27.461	27.493	27.524	27.555	27.587
1.28	27.618	27.649	27.681	27.712	27.744	27.775	27.806	27.838	27.869	27.901
1.29	27.932	27.963	27.995	28.026	28.058	28.089	28.121	28.152	28.184	28.215
1.30	28.247	28.278	28.310	28.341	28.373	28.404	28.436	28.467	28.499	28.530
1.31	28.562	28.594	28.625	28.657	28.689	28.720	28.752	28.784	28.816	28.847
1.32	28.879	28.911	28.942	28.974	29.006	29.037	29.069	29.101	29.133	29.164
1.33	29.196	29.229	29.260	29.292	29.324	29.355	29.387	29.419	29.451	29.483
1.34	29.515	29.547	29.579	29.611	29.643	29.675	29.707	29.739	29.771	29.803
1.35	29.835	29.867	29.899	29.931	29.963	29.995	30.028	30.060	30.092	30.124
1.36	30.156	30.188	30.220	30.252	30.284	30.316	30.349	30.381	30.413	30.445
1.37	30.477	30.509	30.542	30.574	30.606	30.638	30.671	30.703	30.735	30.768
1.38	30.800	30.832	30.865	30.897	30.930	30.962	30.994	31.027	31.059	31.092
1.39	31.124	31.156	31.189	31.221	31.254	31.286	31.318	31.351	31.383	31.416
1.40	31.448	31.480	31.513	31.545	31.578	31.610	31.643	31.675	31.708	31.740
1.41	31.773	31.806	31.838	31.871	31.904	31.936	31.969	32.002	32.035	32.067
1.42	32.100	32.133	32.165	32.198	32.231	32.263	32.296	32.329	32.362	32.394
1.43	32.427	32.460	32.493	32.525	32.558	32.591	32.624	32.657	32.689	32.722
1.44	32.755	32.788	32.821	32.854	32.887	32.920	32.953	32.986	33.019	33.052
1.45	33.085	33.118	33.151	33.184	33.217	33.250	33.283	33.316	33.349	33.382
1.46	33.415	33.448	33.481	33.514	33.547	33.580	33.614	33.647	33.680	33.713
1.47	33.746	33.779	33.812	33.846	33.879	33.912	33.945	33.978	34.012	34.045
1.48	34.078	34.111	34.144	34.178	34.211	34.244	34.277	34.310	34.344	34.377
1.49	34.410	34.443	34.477	34.510	34.544	34.577	34.611	34.644	34.678	34.711
1.50	34.745	34.779	34.812	34.846	34.879	34.913	34.947	34.980	35.014	35.047

TABLE III.—(Continued.)

8-Ft. Weir.

Head in ft.	0	1	2	3	4	5.	6.	7.	8.	9.
.01	.024	.029	.035	.040	.045	.050	.056	.061	.066	.072
.02	.077	.083	.090	.096	.103	.109	.115	.122	.128	.135
.03	.141	.149	.156	.164	.172	.179	.187	.195	.203	.210
.04	.218	.226	.235	.243	.252	.260	.269	.277	.286	.294
.05	.303	.313	.322	.332	.341	.351	.361	.370	.380	.389
.06	.399	.409	.420	.430	.441	.451	.461	.472	.482	.493
.07	.503	.514	.525	.536	.547	.558	.569	.580	.591	.602
.08	.613	.625	.637	.648	.660	.672	.684	.696	.707	.719
.09	.731	.743	.756	.768	.781	.793	.806	.818	.831	.843
.10	.856	.869	.882	.895	.908	.921	.935	.948	.961	.974
.11	.987	1.001	1.014	1.028	1.041	1.055	1.069	1.082	1.096	1.109
.12	1.123	1.137	1.151	1.166	1.180	1.194	1.208	1.222	1.237	1.251
.13	1.265	1.280	1.295	1.309	1.324	1.339	1.354	1.369	1.383	1.398
.14	1.413	1.428	1.444	1.459	1.474	1.489	1.504	1.520	1.535	1.551
.15	1.566	1.582	1.597	1.613	1.629	1.644	1.660	1.676	1.692	1.707
.16	1.723	1.739	1.756	1.772	1.788	1.804	1.821	1.837	1.853	1.870
.17	1.886	1.903	1.919	1.936	1.953	1.969	1.986	2.003	2.020	2.036
.18	2.053	2.070	2.087	2.105	2.122	2.139	2.156	2.173	2.191	2.208
.19	2.225	2.243	2.260	2.278	2.295	2.313	2.331	2.348	2.366	2.383
.20	2.401	2.419	2.437	2.455	2.473	2.491	2.509	2.527	2.545	2.563
.21	2.581	2.599	2.618	2.636	2.655	2.673	2.691	2.710	2.728	2.747
.22	2.765	2.784	2.803	2.821	2.840	2.859	2.878	2.897	2.915	2.934
.23	2.953	2.972	2.991	3.011	3.030	3.049	3.068	3.087	3.107	3.126
.24	3.145	3.165	3.184	3.204	3.223	3.243	3.263	3.282	3.302	3.321
.25	3.341	3.361	3.381	3.401	3.421	3.440	3.460	3.480	3.500	3.520
.26	3.540	3.560	3.581	3.601	3.621	3.641	3.662	3.682	3.702	3.723
.27	3.743	3.764	3.784	3.805	3.825	3.846	3.867	3.887	3.908	3.928
.28	3.949	3.970	3.991	4.012	4.033	4.053	4.074	4.095	4.116	4.137
.29	4.158	4.179	4.200	4.222	4.243	4.264	4.285	4.306	4.328	4.349
.30	4.370	4.391	4.413	4.434	4.456	4.477	4.499	4.520	4.542	4.563
.31	4.585	4.607	4.629	4.650	4.672	4.694	4.716	4.738	4.759	4.781
.32	4.803	4.825	4.847	4.870	4.892	4.914	4.936	4.958	4.981	5.003
.33	5.025	5.048	5.070	5.093	5.115	5.138	5.161	5.183	5.206	5.228
.34	5.251	5.274	5.297	5.320	5.343	5.366	5.389	5.412	5.435	5.458
.35	5.481	5.504	5.528	5.551	5.575	5.598	5.621	5.645	5.668	5.692
.36	5.715	5.739	5.762	5.786	5.810	5.833	5.857	5.881	5.904	5.928
.37	5.952	5.976	6.000	6.024	6.048	6.072	6.096	6.120	6.144	6.168
.38	6.192	6.216	6.240	6.264	6.288	6.312	6.337	6.361	6.385	6.409
.39	6.433	6.457	6.482	6.506	6.531	6.555	6.579	6.604	6.628	6.653
.40	6.677	6.702	6.726	6.751	6.775	6.800	6.825	6.849	6.874	6.898
.41	6.923	6.948	6.973	6.999	7.024	7.049	7.074	7.099	7.125	7.150
.42	7.175	7.200	7.226	7.251	7.277	7.302	7.328	7.353	7.379	7.404
.43	7.430	7.456	7.482	7.507	7.533	7.559	7.585	7.611	7.636	7.662
.44	7.688	7.714	7.740	7.767	7.793	7.819	7.845	7.871	7.898	7.924
.45	7.950	7.976	8.003	8.029	8.056	8.082	8.108	8.135	8.161	8.188
.46	8.214	8.241	8.267	8.294	8.320	8.347	8.374	8.400	8.427	8.453
.47	8.480	8.507	8.534	8.561	8.588	8.615	8.642	8.669	8.696	8.723
.48	8.750	8.777	8.804	8.832	8.859	8.886	8.913	8.940	8.968	8.995
.49	9.022	9.049	9.077	9.104	9.132	9.159	9.187	9.214	9.242	9.269
.50	9.297	9.325	9.352	9.380	9.408	9.435	9.463	9.491	9.519	9.546
.51	9.574	9,602	9.630	9.658	9.686	9.713	9.741	9.769	9.797	9.825
.52	9.853	9.881	9.910	9.938	9.966	9.994	10.023	10.051	10.079	10.108
.53	10.136	10.164	10.193	10.221	10.250	10.278	10.307	10.335	10.364	10.392
.54	10.421	10.450	10.479	10.507	10.536	10.565	10.594	10.623	10.651	10.680
.55	10.709	10.738	10.767	10.796	10.825	10.854	10.833	10.912	10.941	10.970
.56	10.999	11.028	11.057	11.087	11.116	11.145	11.174	11.203	11.233	11.262
.57	11.291	11.321	11.350	11.380	11.409	11.439	11.469	11.498	11.528	11.557
.58	11.587	11.617	11.646	11.676	11.706	11.735	11.765	11.795	11.825	11.854
.59	11.884	11.914	11.944	11.974	12.004	12.034	12.064	12.094	12.124	12.154
.60	12.184	12.214	12.245	12.275	12.305	12.335	12.366	12.396	12.426	12.457
.61	12.487	12.517	12.548	12.578	12.609	12.639	12.670	12.700	12.731	12.761
.62	12.792	12.823	12.853	12.884	12.915	12.945	12.976	13.007	13.038	13.068
.63	13.099	13.130	13.161	13.192	13.223	13.253	13.284	13.315	13.346	13.377
.64	13.408	13.439	13.470	13.501	13.532	13.563	13.595	13.625	13.657	13.688
.65	13.719	13.750	13.782	13.813	13.845	13.876	13.907	13.939	13.970	14.002
.66	14.033	14.065	14.096	14.128	14.159	14.191	14.223	14.254	14.286	14.317
.67	14.349	14.381	14.413	14.444	14.476	14.508	14.540	14.572	14.603	14.635
.68	14.667	14.699	14.731	14.763	14.795	14.827	14.860	14.892	14.924	14.956
.69	14.988	15.020	15.052	15.085	15.117	15.149	15.181	15.213	15.246	15.278
.70	15,310	15.342	15.375	15.407	15.440	15.472	15.505	15.537	15.570	15.602
.71	15.635	15.668	15.700	15.733	15.766	15.798	15.831	15.864	15.897	15.929
.72	15.962	15.995	16.028	16.061	16.094	16.126	16.159	16.192	16.225	16.258
.73	16.291	16.324	16.357	16.390	16.423	16.456	16.490	16.523	16.556	16.589
.74	16.622	16.655	16.689	16.722	16.756	16.789	16.822	16.856	16.889	16.923
.75	16.956	16.989	17.023	17.056	17.090	17.123	17.157	17.190	17.224	17.257
.76	17.291	17.325	17.358	17.392	17.426	17.459	17.493	17.527	17.561	17.594
.77	17.628	17.662	17.696	17.730	17.764	17.798	17.832	17.866	17.900	17.934
.78	17.968	18.002	18.036	18.070	18.104	18.138	18.173	18.207	18.241	18.275
.79	18.309	18.343	18.378	18.412	18.447	18.481	18.515	18.550	18.584	18.619
.80	18.653	18.687	18.722	18.756	18.791	18.825	18.860	18.894	18.929	18.963
.81	18.998	19.033	19.067	19.102	19.137	19.171	19.206	19.241	19.276	19.310
.82	19.345	19.380	19.415	19.450	19.485	19.520	19.555	19.590	19.625	19.660
.83	19.695	19.730	19.765	19.800	18.835	19.870	19.906	19.941	19.976	20.011
.84	20.046	20.081	20.117	20.152	20.187	20.223	20.258	20.293	20.329	20.364
.85	20.399	20.434	20.470	20.505	20.541	20.576	20.612	20.647	20.683	20.718
.86	20.754	20.790	20.825	20.861	20.897	20.932	20.968	21.004	21.040	21.075
.87	21.111	21.147	21.183	21.219	21.255	21.491	21.327	21.363	21.399	21.435
.88	21.471	21.507	21.543	21.579	21.615	21.651	21.688	21.724	21.760	21.796
.89	21.832	21.868	21.904	21.941	21.977	22.013	22.049	22.085	22.122	22.158
.90	22.194	22.230	22.267	22.303	22.340	22.376	22.412	22.449	22.485	22.522
.91	22.558	22.595	22.631	22.669	22.705	22.741	22.778	22.815	22.852	22.888
.92	22.925	22.962	22.999	23.035	23.072	23.109	23.146	23.183	23.219	23.256
.93	23.293	23.330	23.367	23.404	23.441	23.478	23.515	23.552	23.589	23.626
.94	23.663	23.700	23.737	23.774	23.811	23.848	23.886	23.923	23.960	23.997
.95	24.034	24.071	24.109	24.146	24.184	24.221	24.258	24.296	24.333	24.371
.96	24.408	24.445	24.483	24.520	24.558	24.595	24.633	24.670	24.708	24.745
.97	24.783	24.821	24.859	24.896	24.934	24.972	25.009	25.048	25.085	25.123
.98	25.161	25.199	25.237	25.274	25.312	25.350	25.388	25.426	25.463	25.501
.99	25.539	25.577	25.615	25.653	25.691	25.729	25.767	25.805	25.843	25.881
1.00	25.919	25.957	25.996	26.034	26.072	26.110	26.149	26.187	26.225	26.263
1.01	26.302	26.340	26.379	26.417	26.456	26.494	26.532	26.571	26.609	26.648
1.02	26.686	26.724	26.763	26.801	26.840	26.878	26.917	26.955	26.994	27.032
1.03	27.071	27.110	27.148	27.187	27.226	27.264	27.303	27.342	27.381	27.419
1.04	27.458	27.497	27.536	27.575	27.614	27.652	27.691	27.730	27.769	27.808
1.05	27.847	27.886	27.925	27.964	28.003	28.042	28.082	28.121	28.160	28.199
1.06	28.238	28.277	28.316	28.356	28.395	28.434	28.473	28.512	28.552	28.591
1.07	28.630	28.669	28.709	28.748	28.788	28.827	28.866	28.906	28.945	28.985
1.08	29.024	29.064	29.103	29.142	29.182	29.222	29.262	29.301	29.341	29.380
1.09	29.420	29.460	29.499	29.539	29.579	29.618	29.658	29.698	29.738	29.777
1.10	29.817	29.857	29.897	29.937	29.977	30.016	30.056	30.096	30.136	30.176
1.11	30.216	30.256	30.296	30.336	30.376	30.416	30.456	30.496	30.536	30.576
1.12	30.616	30.656	30.696	30.737	30.777	30.817	30.857	30.897	30.938	30.978
1.13	31.019	31.058	31.099	31.139	31.180	31.220	31.260	31.301	31.342	31.382
1.14	31.422	31.462	31.503	31.543	31.584	31.624	31.665	31.705	31.746	31.786
1.15	31.827	31.868	31.908	31.949	31.990	32.030	32.071	32.112	32.153	32.193
1.16	32.234	32.275	32.316	32.356	32.397	32.438	32.479	32.520	32.560	32.601
1.17	32.642	32.683	32.724	32.765	32.806	32.847	32.888	32.929	32.970	33.011
1.18	33.052	33.093	33.134	33.176	33.217	33.258	33.299	33.340	33.382	33.423
1.19	33.464	33.505	33.547	33.588	33.629	33.670	33.712	33.753	33.794	33.836
1.20	33.877	33.918	33.960	34.001	34.043	34.084	34.125	34.167	34.208	34.250
1.21	34.291	34.333	34.374	31.416	24.457	34.499	34.541	34.582	24.624	34.665
1.22	34.707	34.749	34.790	34.832	34.874	34.915	34.951	34.999	35.041	35.082
1.23	35.124	35.166	35.208	35.250	35.292	35.334	35.376	35.418	35.460	35.502
1.24	35.544	35.586	35.628	35.670	35.712	35.754	35.796	35.838	35.880	35.922
1.25	35.964	36.006	36.048	36.091	36.133	36.175	36.217	36.259	36.302	36.344
1.26	36.386	36.428	36.471	36.513	36.556	36.598	36.640	36.683	36.725	36.768
1.27	36.810	36.852	36.895	36.937	36.980	37.022	37.064	37.107	37.149	37.192
1.28	37.234	37.277	37.319	37.362	37.405	37.447	37.490	37.533	37.576	37.618
1.29	37.661	37.704	37.747	37.789	37.832	37.875	37.917	37.961	38.003	38.046
1.30	38.089	38.132	38.175	38.218	38.261	38.303	38.346	38.389	38.432	38.475
1.31	38.518	38.561	38.604	38.647	38.690	38.733	38.776	38.819	38.862	38.905
1.32	38.948	38.991	39.034	39.078	39.121	39.164	39.207	39.250	39.294	39.337
1.33	39.380	39.423	39.467	39.510	39.554	39.597	39.640	39.684	39.727	39.771
1.34	39.814	39.857	39.901	39.944	39.988	40.031	40.075	40.118	40.162	40.205
1.35	40.249	40.293	40.336	40.380	40.423	40.467	40.511	40.554	40.598	40.641
1.36	40.685	40.729	40.773	40.816	40.860	40.904	40.948	40.992	41.035	41.079
1.37	41.123	41.167	41.211	41.255	41.299	41.342	41.386	41.430	41.474	41.518
1.38	41.562	41.606	41.650	41.694	41.738	41.782	41.826	41.870	41.914	41.958
1.39	42.002	42.046	42.091	42.135	42.179	42.223	42.267	42.311	42.356	42.400
1.40	42.444	42.488	42.533	42.577	42.621	42.665	42.710	42.754	42.798	42.843
1.41	42.887	42.931	42.976	43.020	43.065	43.109	43.153	43.198	43.242	43.287
1.42	43.331	43.376	43.420	43.465	43.569	43.554	43.599	43.643	43.688	43.732
1.43	43.777	43.823	43.867	43.911	43.956	44.001	44.046	44.091	44.135	44.180
1.44	44.225	44.270	44.315	44.359	44.404	44.449	44.494	44.539	44.583	44.628
1.45	44.673	44.718	44.763	44.808	44.853	44.898	44.943	44.988	45.033	45.078
1.46	45.123	45.168	45.213	45.258	45.303	45.348	45.394	45.439	45.484	45.529
1.47	45.574	45.619	45.665	45.710	45.755	45.800	45.846	45.891	45.936	45.982
1.48	46.027	46.072	46.118	46.163	46.209	46.254	46.299	46.345	46.390	46.436
1.49	46.481	46.526	46.572	46.617	46.663	46.708	46.754	46.799	46.845	46.890
1.50	46.936	46.982	47.027	47.073	47.118	47.164	47.210	47.255	47.301	47.346
1.51	47.392	47.438	47.484	47.529	47.575	47.621	47.667	47.713	47.758	47.804
1.52	47.850	47.896	47.942	47.988	48.034	48.079	48.125	48.171	48.217	48.263
1.53	48.309	48.355	48.401	48.447	48.493	48.539	48.585	48.631	48.677	48.723
1.54	48.769	48.815	48.861	48.907	48.953	48.999	49.046	49.092	49.138	49.184
1.55	49.230	49.276	49.323	49.369	49.415	49.461	49.508	49.554	49.600	49.647
1.56	49.693	49.739	49.786	49.832	49.879	49.925	49.972	50.018	50.065	50.111
1.57	50.158	50.204	50.251	50.297	50.344	50.392	50.437	50.483	50.530	50.576
1.58	50.623	50.670	50.716	50.763	50.810	50.856	50.903	50.950	50.997	51.043
1.59	51.090	51.137	51.184	51.230	51.277	51.324	51.371	51.418	51.464	51.511
1.60	51.558	51.605	51.652	51.698	51.745	51.792	51.839	51.886	51.932	51.979
1.61	52.026	52.073	52.120	52.167	52.214	52.261	52.308	52.355	52.402	52.449
1 62	52.496	52.543	52.590	52.637	52.684	52.731	52.779	52.826	52.873	52.920
1.63	52.967	53.014	53.062	53.109	53.156	53.203	53.251	53.298	53.345	53.393
1.64	53.440	53.487	53.535	53.582	53.630	53.677	53.724	53.772	53.819	53.867
1.65	53.914	53.961	54.009	54.056	54.104	54.151	54.199	54.246	54.294	54.341
1.66	54.389	54.437	54.484	54.532	54.579	54.627	54.675	54.722	54.770	54.817
1.67	54.865	54.913	54.961	55.008	55.056	55.104	55.152	55.200	55.247	55.295
1.68	55.343	55.391	55.439	55.486	55.534	55.582	55.630	55.678	55.725	55.773
1.69	55.821	55.869	55.917	55.965	56.013	56.061	56.109	56.157	56.205	56.253
1.70	56.301	56.349	56.397	56.445	56.493	56.541	56.589	56.638	56.686	56.734
1.71	56.782	56.830	56.878	56.927	56.975	57.023	57.071	57.119	57.168	57.216
1.72	57.264	57.312	57.361	57.409	57.457	57.505	57.554	57.602	57.650	57.699
1.73	57.747	57.795	57.844	57.892	57.941	57.989	58.038	58.086	58.135	58.183
1.74	58.232	58.281	58.329	58.378	58.426	58.475	58.524	58.572	58.621	58.669
1.75	58.718	58.767	58.815	58.864	58.912	58.961	59.010	59.058	59.107	59.155
1.76	59.204	59.253	59.302	59.350	59.399	59.448	59.497	59.545	59.594	59.643
1.77	59.692	59.741	59.790	59.839	59.888	59.936	59.985	60.034	60.083	60.132
1.78	60.181	60.230	60.279	60.328	60.377	60.426	60.475	60.524	60.573	60.622
1.79	60.671	60.720	60.769	60.819	60.868	60.917	60.966	61.015	61.065	61.114
1.80	61.163	61.212	61.261	61.311	61.360	61.409	61.458	61.507	61.557	61.606
1.81	61.655	61.704	61.754	61.803	61.852	61.901	61.951	62.000	62.049	62.099
1.82	62.148	62.197	62.247	62.296	62.346	62.395	62.445	62.494	62.544	62.593
1.83	62.643	62.693	62.742	62.792	62.841	62.891	62.941	62.990	63.040	63.089
1.84	63.139	63.189	63.238	63.288	63.338	63.387	63.437	63.487	63.537	63.586
1.85	63.636	63.686	63.736	63.785	63.835	63.885	63.935	63.985	64.034	64.084
1.86	64.134	64.184	64.234	64.284	64.334	64.383	64.433	64.483	64.533	64.583
1.87	64.633	64.683	64.733	64.783	64.833	64.883	64.933	64.983	65.033	65.083
1.88	65.133	65.183	65.233	65.283	65.333	65.383	65.434	65.484	65.534	65.584
1.89	65.634	65.684	65.734	65.785	65.835	65.885	65.935	65.985	66.036	66.086

Head in ft.	0	1	2	3	4	5	6	7	8	9
1.90..	66.136	66.186	66.237	66.287	66.337	66.388	66.438	66.488	66.539	66.589
1.91..	66.639	66.689	66.740	66.790	66.841	66.891	66.941	66.992	67.042	67.093
1.92..	67.143	67.194	67.244	67.295	67.345	67.396	67.447	67.497	67.548	67.598
1.93..	67.649	67.700	67.750	67.801	67.852	67.902	67.953	68.003	68.055	68.105
1.94..	68.156	68.207	68.257	68.308	68.359	68.409	68.460	68.511	68.562	68.612
1.95..	68.663	68.714	68.765	68.815	68.866	68.917	68.968	69.019	69.069	69.120
1.96..	69.171	69.222	69.273	69.324	69.375	69.426	69.477	69.528	69.579	69.630
1.97..	69.681	69.732	69.783	69.834	69.885	69.936	69.988	70.039	70.090	70.141
1.98..	70.192	70.243	70.294	70.346	70.397	70.448	70.499	70.550	70.602	70.653
1.99..	70.704	70.755	70.806	70.858	70.909	70.960	71.011	71.062	71.114	71.165
2.00..	71.216	71.267	71.319	71.370	71.421	71.472	71.524	71.575	71.626	71.678

TABLE III.—(Continued.)

10-Ft. Weir.

Head in ft.	0	1	2	3	4	5	6	7	8	9
.01..	.034	.040	.046	.053	.059	.065	.071	.077	.084	.090
.02..	.096	.104	.112	.120	.128	.136	.145	.153	.161	.169
.03..	.177	.186	.196	.205	.215	.224	.234	.243	.253	.262
.04..	.272	.283	.294	.304	.315	.326	.337	.348	.358	.369
.05..	.380	.392	.404	.416	.428	.440	.452	.464	.476	.488
.06..	.500	.513	.526	.539	.552	.564	.577	.590	.603	.616
.07..	.629	.643	.657	.670	.684	.698	.712	.726	.739	.753
.08..	.767	.782	.797	.811	.826	.841	.857	.871	.885	.900
.09..	.915	.930	.946	.961	.977	.992	1.008	1.023	1.039	1.054
.10..	1.070	1.086	1.103	1.119	1.136	1.152	1.168	1.185	1.201	1.217
.11..	1.234	1.251	1.268	1.285	1.302	1.319	1.337	1.354	1.371	1.388
.12..	1.405	1.423	1.441	1.458	1.476	1.494	1.512	1.530	1.547	1.565
.13..	1.583	1.601	1.620	1.638	1.657	1.675	1.694	1.712	1.731	1.749
.14..	1.768	1.787	1.806	1.826	1.845	1.864	1.883	1.902	1.922	1.941
.15..	1.960	1.980	2.000	2.019	2.039	2.059	2.079	2.099	2.118	2.138
.16..	2.158	2.178	2.198	2.219	2.239	2.259	2.279	2.299	2.320	2.340
.17..	2.360	2.381	2.402	2.423	2.444	2.464	2.485	2.506	2.527	2.548
.18..	2.569	2.590	2.612	2.633	2.655	2.676	2.698	2.719	2.741	2.762
.19..	2.784	2.806	2.828	2.850	2.872	2.894	2.916	2.938	2.960	2.982
.20..	3.004	3.026	3.049	3.071	3.094	3.116	3.139	3.161	3.184	3.206
.21..	3.229	3.252	3.275	3.298	3.321	3.344	3.367	3.390	3.413	3.436
.22..	3.459	3.483	3.506	3.530	3.554	3.577	3.601	3.625	3.649	3.672
.23..	3.696	3.720	3.745	3.769	3.793	3.817	3.842	3.866	3.890	3.915
.24..	3.939	3.964	3.988	4.013	4.038	4.062	4.087	4.112	4.137	4.161
.25..	4.186	4.211	4.236	4.261	4.286	4.311	4.337	4.362	4.387	4.411
.26..	4.437	4.462	4.488	4.513	4.539	4.564	4.590	4.615	4.641	4.466
.27..	4.692	4.718	4.744	4.770	4.796	4.822	4.848	4.874	4.900	4.926
.28..	4.952	4.978	5.005	5.031	5.058	5.084	5.110	5.137	5.163	5.190
.29..	5.216	5.243	5.269	5.296	5.323	5.349	5.376	5.403	5.430	5.456
.30..	5.483	5.510	5.537	5.564	5.591	5.618	5.645	5.672	5.699	5.726
.31..	5.753	5.780	5.808	5.835	5.863	5.890	5.917	5.945	5.972	6.000
.32..	6.027	6.055	6.083	6.110	6.138	6.166	6.194	6.222	6.249	6.277
.33..	6.305	6.333	6.361	6.389	6.417	6.445	6.474	6.502	6.530	6.558
.34..	6.586	6.615	6.643	6.672	6.700	6.729	6.758	6.786	6.815	6.843
.35..	6.872	6.901	6.930	6.959	6.988	7.017	7.047	7.076	7.105	7.134
.36..	7.163	7.192	7.222	7.251	7.281	7.310	7.339	7.369	7.398	7.428
.37..	7.457	7.487	7.517	7.546	7.576	7.606	7.636	7.666	7.695	7.725
.38..	7.755	7.785	7.815	7.846	7.876	7.906	7.936	7.966	7.996	8.027
.39..	8.057	8.087	8.118	8.148	8.179	8.209	8.240	8.270	8.301	8.331
.40..	8.362	8.393	8.424	8.455	8.486	8.516	8.547	8.578	8.609	8.640
.41..	8.671	8.702	8.734	8.765	8.797	8.828	8.859	8.891	8.922	8.953
.42..	8.985	9.017	9.049	9.081	9.113	9.145	9.177	9.209	9.241	9.273
.43..	9.305	9.337	9.370	9.402	9.435	9.467	9.499	9.532	9.564	9.597
.44..	9.629	9.662	9.695	9.728	9.761	9.794	9.828	9.861	9.894	9.927
.45..	9.960	9.993	10.026	10.060	10.093	10.126	10.159	10.192	10.226	10.259
.46..	10.292	10.325	10.359	10.392	10.426	10.459	10.493	10.526	10.560	10.593
.47..	10.627	10.661	10.694	10.728	10.762	10.795	10.829	10.863	10.897	10.930
.48..	10.964	10.998	11.032	11.066	11.100	11.133	11.167	11.201	11.235	11.269
.49..	11.303	11.337	11.371	11.406	11.440	11.474	11.508	11.542	11.577	11.611
.50..	11.645	11.680	11.714	11.749	11.783	11.818	11.853	11.887	11.922	11.956
.51..	11.991	12.026	12.061	12.096	12.131	12.166	12.201	12.236	12.271	12.306
.52..	12.341	12.376	12.412	12.447	12.482	12.517	12.553	12.588	12.623	12.659
.53..	12.694	12.730	12.766	12.801	12.837	12.873	12.909	12.945	12.980	13.016
.54..	13.052	13.088	13.125	13.161	13.197	13.233	13.270	13.306	13.342	13.379
.55..	13.415	13.452	13.488	13.525	13.562	13.598	13.635	13.672	13.709	13.745
.56..	13.782	13.819	13.856	13.893	13.930	13.967	14.004	14.041	14.078	14.115
.57..	14.152	14.189	14.227	14.264	14.302	14.339	14.376	14.414	14.451	14.489
.58..	14.526	14.564	14.602	14.639	14.677	14.715	14.753	14.791	14.828	14.866
.59..	14.904	14.942	14.980	15.018	15.056	15.094	15.133	15.171	15.209	15.247
.60..	15.285	15.323	15.362	15.400	15.439	15.477	15.515	15.554	15.592	15.631
.61..	15.669	15.708	15.746	15.785	15.824	15.862	15.901	15.940	15.979	16.017
.62..	16.056	16.095	16.134	16.173	16.212	16.251	16.290	16.329	16.368	16.407
.63..	16.446	16.485	16.524	16.564	16.603	16.642	16.681	16.720	16.760	16.799
.64..	16.838	16.877	16.917	16.956	16.996	17.035	17.074	17.114	17.153	17.193
.65..	17.232	17.272	17.311	17.351	17.390	17.430	17.470	17.509	17.549	17.588
.66..	17.628	17.668	17.707	17.747	17.787	17.826	17.866	17.906	17.946	17.985
.67..	18.025	18.065	18.105	18.144	18.184	18.224	18.264	18.304	18.343	18.383
.68..	18.423	18.463	18.503	18.543	18.583	18.623	18.663	18.703	18.743	18.783
.69..	18.823	18.863	18.904	18.944	18.984	19.024	19.065	19.105	19.145	19.186
.70..	19.226	19.266	19.307	19.347	19.388	19.428	19.469	19.509	19.550	19.590
.71..	19.631	19.672	19.713	19.753	19.794	19.835	19.876	19.917	19.957	19.998
.72..	20.039	20.080	20.121	20.162	20.203	20.244	20.285	20.326	20.367	20.408
.73..	20.449	20.490	20.532	20.573	20.614	20.656	20.697	20.738	20.779	20.820
.74..	20.862	20.904	20.945	20.987	21.028	21.070	21.112	21.153	21.195	21.236
.75..	21.278	21.320	21.362	21.404	21.446	21.488	21.530	21.572	21.614	21.656
.76..	21.698	21.740	21.783	21.825	21.868	21.910	21.952	21.995	22.037	22.080
.77..	22.122	22.165	22.207	22.250	22.293	22.335	22.378	22.421	22.464	22.506
.78..	22.549	22.592	22.635	22.678	22.721	22.764	22.807	22.850	22.893	22.936
.79..	22.979	23.022	23.066	23.109	23.152	23.195	23.239	23.282	23.325	23.369
.80..	23.412	23.455	23.499	23.542	23.586	23.629	23.672	23.715	23.759	23.803
.81..	23.846	23.890	23.933	23.977	24.021	24.064	24.108	24.152	24.196	24.239
.82..	24.283	24.327	24.371	24.415	24.459	24.503	24.547	24.591	24.635	24.679
.83..	24.723	24.767	24.811	24.856	24.900	24.944	24.988	25.032	25.077	25.121
.84..	25.165	25.209	25.254	25.298	25.343	25.387	25.432	25.476	25.521	25.565
.85..	25.610	25.655	25.699	25.744	25.789	25.833	25.878	25.923	25.967	26.012
.86..	26.057	26.102	26.147	26.192	26.237	26.282	26.327	26.372	26.417	26.462
.87..	26.507	26.552	26.598	26.643	26.688	26.733	26.779	26.824	26.869	26.915
.88..	26.960	27.005	27.051	27.096	27.142	27.187	27.233	27.278	27.324	27.369
.89..	27.415	27.461	27.507	27.552	27.598	27.644	27.689	27.736	27.781	27.827
.90..	27.873	27.919	27.965	28.011	28.057	28.103	28.149	28.195	28.241	28.287
.91..	28.333	28.379	28.425	28.471	28.517	28.563	28.610	28.656	28.702	28.748
.92..	28.794	28.840	28.887	28.933	28.980	29.026	29.072	29.119	29.165	29.212
.93..	29.258	29.305	29.551	29.398	29.445	29.491	29.538	29.585	29.632	29.678
.94..	29.725	29.772	29.819	29.865	29.912	29.959	30.006	30.053	30.099	30.146
.95..	30.193	30.240	30.287	30.334	30.381	30.428	30.475	30.522	30.569	30.616
.96..	30.663	30.710	30.757	30.805	30.852	30.899	30.946	30.993	31.041	31.088
.97..	31.135	31.182	31.230	31.277	31.325	31.372	31.419	31.467	31.514	31.562
.98..	31.609	31.657	31.704	31.752	31.799	31.847	31.895	31.942	31.990	32.037
.99..	32.085	32.133	32.181	32.228	32.276	32.324	32.372	32.420	32.467	32.515
1.00..	32.563	32.611	32.659	32.707	32.755	32.803	32.851	32.899	32.947	32.995
1.01..	33.043	33.091	33.140	33.188	33.236	33.284	33.333	33.381	33.429	33.478
1.02..	33.526	33.575	33.623	33.671	33.720	33.758	33.818	33.866	33.916	33.963
1.03..	34.012	34.061	34.110	34.159	34.208	34.256	34.305	34.354	34.403	34.452
1.04..	34.501	34.550	34.600	34.649	34.699	34.748	34.797	34.847	34.896	34.945
1.05..	34.995	35.044	35.094	35.143	35.193	35.242	35.292	35.341	35.391	35.440
1.06..	35.490	35.539	35.589	35.638	35.688	35.737	35.787	35.836	35.886	35.935
1.07..	35.985	36.035	36.084	36.134	36.184	36.233	36.283	36.333	36.383	36.432
1.08..	36.482	36.532	36.582	36.632	36.682	36.731	36.781	36.831	36.881	36.931
1.09..	36.981	37.031	37.081	37.132	37.182	37.232	37.282	37.332	37.382	37.432
1.10..	37.483	37.533	37.584	37.633	37.684	37.734	37.784	37.835	37.885	37.936
1.11..	37.986	38.036	38.087	38.137	38.188	38.238	38.289	38.339	38.390	38.440
1.12..	38.491	38.542	38.592	38.643	38.694	38.744	38.796	38.847	38.898	38.948
1.13..	38.998	39.049	39.100	39.151	39.202	39.253	39.304	39.355	39.406	39.457
1.14..	39.508	39.559	39.610	39.661	39.712	39.763	39.815	39.866	39.917	39.968
1.15..	40.019	40.070	40.122	40.173	40.225	40.276	40.327	40.379	40.430	40.482
1.16..	40.533	40.585	40.636	40.688	40.739	40.791	40.843	40.894	40.946	40.977
1.17..	41.049	41.101	41.153	41.204	41.256	41.308	41.360	41.412	41.463	41.515
1.18..	41.567	41.619	41.671	41.723	41.775	41.827	41.879	41.931	41.983	42.03
1.19..	42.087	42.139	42.191	42.243	42.295	42.347	42.400	42.452	42.504	42.55
1.20..	42.608	42.660	42.713	42.765	42.818	42.870	42.922	42.975	43.027	43.08
1.21..	43.132	43.184	43.237	43.289	43.342	43.394	43.447	43.499	43.552	43.60
1.22..	43.657	43.710	43.762	43.815	43.868	43.920	43.973	44.026	44.079	44.13
1.23..	44.184	44.237	44.290	44.343	44.396	44.448	44.501	44.554	44.607	44.66
1.24..	44.713	44.766	44.819	44.872	44.925	44.978	45.032	45.085	45.138	45.19
1.25..	45.244	45.297	45.351	45.404	45.458	45.511	45.564	45.618	45.671	45.725
1.26..	45.778	45.832	45.885	45.939	45.992	46.046	46.100	46.153	46.207	46.26
1.27..	46.314	46.368	46.421	46.475	46.529	46.582	46.636	46.690	46.744	46.79
1.28..	46.851	46.905	46.959	47.013	47.067	47.120	47.174	47.228	47.282	47.33
1.29..	47.390	47.444	47.498	47.552	47.607	47.661	47.715	47.769	47.824	47.87
1.30..	47.932	47.986	48.041	48.095	48.149	48.203	48.258	48.312	48.366	48.42
1.31..	48.475	48.529	48.584	48.638	48.693	48.747	48.802	48.856	48.911	48.96
1.32..	49.020	49.075	49.129	49.184	49.238	49.293	49.348	49.402	49.457	49.51
1.33..	49.566	49.621	49.675	49.730	49.785	49.839	49.894	49.949	50.004	50.0
1.34..	50.113	50.168	50.223	50.278	50.333	50.387	50.442	50.497	50.552	50.60
1.35..	50.662	50.717	50.772	50.828	50.883	50.938	50.993	51.048	51.104	51.15
1.36..	51.214	51.269	51.325	51.380	51.436	51.491	51.546	51.602	51.657	51.71
1.37..	51.768	51.824	51.879	51.935	51.990	52.046	52.102	52.157	52.213	52.26
1.38..	52.324	52.380	52.435	52.491	52.547	52.602	52.658	52.714	52.770	52.82
1.39..	52.881	52.937	52.993	53.049	53.105	53.160	53.216	53.272	53.328	53.38
1.40..	53.440	53.496	53.552	53.608	53.664	53.720	53.776	53.832	53.888	53.94
1.41..	54.000	54.056	54.117	54.169	54.225	54.281	54.338	54.394	54.450	54.50
1.42..	54.563	54.619	54.676	54.732	54.789	54.845	54.902	54.958	55.015	55.07
1.43..	55.128	55.185	55.241	55.298	55.354	55.411	55.468	55.524	55.581	55.63
1.44..	55.694	55.751	55.808	55.864	55.921	55.978	56.035	56.092	56.148	56.20
1.45..	56.262	56.319	56.376	56.433	56.490	56.546	56.603	56.660	56.717	56.77
1.46..	56.831	56.888	56.945	57.003	57.060	57.117	57.174	57.231	57.289	57.34
1.47..	57.403	57.460	57.518	57.575	57.632	57.689	57.747	57.804	57.861	57.91
1.48..	57.976	58.033	58.091	58.148	58.206	58.263	58.320	58.378	58.435	58.49
1.49..	58.550	58.608	58.665	58.723	58.781	58.838	58.896	58.954	59.012	59.06
1.50..	59.127	59.185	59.243	59.300	59.358	59.416	59.474	59.532	59.589	59.64
1.51..	59.705	59.763	59.821	59.879	59.937	59.995	60.053	60.111	60.169	60.22
1.52..	60.285	60.343	60.401	60.459	60.517	60.575	60.634	60.692	60.750	60.80
1.53..	60.866	60.924	60.983	61.041	61.099	61.157	61.216	61.274	61.332	61.39
1.54..	61.449	61.507	61.566	61.624	61.683	61.741	61.800	61.858	61.917	61.97
1.55..	62.034	62.093	62.151	62.210	62.269	62.327	62.386	62.445	62.504	62.56
1.56..	62.621	62.680	62.739	62.798	62.857	62.915	62.974	63.033	63.092	63.15
1.57..	63.210	63.269	63.328	63.387	63.446	63.505	63.564	63.623	63.682	63.74
1.58..	63.800	63.859	63.918	63.978	64.037	64.096	64.155	64.214	64.274	64.33
1.59..	64.392	64.451	64.511	64.570	64.629	64.688	64.748	64.807	64.866	64.92
1.60..	64.985	65.044	65.104	65.163	65.223	65.282	65.341	65.401	65.460	65.52
1.61..	65.579	65.639	65.698	65.758	65.817	65.877	65.937	65.996	66.056	66.11
1.62..	66.175	66.235	66.294	66.354	66.414	66.473	66.533	66.593	66.653	66.71
1.63..	66.772	66.832	66.892	66.952	67.012	67.071	67.131	67.191	67.251	67.31
1.64..	67.371	67.431	67.491	67.551	67.611	67.671	67.731	67.791	67.851	67.91
1.65..	67.971	68.031	68.091	68.152	68.212	68.272	68.332	68.392	68.453	68.51
1.66..	68.573	68.633	68.694	68.754	68.815	68.875	68.936	68.996	69.057	69.11
1.67..	69.178	69.239	69.299	69.360	69.421	69.481	69.542	69.603	69.664	69.72
1.68..	69.785	69.846	69.907	69.967	70.028	70.089	79.150	70.211	70.271	70.33
1.69..	70.393	70.454	70.515	70.578	70.637	70.697	70.758	70.819	70.880	70.941
1.70..	71.002	71.063	71.124	71.485	71.246	71.307	71.369	71.430	71.491	71.55
1.71..	71.613	71.674	71.735	71.797	71.858	71.919	71.980	72.041	72.103	72.16
1.72..	72.225	72.286	72.348	72.409	72.470	72.531	72.593	72.654	72.715	72.77
1.73..	72.838	72.899	72.961	73.022	73.084	73.145	73.207	73.268	73.330	73.391
1.74..	73.453	73.515	73.576	73.638	73.699	73.761	73.823	73.884	73.946	74.00
1.75..	74.069	74.131	74.193	74.254	74.316	74.378	74.440	74.502	74.563	74.62
1.76..	74.687	74.749	74.811	74.873	74.935	74.996	75.058	75.120	75.182	75.24
1.77..	75.306	75.368	75.430	75.492	75.554	75.616	75.679	75.741	75.803	75.86
1.78..	75.927	75.989	76.052	76.114	76.176	76.238	76.301	76.363	76.425	76.487
1.79..	76.550	76.612	76.675	76.737	76.800	76.862	76.924	76.987	77.049	77.11
1.80..	77.174	77.236	77.299	77.361	77.424	77.486	77.549	77.611	77.674	77.73
1.81..	77.799	77.862	77.924	77.987	78.050	78.112	78.175	78.238	78.301	78.36
1.82..	78.426	78.489	78.552	78.615	78.678	78.740	78.803	78.866	78.929	78.992
1.83..	79.055	79.118	79.181	79.244	79.307	79.370	79.433	79.496	79.559	79.62
1.84..	79.685	79.748	79.811	79.874	79.937	80.000	80.064	80.127	80.190	80.25
1.85..	80.316	80.379	80.443	80.506	80.569	80.633	80.696	80.759	80.822	80.88
1.86..	80.949	81.012	81.076	81.139	81.203	81.266	81.329	81.393	81.456	81.520
1.87..	81.583	81.647	81.710	81.774	81.837	81.901	81.965	82.028	82.092	82.155
1.88..	82.219	82.283	82.346	82.410	82.474	82.537	82.601	82.665	82.729	82.792
1.89..	82.856	82.920	82.984	83.047	83.111	83.175	83.239	83.303	83.366	83.430
1.90..	83.494	83.558	83.622	83.686	83.750	83.814	83.878	83.942	84.006	84.070
1.91..	84.134	84.198	84.262	84.326	84.390	84.454	84.519	84.583	84.647	84.711
1.92..	84.775	84.839	84.904	84.968	85.032	85.096	85.161	85.225	85.289	85.354
1.93..	85.418	85.482	85.547	85.611	85.676	85.740	85.805	85.869	85.934	85.998
1.94..	86.063	86.128	86.192	86.257	86.321	86.386	86.451	86.515	86.580	86.644
1.95..	86.709	86.774	86.838	86.903	86.968	87.032	87.097	87.162	87.227	87.291
1.96..	87.356	87.421	87.486	87.550	87.615	87.680	87.745	87.810	87.874	87.939
1.97..	88.004	88.069	88.134	88.199	88.264	88.329	88.394	88.459	88.524	88.589
1.98..	88.654	88.719	88.784	88.849	88.914	88.979	89.045	89.109	89.175	89.240
1.99..	89.305	89.370	89.435	89.501	89.566	89.631	89.696	89.761	89.827	89.892
2.00..	89.957	90.022	90.088	90.153	90.219	90.284	90.349	90.415	90.480	90.545
2.01..	90.611	90.676	90.742	90.807	90.873	90.938	91.004	91.069	91.135	91.200
2.02..	91.266	91.332	91.397	91.463	91.528	91.594	91.660	91.725	91.791	91.856
2.03..	91.922	91.988	92.054	92.119	92.185	92.251	92.317	92.383	92.448	92.514
2.04..	92.580	92.646	92.712	92.778	92.844	92.910	92.976	93.042	93.108	93.174
2.05..	93.240	93.306	93.372	93.438	93.504	93.570	93.637	93.703	93.769	93.835
2.06..	93.901	93.967	94.033	94.100	94.166	94.232	94.298	94.364	94.431	94.496
2.07..	94.563	94.629	94.696	94.762	94.828	94.894	94.961	95.027	95.093	95.160
2.08..	95.226	95.292	95.359	95.425	95.492	95.558	95.625	95.691	95.758	95.824
2.09..	95.891	95.958	96.024	96.091	96.157	96.224	96.291	96.357	96.424	96.490
2.10..	96.557	96.624	96.690	96.757	96.824	96.890	96.957	97.024	97.091	97.157
2.11..	97.224	97.291	97.358	97.425	97.492	97.558	97.625	97.692	97.759	97.826
2.12..	97.893	97.960	98.027	98.094	98.161	98.228	98.295	98.362	98.429	98.496
2.13..	98.563	98.630	98.697	98.764	98.831	98.898	98.966	99.033	99.100	99.167
2.14..	99.234	99.301	99.368	99.436	99.503	99.570	99.637	99.704	99.772	99.839
2.15..	99.906	99.973	100.041	100.108	100.175	100.242	100.310	100.377	100.444	100.512
2.16..	100.579	100.646	100.714	100.781	100.849	100.916	100.984	101.051	101.119	101.186
2.17..	101.254	101.322	101.389	101.457	101.525	101.592	101.660	101.728	101.796	101.863
2.18..	101.931	101.999	102.067	102.134	102.202	102.270	102.338	102.406	102.473	102.541
2.19..	102.609	102.677	102.745	102.813	102.881	102.948	103.016	103.084	103.152	103.220
2.20..	103.288	103.356	103.424	103.492	103.560	103.628	103.696	103.764	103.832	103.900
2.21..	103.968	104.036	104.104	104.172	104.240	104.308	104.377	104.445	104.513	104.581
2.22..	104.649	104.717	104.786	104.854	104.922	104.990	105.059	105.127	105.195	105.264
2.23..	105.332	105.400	105.469	105.537	105.606	105.674	105.742	105.811	105.879	105.948
2.24..	106.016	106.085	106.153	106.222	106.290	106.359	106.428	106.496	106.565	106.633
2.25..	106.702	106.771	106.839	106.908	106.976	107.045	107.114	107.182	107.251	107.319
2.26..	107.388	107.457	107.526	107.594	107.663	107.732	107.801	107.870	107.938	108.007
2.27..	108.076	108.145	108.214	108.283	108.352	108.420	108.489	108.558	108.627	108.696
2.28..	108.765	108.834	108.903	108.972	109.041	109.110	109.179	109.248	109.317	109.386
2.29..	109.455	109.524	109.593	109.662	109.731	109.800	109.870	109.939	110.008	110.077
2.30..	110.146	110.215	110.284	110.354	110.423	110.492	110.561	110.630	110.700	110.769
2.31..	110.838	110.907	110.977	111.046	111.116	111.185	111.254	111.324	111.393	111.463
2.32..	111.532	111.601	111.671	111.740	111.810	111.879	111.949	112.018	112.088	112.157
2.33..	112.227	112.297	112.366	112.436	112.505	112.575	112.645	112.714	112.784	112.853
2.34..	112.923	112.993	113.062	113.132	113.202	113.271	113.341	113.411	113.481	113.550
2.35..	113.620	113.690	113.760	113.830	113.900	113.969	114.039	114.109	114.179	114.249
2.36..	114.319	114.389	114.459	114.529	114.599	114.669	114.739	114.809	114.879	114.949
2.37..	115.019	115.089	115.159	115.229	115.299	115.369	115.440	115.510	115.580	115.650
2.38..	115.720	115.790	115.861	115.931	116.001	116.071	116.142	116.212	116.282	116.353
2.39..	116.422	116.492	116.563	116.633	116.703	116.773	116.844	116.914	116.984	117.055
2.40..	117.125	117.195	117.266	117.336	117.407	117.477	117.547	117.618	117.688	117.759
2.41..	117.829	117.900	117.970	118.041	118.111	118.182	118.253	118.323	118.394	118.464
2.42..	118.535	118.606	118.676	118.747	118.818	118.888	118.959	119.030	119.101	119.171
2.43..	119.242	119.313	119.384	119.454	119.525	119.596	119.667	119.738	119.808	119.879
2.44..	119.950	120.021	120.092	120.163	120.234	120.304	120.375	120.446	120.517	120.588
2.45..	120.659	120.730	120.801	120.872	120.943	121.014	121.085	121.156	121.227	121.298
2.46..	121.369	121.440	121.511	121.582	121.653	121.724	121.796	121.867	121.938	122.009
2.47..	122.080	122.151	122.222	122.294	122.365	122.436	122.507	122.578	122.650	122.721
2.48..	122.792	122.863	122.935	123.006	123.077	123.148	123.220	123.291	123.362	123.434
2.49..	123.505	123.576	123.648	123.719	123.791	123.862	123.934	124.005	124.077	124.148
2.50..	124.220	124.292	124.363	124.435	124.506	124.578	124.650	124.721	124.793	124.864

ENGINEERING NEWS
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THE JERSEY CITY WATER CONTRACT has been awarded to the East Jersey Water Co. by the Board of Street and Water Commissioners. The Board of Finance must concur in the award and the Mayor must approve it, after which it must be executed and signed. The accepted proposal is for a gravity supply from the Rockaway River, to be delivered at the present high service reservoirs in Jersey City, 210 ft. above the tide, through a single pipe line with a daily carrying capacity of 50,000,000 gallons. Storage will be provided to ensure a daily supply of 35,000,000 gallons at the start, with an increase at any time to 50,000,000 gallons, on three years' notice from the city. The city agrees to take at least 20,000,000 gallons of water per day, and 30,000,000 gallons in case it orders the works increased to a capacity of 50,000,000 gallons. The prices by the million gallons, are $35 for the first 20,000,000; $36 for all between 20,000,000 and 30,000,000; $35 for between 30,000,000 and 40,000,000; and $34 for between 40,000,000 and 50,000,000 gallons. This curious sliding scale, with its upward and downward turn, results in an average price of $35 per 1,000,000 gallons when the full contract quantity is reached, and makes the average cost for all water between 20,000,000 and 40,000,000 gallons per day greater than the first 20,000,000 gallons. The city has the option of buying the plant at the end of 5, 10 or 15 years for $6,990,000. The other bids, submitted both by the East Jersey Water Co. and its only competitor, the Rockaway & Hudson Water Co., were given in our issue of Aug. 27, 1896. Legal proceedings to upset the award are already promised, in case the other authorities concur with the Street and Water Commissioners. Editorial comment on this subject is made elsewhere in this issue.

◆

THE NEW DRIVEN WELL WATER SUPPLY for Brooklyn is said to fall short by about 2,000,000 or 3,000,000 gallons of the 25,000,000 gallons called for by the contract with Edwards, Monohan, Miller & Edwards. No official information is at hand. All possible capital is being made of the above report by those who wish the city to take steps to secure water outside of Long Island. Some of the expressions of opinion are doubtless due to real concern for the city, but others bear the stamp of the ceaseless agitation of some months past, in the apparent interest of private parties who wish to sell the city distant water or water rights.

◆

THE DU BOIS, PA., RESERVOIR, now under construction for the water supply of that town, is located on the Juniata River, very close to the limits of the watershed. The reservoir is made by building an earth and rock-faced dam, 150 ft. long, across a ravine, the reservoir covering about one acre and having a capacity of 3,000,000 gallons. But to obtain more water than the Juniata at this point affords, a tunnel is being driven 1,542 ft. through the dividing ridge to the streams heading on the other side. In this manner water will be obtained from the upper Juniata Narrows Creek and by Wolf Creek. The engineer is Mr. H. S. McMinn, and the reservoir is being built by Mr. John E. Du Bois, who owns all the land covered by this watershed.

THE REMOVAL OF SNOW from the streets of New York during this winter will probably be done by Mr. G. M. Furman, of 1 Broadway, Col. Geo. E. Waring, Jr., M. Inst. C. E., having recommended the award of the contract to Mr. Furman. The price will be 42 cts. per cu. yd., against 56 cts. paid last year.

◆

THE ANNUAL TRACK INSPECTION on the Columbus, Hocking Valley & Toledo Ry., shows that the general average condition of the track has advanced from an average marking of 78.2% to 80.4%. The report issued to the supervisors, foremen and section men states that there has been a marked improvement in the condition of switches and frogs, and the leads connecting them, but that there is a tendency to neglect the condition of the sidings. The premiums are awarded for the greatest improvement resulting from the labors of trackmen during the year. The company is responsible for the quantity and quality of materials furnished, and those who have made the best use of such materials are entitled to the most credit. The report is issued by Mr. F. B. Sheldon, Chief Engineer, and Mr. Wm. Michel, Engineer of Maintenance of Way.

◆

A DOUBLE DECK TUNNEL is the project of the Metropolitan District Ry., of London, for facilitating traffic on its underground line in that city. The present underground line has a double track, and it is proposed to build two single track tunnels at some distance below this line, to be used for express trains, there being only one station between the terminus and the point where the low-level line will rise to the grade of the existing line.

◆

THE BOSTON TERMINAL CO. is making good progress with the acquisition of land and the preparation of plans for its great terminal station at Summer St. and Atlantic Ave., Boston, Mass. The station and yards will occupy about 40 acres, and 30 acres have already been purchased and paid for. This station will take the place of the present Park Square and Kneeland St. terminals of the New York, New Haven & Hartford R. R., and the Kneeland St. terminal of the Boston & Albany R. R. Special attention is being given to secure a prompt and easy handling of the very heavy suburban traffic. Mr. Geo. B. Francis, M. Am. Soc. C. E., is the engineer.

◆

A RAILWAY TERMINAL on a large scale at Washington, D. C., is proposed for the joint use of the Pennsylvania R. R., Chesapeake & Ohio Ry. and Southern Ry. The plans will include a large union station with depressed approaches, and extensive freight yards.

◆

PLANS FOR RAILWAY TERMINALS at Christiania, Norway, are invited by the government, and prizes of $2,500, $1,000, $500 and $250 are offered for the best plans submitted in competition. Further information may be obtained on application to the Railway Office of the Department of Public Works, 6 Victoria Terrace, Christiania, Norway. Plans must be sent in by March 31, 1897.

◆

100-LB. RAILS are being used quite extensively on the Chesapeake & Ohio Ry. With a recent order of 1,000 tons of these rails, now being laid, this company will have 45 miles of track laid with 100-lb. rails, all on the Huntington Division. About 1,800 tons of these rails are in lengths of 60 ft.

◆

A DOUBLE-END TANK LOCOMOTIVE has been built by the Brooks Locomotive Works, Dunkirk, N. Y., for service in Japan. It is for a gage of 3 ft. 6 ins., and has six driving wheels and leading and trailing pony trucks. The tanks are at each side of the boiler, and there is a completely enclosed cab and a rear coal bunker. The leading dimensions are as follows:

Driving wheels, diameter		4 ft. 0 ins.
Cylinders		15 × 22 ins.
Boiler, diameter		4 ft. 6 ins.
Firebox		6 ft. 6 ins. × 2 ft. 5 ins.
Heating surface,	tubes	895 sq. ft.
" "	firebox	83 " "
" "	total	978 " "

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision Dec. 7 on the Baltimore & Ohio Southwestern Ry. at Sodamsville, O. An inspection train carrying officers of the road ran into an accommodation train, three persons being killed and eight injured. The accident is said to have been caused by a misunderstanding of orders on the part of the crew of the special train.——A freight train on the Gulf, Colorado & Santa Fe R. R. ran into an open switch at a gravel pit near Justin, Ind. Ter., Dec. 4. Three men were killed.

◆

A COAL YARD FIRE occurred Dec. 1 at the Charlestown yards of the Boston & Maine R. R., and the coaling station and about 10,000 tons of coal were destroyed. A fire had been smouldering in the coal pile for some days, and the men had been at work trying to reach it, but it broke out suddenly, and it was then too late for the fire department to do much good. Traffic was blocked for several hours.

ANOTHER SERIOUS FLOOD in the Pacific northwest has again caused extensive damage to railways and serious interference with traffic. In Washington the greatest damage has been done, bridges and banks having been washed out on the Great Northern Ry. and Northern Pacific R. R.——Severe floods have been caused near Chippewa Falls, Wis., by a heavy jam of ice and logs in the river.

◆

GOVERNMENT AID TO RAILWAYS in Canada has been pretty expensive, according to the "Canadian Magazine." On June 30, 1895, there were 16,091 miles of track laid in Canada, and the Dominion Government has contributed to this at the rate of $9,369 per mile constructed, the Provincial Government at the rate of $1,847 and the municipalities at the rate of $81 per mile. That is, for the net result of 16,091 miles, Canada has contributed about $195,000,000. In Cape Colony the proportion of net revenue to capital cost of railways is 5.75%; in India, 4.96%; in South Australia, 3.13%; in New South Wales, 3.46%; in New Zealand, 2.73%; in Queensland, 2.13%, and in Canada, 1.57%. In only one British colony is the proportion lower than in Canada, and that is Tasmania. The "Magazine" thinks that this seems to indicate that Canada is building railways too fast.

◆

ELECTRIC TRACTION is contemplated for the suburban and branch lines of the New York, New Haven & Hartford R. R. According to a published statement by Mr. C. F. Clark, the President, the general policy of the road relative to the introduction of electricity as a motive power may be given as follows: Electricity as a motive power is foreshadowed in the last annual statement of the road. On the South Shore branch of the Old Colony system, the current has been successfully and economically conveyed in a third rail, insulated upon wooden blocks in the center of each track. The results have surprised experts, and it is now probable that a third rail will be laid at various points upon the company's property during the year to come. Short branches to the centers of business and population may then be constructed from the company's lines.

◆

AN ELECTRIC RACK-RAILWAY to the top of the Jungfrau, in Switzerland, is proposed. The line would be 7½ miles long, starting at Scheidegg, and of this distance about 6 miles would be in tunnel. Grades of 25% are proposed and on the Eiger, the Mouch and other points will be stations selected with regard to scenic features. The maximum speed on grades of 15% and more will be 5 miles per hour, and 5 to 6 miles on other parts. At the foot of the main peak of the Jungfrau an inclined elevator shaft would be operated by electricity, with a lift of 330 ft., leading to the very summit. The estimated cost is $2,000,000, and the project is the outcome of the engineering and financial success of the Mont Saleve electric road, near Geneva. The cars would be lighted and heated by electricity, the latter provision being especially necessary as the average temperature in the tunnel is estimated at 2° to 3° below zero C., to the Mouch, and at from 6° to 10° below from that point to the Jungfrau.

◆

THE ERIE CANAL SEASON OF 1896 lasted seven months. The Collector of the Port of Buffalo says that while the showing of traffic is decidedly superior to that of 1895, it can not be said to be satisfactory. The shipments of grain from Buffalo aggregated 35,868,966 bushels, an increase of nearly 16,000,000 over the preceding year, but nearly 13,000,000 bushels less than the record for 1894. But the grain receipts by the lake at Buffalo for this season are the largest on record, aggregating 154,338,921 bushels, for 1896, exceeding the receipts of 1895 by 51,000,000 and those of 1894 by 57,500,000 bushels. The previous largest record was 132,808,234 bushels in 1893.

◆

A NEW SYSTEM OF VENTILATION has been put in use in the U. S. Senate chamber at Washington, designed by Prof. S. H. Woodridge, of the Massachusetts Institute of Technology. The benches in the visitors' gallery have been removed and theater chairs, with folding seats, substituted. The legs of the chairs are hollow, with perforated sides, and the fresh air for ventilation is distributed through the perforations. The air is furnished by a fan driven by an electric motor, and in warm weather it is first cooled to 60° by an ammonia refrigerating apparatus, depositing its moisture, and is then dried and heated to 70° or 75° by passing over hot water pipes. In cold weather the refrigerating apparatus is omitted and the air is warmed to the desired temperature.

◆

CIVIL SERVICE EXAMINATIONS will be held by the New York Civil Service Commission as follows: Dec. 17, building inspectors of masonry; Dec. 18, inspectors of pier building. Particulars may be obtained from Mr. S. William Briscoe, secretary to the commission, New Criminal Court Building. The Civil Service Commission of Brooklyn, N. Y., is receiving applications for the following positions: Expert civil engineer, chief examiner of plans, expert for steel and iron construction, engineer of sewage purification, superintendent of sewer and water pumping station, inspector of construction of buildings, and inspector of sewers.

MASONRY VIADUCT OVER KINNICKINNICK CREEK; CHESAPEAKE & OHIO RY.

The accompanying illustration shows part of a five-arch masonry railway viaduct built over the Kinnickinnick Creek on the line of the Chesapeake & Ohio Ry., in southeastern Kentucky. This bridge was originally built, in 1856, under the direction of Col. Childs, for the Maysville & Big Sandy Ry. Co. The builder was a Cincinnati contractor, who also constructed the arch culvert over Briary Creek, at Quincy. The railway company failed when the bridge was only partially completed, the arches being sprung and the spandrel filling in place. As the work was not in a condition to stand the weather, Col. Childs, at his own expense, put on enough of the upper courses to preserve the masonry, and the bridge stood in this condition for a number of years. The country people in the neighborhood, sometime in the "60's," built a wooden approach at each end of the viaduct and used the structure as a highway bridge. In 1886 the Chesapeake & Ohio Ry. extended its line to Cincinnati, under Col. Childs as Chief Engineer, and buying out the old charter this company completed the bridge.

Masonry Viaduct Over Kinnickinnick Creeek, Ky., Chesapeake & Ohio Ry.

The viaduct has five full-center arches of about 50-ft. span each, with a width of 8 ft. at the piers, and racked out to a finished width of 12 ft. above by means of projecting courses. The bridge carries a single line of rails with inside iron guard rails. The work is in excellent condition, without a crack in the masonry or a spawled joint and is a fitting monument to the skill of the designer and to the honest work of the contractor.

It is worth noting that the failure of the railway company of 1856 to pay for this masonry caused the financial ruin of this honest contractor. The Chesapeake & Ohio Ry. Co., after coming into possession, 30 years after, sought out the widow of this man and paid in full this old debt. For the view and the interesting notes accompanying it we are indebted to Mr. S. P. Baird, of Portsmouth, Ohio.

◆

THE LATEST AMERICAN BATTLESHIPS.

(With inset.)

At the recent fourth annual meeting of the Society of Naval Architects and Marine Engineers Mr. Philip Hichborn, Chief Constructor, U. S. N., described the special features of the "Alabama" class, the most recently designed of the battleships of our new navy. These features are briefly set forth as follows:

The shallowness of our harbors is one of the first and chief difficulties met with by our naval architects; imposing as it does limitations and restrictions which greatly complicate the general design where so many other elements have to be considered. But the success attained in this direction is quite satisfactory, and in these new battleships the draft is only 23 ft. 6 ins. at their normal displacement, with all outfits and two-thirds supply of stores, ammunition, etc., on board, and 800 tons of coal in the bunkers.

The freeboard forward is increased, as contributing not only to the sea-going qualities of the vessel, but as also giving additional berthing space in the forecastle deck provided, and this increase in height lifts the axis of the forward turret guns and enables them to be worked in almost any weather. In the matter of speed, our designers believe that it is not desirable, in battleships, to sacrifice other and essential qualities to obtain the high speed aimed at in some foreign navies. The highest speed heretofore adopted in fleet tactics with these vessels does not exceed 12 knots; while the "Alabama" class is designed for 16 knots, thus still greatly exceeding the speed called for in the actual operations of war. On the other hand, the contract speed required in our new ships must be steadily maintained for four hours, and is not a mere measured mile record such as is demanded for foreign ships.

The framing of the new battleships differs slightly from that in vogue in other vessels of this class in our navy. The main frames are continuous from the keel to the armor shelf, and again from the armor shelf to the deck. The longitudinals are, of course, continuous, their lower edges being scored over the main frame angles and the lower angles of the longitudinals being worked intercostally. The upper angles of the longitudinals, however, are continuous while the reverse bars are worked intercostally. Between the frame angles and the reverse bars are worked bracket-plates of uniform width, flanged at one end so as to connect with the longitudinals, and also flanged at the other end to give local stiffness. In this manner great rigidity is given to the floors, and there is less liability to damage in grounding or in docking. The flanged floor plate provides greater strength with less weight. Docking keels are provided, and the bilge keels are narrowed down to nothing as they approach the midship section, thus forming no obstruction in passing the gateway of the dry docks. The continuous bilge keel would be preferred for increased resistance to rolling and diminished resistance to progress through the water; but dry-docks impose limitations in this direction, and the plan adopted is a compromise.

In the arrangement of coal-bunkers especial care has been taken to provide easy storage and accessibility for firing, while affording good protection for the boilers. A distinct departure is made in setting the boilers athwartships instead of fore and aft, as in former practice. The advantages of the new arrangement are the increased and excellent facilities for firing and easy communication between the fire-rooms.

The hull is protected against injury at the water line by heavy tapering armor of a maximum thickness of 16½ ins., extending from 3 ft. 6 ins. above to 4 ft. below the normal load water-line. The maximum thickness covers the entire length of the engine and boiler spaces; from the forward cross coal-bunker bulkhead the thickness is gradually reduced to 4 ins., and this thickness is maintained to the bow. At the top of the armor belt, and covering the engine and boiler spaces, is a flat protective deck, 2¾ ins. thick, worked in three layers and extending from side to side of the ship. This deck is tap-riveted to the upper edge of the side armor. Forward of the machinery space, however, the protective deck is turned down to the armor shelf level, so that any projectile passing through the vertical armor would have to encounter a sloping deck 3 ins. thick. Aft of the armor-belt the protection deck is inclined in a similar manner, except that this deck is 4 ins. thick to better protect the steering gear. Where this protective deck is inclined at the sides, coffer-dams are provided, 3 ft. wide, and extending to the top of the armorbelt, and packed with corn-pith cellulose compressed to a density of 6 lbs. per cubic foot. To meet a raking fore or aft fire, and to protect the boilers and engines, the opening between the flat deck and the sloping sides is closed at each end by diagonal armor bulkheads, 12 ins. thick.

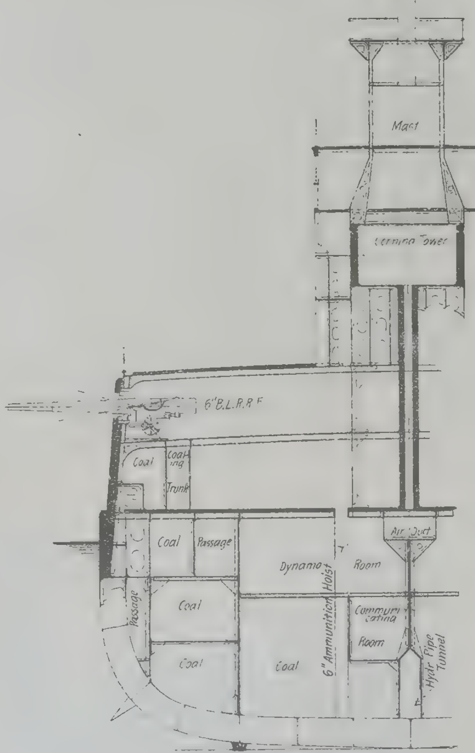
From the top of the thick belt, extending to the main deck, the hull is further protected by a belt of 5½-in. armor, extending from barbette to barbette, and ending in diagonal bulkheads on a line with the 12-in. armor below. Within the limits of this belt the broadside torpedo tubes are placed. Inboard of this 5½-in. armor, and extending well forward and aft, are other corn-pith cellulose coffer-dams, 3 ft. high by 3 ft. wide, with the top of these dams 6½ ft. above the load water-line. Between the main and upper decks, and from the forward barbette to a point just forward of the after turret, the side of this ship is protected by 5½-in. armor, with diagonal armor terminations. Within the armor are placed eight of the 6-in. rapid-fire guns. The central part of the ship is thus completely enclosed in a continuous wall of armor, extending from 4 ft. below load water-line to the level of the upper deck, about 23 ft. in all, with the walls nowhere less than 5½ ins. thick. As additional security, 1½-in. splinter bulkheads are placed between each pair of 6-in. guns; and the other 6-in. guns on the gun deck forward and on the upper deck amidships are protected by special armor 6 ins. thick and curved to protect against a raking fire. The conning tower is protected by 10-in. armor, and it is connected with a central station below the protective deck by a tube with walls 7 ins. thick. In addition to the forward conning tower there is a signal tower at the after end of the superstructure deck, with walls 6 ins. thick.

In the character and arrangement of the battery decided changes have been made. The 8-in. battery has been entirely abandoned and only two calibers of heavy guns are used, 13-in. and 6-in. The special board on battery arrangement, to which this question was submitted, decided that the use of an intermediate caliber was unnecessary and complicated the arrangement for ammunition supply, and the arrangement adopted is in line with recent foreign practice. The main battery includes four 13-in. guns, mounted in pairs in forward and aft turrets placed on the midship line, and protected by 15-in. armor with 17-in. port-plates. The ammunition hoists and revolving gear for the turrets are protected by barbettes 15 ins. thick, except over the arc within the diagonal armor, where it is reduced to 10 ins. to save weight. The turrets are oval in shape, with the front plates slightly inclined, and the rear plates vertical to give more room for loading. The center of gravity of the turret is in the axis of rotation, so that the turret is balanced and can be turned without serious retardation when the ship has a heavy list.

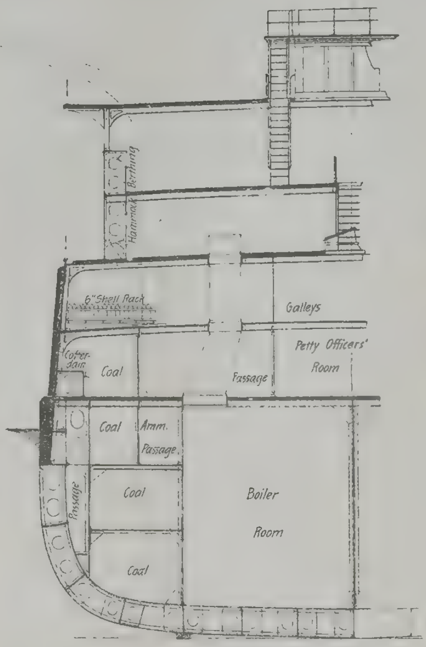
The forward turret is at the level of the forecastle deck with the axis of the guns 26 ft. 6 ins. above the normal load water-line. The after

Comparison of the Latest Battleships of the Principal Naval Powers.

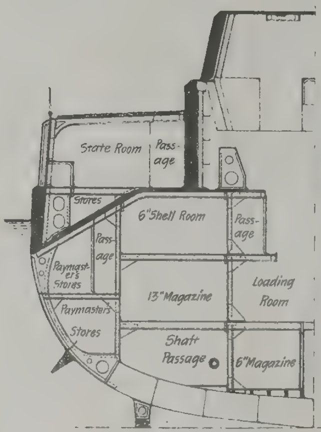
	Nation.					
Name of vessel	United States. "Alabama."	England. "New Renown."	France. "St. Louis."	Germany. "Ersatz Preussen."	Russia. "Oslabya."	Italy. "St. Bon."
Length	368 ft.	390 ft.	385 ft.	397 ft.	402 ft.	344½ ft.
Beam	72 "	74 "	66½"	66.93"	70½"	69½"
Mean draft	23 ft. 6 ins.	25 ft. 5 ins.	25 ft. 11 ins.	25 ft. 9 ins.	26 ft.	24 ft. 9 ins.
Displacement, tons	11,500	12,900	11,,275	11,130	12,674	9,800
Indicated horse-power	10,000	15,000	14,500	13,000	14,500	13,500
Speed	16 knots.	18¾ knots.	18 knots.	18 knots.	17½ knots.	18 knots.
Coal, normal	800 tons.	..... tons.	680 tons.	650 tons.	..... tons.	..... tons.
Coal, maximum	1,200 "	1,850 "	1,100 "	..... "	..... "	1,000 "
Battery: Main	(4) 13-in. (14) 6-in.	(4) 12-in. (12) 6-in.	(4) 12-in. (10) 5½-in.	(4) 9½-in. (18) 6-in.	34 guns.	(4) 10-in. (8) 6-in.
Battery: Secondary	...... (17) 6 pdrs. (6) 1 " (5) machn.	...... (16) 12pdrs. (12) 3 " (2) machn.	(8) 3.9-in. (16) 1.8-in. (10) 1.4-in. (8) machine.	(12) 3½-in. (12) 6 pdrs. ...... (8) machn.		(8) 4.7-in. (2) 2.9-in. (12) 1.4-in. (2) machn.
Torpedo tubes	4	5	4	....	....	5
Armor: Belt	16½ ins.	8 ins.	15¾ ins.	11¾ ins.	9 ins.	9¾ ins.
Casemate	5½ "	6 "	3 "	5.9 "	....	4 "
Turrets	17-15 "	10 "	15¾ "	9.8 "	....	9¾ "
Barbettes	15 "	10 "	.... "	9.8 "	....	9¾ "
Protective deck	3 "	3 "	3½ "	2.56 "	....	3 "
Splinter deck	½-in.	......	.... "	¾ "	....	.. "



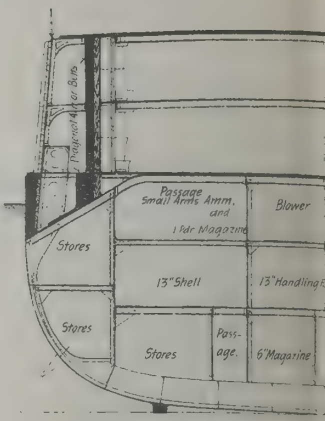
Section at Frame 33,
through Conning Tower.



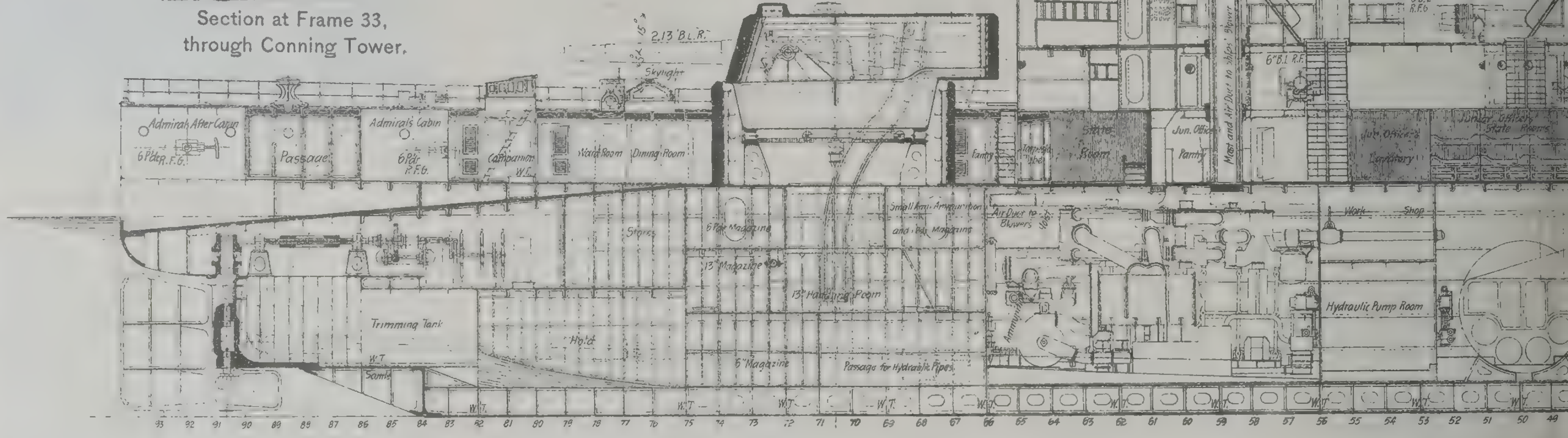
Section at Frame 37,
through Boiler Room.



Section at Frame 70,
through After Turret.



Section at Frame 30,
through Magazines.



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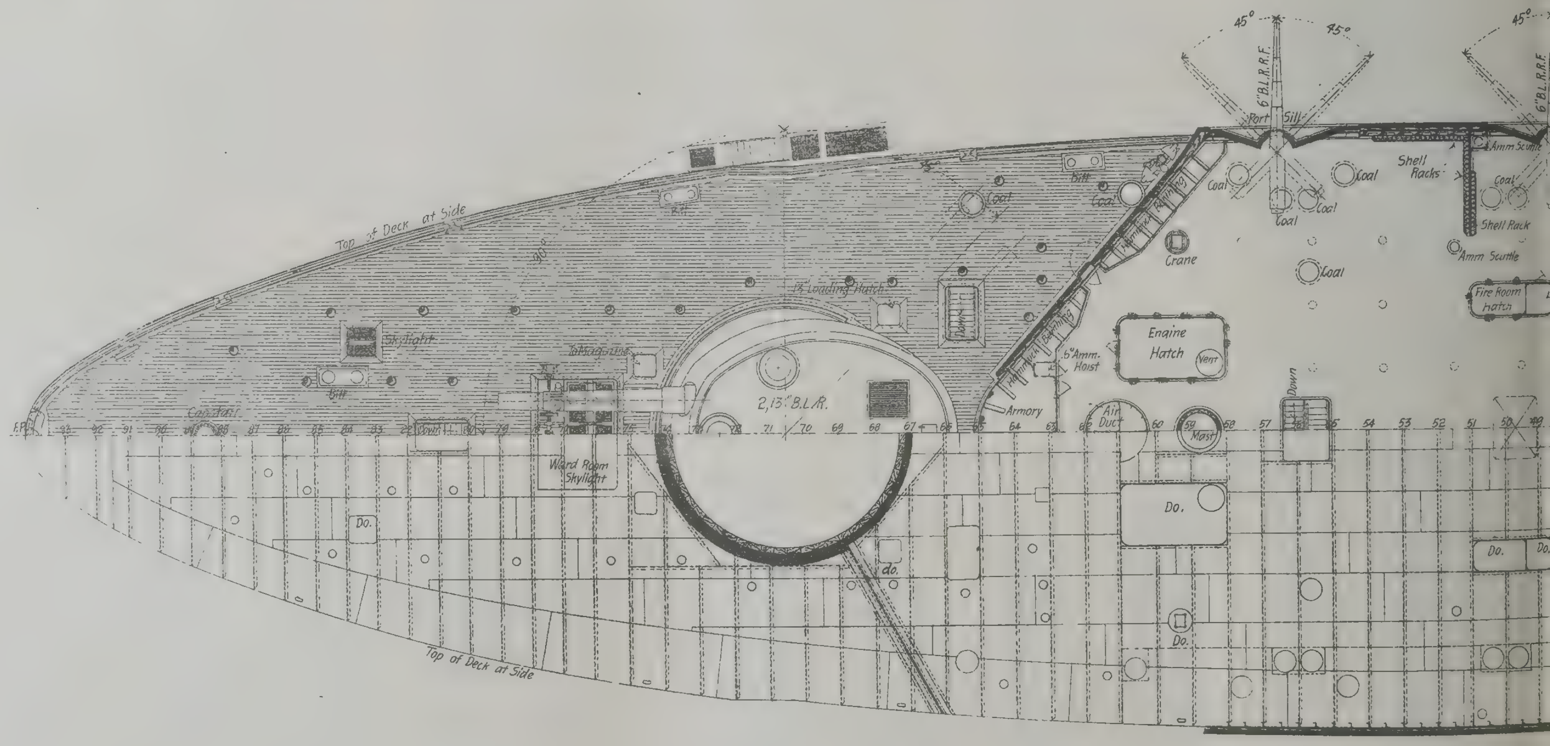

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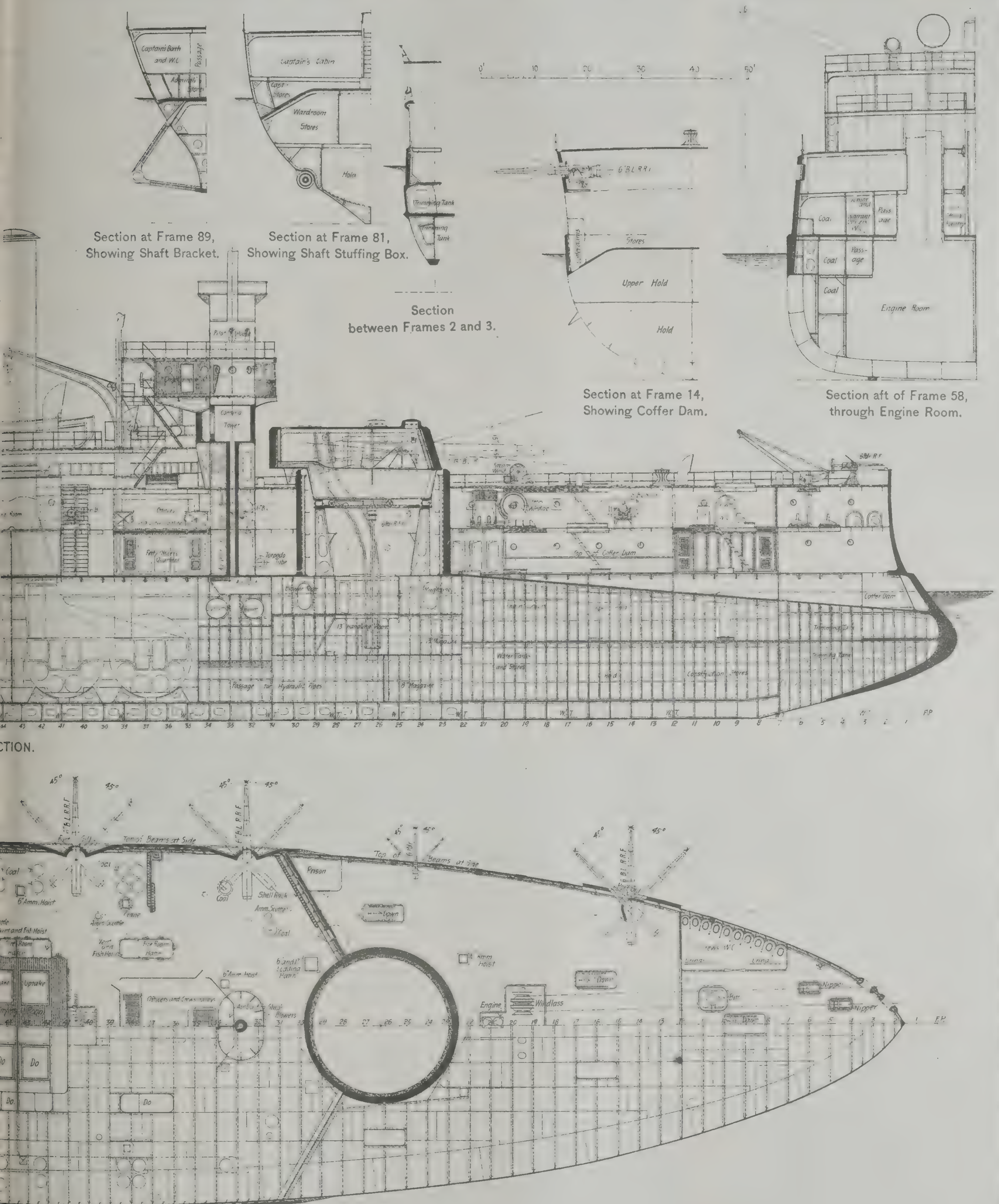
THE NEW U. S. BATTLES

(From Drawings Accompanying a Pap

Read at the Fourth General Meeting of



Section at Frame 89, Showing Shaft Bracket.

Section at Frame 81, Showing Shaft Stuffing Box.

Section between Frames 2 and 3.

Section at Frame 14, Showing Coffer Dam.

Section aft of Frame 58, through Engine Room.

CTION.

AN.

T THE "ALABAMA" CLASS.

chborn, Chief Constructor, U. S. Navy.

Naval Architects and Marine Engineers.)

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

turret is on the main deck, with the axis of the guns 19 ft. above the same water line. Each pair of guns sweeps an arc of 135° from the midship line. Three sighting hoods are provided for each turret; one in the middle for the turret-turner, who simply keeps the guns pointed at the target, and two side hoods for the gun-pointers. The eight 6-in. guns in broadside have a total arc of train of 90°, and are each protected by 3-in. shields on the carriage and the 5½-in. armor of the sides. The auxiliary battery consists of 17 6-pdr. and 6 1-pdr. guns, mounted wherever they obtain good command and are yet clear of the blast from the heavy guns. Four broadside torpedo tubes, in the 5½-in. armor, complete the armament of these ships.

Mr. Hichborn gives the following table, showing the weight of fire of one discharge, neglecting the auxiliary battery, from all the guns available for the bearings given and for several classes of our war ships:

Class.	Ahead or astern, lbs.	Bow to quarter, lbs.
"Alabama"	2,400	5,100
"Kentucky"	2,700	5,750
"Iowa"	2,766	4,499
"Indiana"	3,400	5,600

This weight of discharge is obtained from the following primary and secondary batteries, the auxiliary battery being added for comparison:

	Batteries.		
Class.	Primary.	Secondary.	Aux'lary.
"Alabama"	(4) 13-in. B.L.R.	(14) 6-in. R.F.	(17) 6 pdrs. (6) 1 "
"Kentucky"	(4) 13-in. " "	(14) 5-in. "	(20) 6 " (6) 1 "
"Iowa"	(4) 12-in. " "	(6) 4-in. "	(20) 6 " (6) 1 "
"Indiana"	(4) 13-in. " " (4) 8-in. " "	(4) 6-in. "	(20) 6 " (6) 1 "

The general dimensions of the battleships of the "Alabama" class are given as follows:

Length on load water line	368 ft. 0 ins.
Length over all	373 " 9 "
Breadth molded	72 " 0 "
Breadth extreme	72 " 2½"
Freeboard forward	20 " 0 "
Freeboard aft	13 " 3 "
Freeboard amidships	19 " 10 "
Mean draft (800 tons coal, ⅔ stores, ammunition)	23.6 ft.
Corresponding displacement	11,520 tons.
Speed, per hour	16 knots.
Steam power	10,000 I. HP.
Mean draft (1,200 tons coal, all stores, etc., on board)	24 ft. 7 ins.
Corresponding displacement	12,140 tons.

General Schedule of Weights.

	Tons.
Hull and fittings, including wood-backing, etc.	4,918
Armor and bolts	2,719
Protective deck armor	593
Armament and two-thirds ammunition	864
Equipment and two-thirds stores, water, etc.	498
Machinery, with water	1,128
Normal coal	800
Total	11,520

The main propelling engines will be of the vertical, inverted cylinder, direct-acting, triple expansion type, and they will be placed in two water-tight compartments, separated by a middle line bulkhead. The propelling air-pump and circulating pump engines will have a collective power of 10,000 1 HP., at 120 revolutions per minute. The cylinders are 33½, 51 and 78 in. in diameter and 48 in. stroke; there are 7,000 sq. ft. of cooling surface in main condensers and 800 sq. ft. in auxiliary condenser. There will be 8 single-ended steel boilers of the horizontal-return fire-tube type, placed in four water-tight compartments. These boilers have the following general dimensions:

Length	9 ft. 11¼ ins.
Diameter	15 " 6½ "
Working pressure, per sq. in.	180 lbs.
Total heating surface for all boilers	21,000 sq. ft.
Total grate surface	685 " "
Number of furnace flues	4
Diameter of flues	39 ins.

An interesting table herewith compares the "Alabama" type with the recently built battleships of foreign nations.

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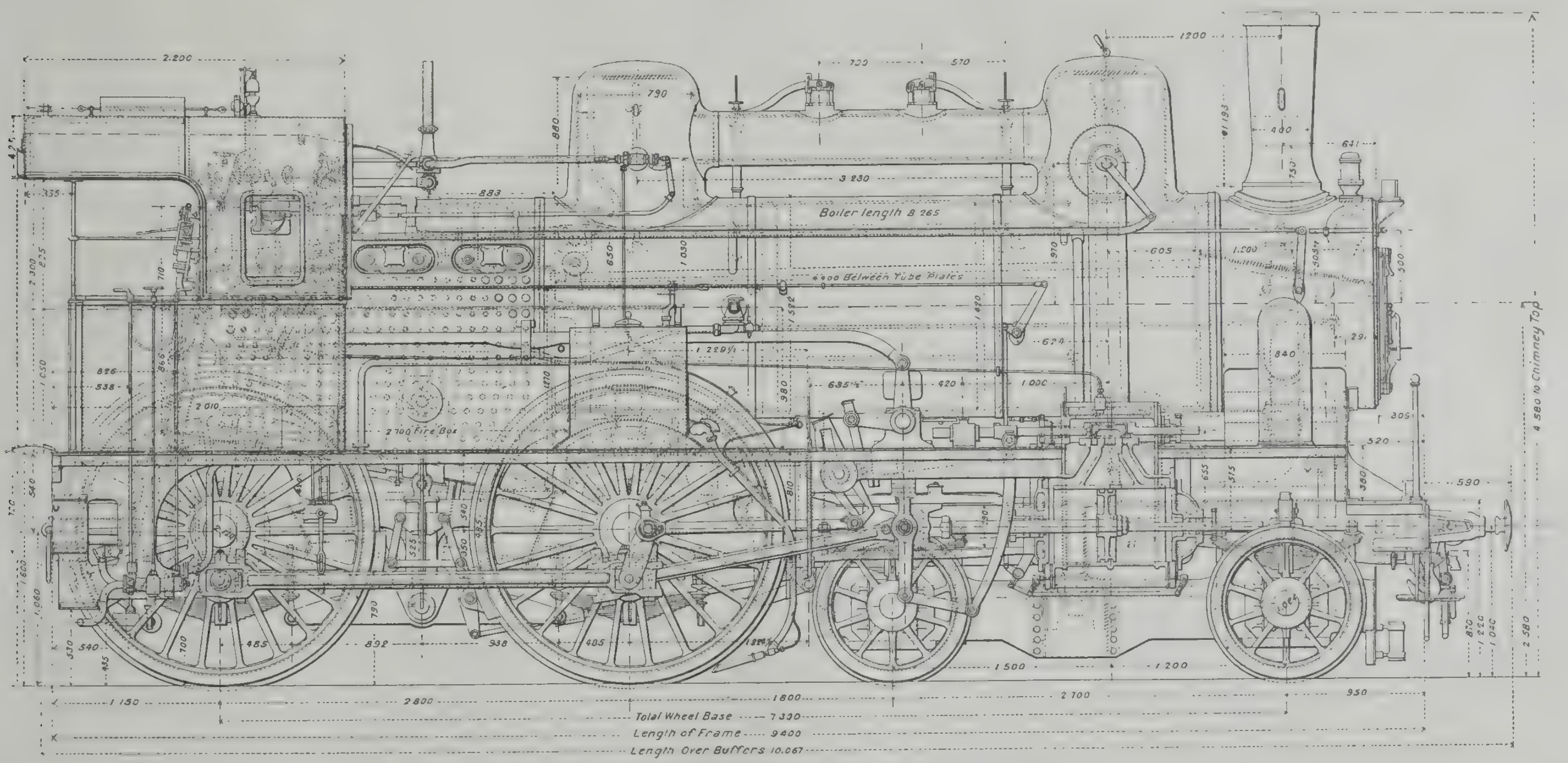
TWO-CYLINDER COMPOUND LOCOMOTIVE; AUSTRIAN STATE RAILWAYS.

The compound locomotive continues to grow in favor on the railways of continental Europe, and we illustrate herewith one of a large number of two-cylinder compound express engines, designed by Mr. Golsdorf, Superintendent of Motive Power of the Austrian State Railways, and built by the Wiener Locomotiven Fabriks-Actien Gesellschaft, of Florisdorf, Austria. The details of the compounding arrangement are on the Golsdorf system, which has recently been applied to a freight engine of the Pennsylvania R. R.

The engine shown is of the eight-wheel type, with a long truck wheel-base, and is of considerable weight and power, designed for heavy express service and for hauling the Oriental Express (from Paris to Constantinople) between Vienna and Linz. The trains average from 15 to 18 cars, or about 240 tons behind the tender. The general style of the engine is shown in the accompanying cut, reproduced from the London "Engineer." The boiler is of large capacity, and has two domes of 102 cu. ft. capacity connected by a horizontal pipe 11¾ ins. diameter, on which are mounted the safety valves. The throttle is in the forward dome. No special starting valve is used, but steam inlets are bored in the faces of the low-pressure steam chests and controlled by a special form of slide valve. The general dimensions of the engine are as follows:



COMPOUND EXPRESS LOCOMOTIVE; AUSTRIAN STATE RAILWAYS.
The Wiener Locomotiven Fabriks-Actien Gesellschaft, Builders

Running Gear:	
Driving wheels (4), diam.	6 ft. 11½ ins.
Truck wheels (4), diam.	3 " 4¼ "
Tender wheels (6), diam.	3 " 4¼ "
Journals, driving axles	7⅞ × 10½ "
Journals, truck axles	7⅛ × 9⅝ "
Wheel Base:	
Driving	9 ft. 2 "
Truck	8 " 10 "
Total engine	23 " 10¾ "
Total tender	10 " 5¾ "
Center of truck pin to c. of leading driver	10 " 0 "
Total length of engine	33 " 0 "
Weight in Working Order:	
On driving wheels	63,392 lbs.
On truck wheels	58,912 "
Engine, total	122,304 "
Tender, total	83,776 "
Engine and tender, loaded	206,080 "
Engine, empty	109,088 "
Tender, empty	33,600 "
Cylinders:	
Size of h. p.	19⅜ × 26¾ ins.
Size of l. p.	29 × 26¾ "
Distance center to center	6 ft. 3⅜ "
Piston rod, diam.	3¼ "
Connecting rod, length between centers	6 ft. 5 "
Boiler:	
Diameter of barrel inside (largest ring)	4 ft. 9 ins.
Thickness of barrel plates	9-16-in.
Height from rail to center line	8 ft. 5½ ins.
Length of smokebox	3 " 11¾ "
Working steam pressure	190 lbs.
Domes (2), height	2 ft. 10½ ins.
Firebox:	
Length inside	8 ft. 3½ ins.
Width inside	3 " 8½ "
Depth at front	5 " 0¾ "
Depth at back	3 " 9 "
Thickness, side and back plates (copper)	½ and ⅝-in.
Thickness of tube sheet (copper)	½ and 1 in.
Grate area	31.2 sq ft.
Tubes: Material, steel; No.	205
Diameter outside	2 ins.
Length between tube plates	14 ft. 5 "
Heating Surface:	
Tubes	1,554.8 sq. ft.
Firebox	118.3 "
Total	1,673.1 "
Miscellaneous:	
Smokestack, diam. bottom, 1 ft. 3⅝ ins; top, 1 ft. 6¾ ins.	
Smokestack, height	4 ft. 2⅛ "
Smokestack, height from rail to top	15 " 0 "
Capacity of tank	4,422 gallons
Capacity of coal space	11,650 lbs.

◆

FRICTION HORSE-POWER IN FACTORIES.*

By C. H. Benjamin, M. Am. Soc. M. E.†

During the winter of 1895-96 a series of experiments were made under the direction of the writer to determine the ratio of the power required to drive shafting and belts in various factories in this city to the total power consumed. In the course of these investigations visits were made to 16 different establishments, comprising rolling and stamping mills, bridge works, general machine works, and screw factories.

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*A paper presented at the New York meeting of the American Society of Mechanical Engineers.

†Professor of Applied Science in the Case School, Cleveland, O.

Indicator cards were taken from the engine during the day, at intervals of about one hour, while the factory was in full operation. During the noon hour or after working hours at night, cards were taken from the same engine when it was driving line and counter shafts only, no machines being in operation. Averages of these two sets of cards were assumed to show respectively the total horse-power and the friction horse-power of that establishment.

During the day the observers measured the lengths, diameters, and speeds of rotation of the line shafts, estimated the number and lengths of bearings, and noted the method of oiling. They also counted the belts running from line shafts and estimated their widths and the average diameter of pulleys. The number of counter shafts was noted, and the number and character of machines in operation. As far as possible an estimate was made of the actual number of men at work with machines during the day. These are the data which seemed to the writer most likely to be useful in determining the power consumed under various conditions, and while a great degree of accuracy in all the estimates was not practicable, the average results will be reasonably close to the truth.

The tabular form is best adapted to comparisons of this nature, and the accompanying table is largely self-explanatory.

The first main column of the table gives simply the data on which were based the calculations with regard to each factory. In all the tables the establishments are arranged according to the character of the work done in each. The next four columns show how the horse-power was divided between the machinery and the shafting and belts.

The percentage of power lost in overcoming friction depends more upon the arrangement of the shafting and machinery than upon the particular character of the work done. For instance, in the case of Works No. 4, there are two one-story buildings, covering considerable territory and containing machinery distributed at wide intervals. The power is transmitted from one shop to the other by a long shaft, and there are numerous transverse shafts driven by bevel gears. This would seem to be one of those cases where electrical transmission would be a good investment. A somewhat similar condition of things exists in Works No. 3.

The record of the shafting at Works No. 13 is remarkable, especially when it is noted that the works were running at only one-quarter their capacity. As the machinery is of the automatic type, very compactly arranged, the conditions are about the same as in several other shops visited; but an inspection of the shafting shows that great care has been exercised in its construction and operation. It is in perfect alinement, runs in cast iron boxes, without babbitt metal, and supported by unusually rigid hangers, while it is oiled by hand instead of by wick-oilers. That these conditions do not always obtain is shown by the remark made to the writer by the superintendent of one of the establishments visited, who said that he wished the test could be repeated, as after the first visit he had examined his line shafting, and found that one length was about 3 ins. out of line.

It will be seen that the figures for horse-power per 100 ft. and per 100 lbs. of shafting show a wide variation in different factories, since the work of friction is dependent on speed as much as on pressure.

By "HP. per 100 sq. ft. of shafting per min." is meant the friction horse-power was divided by the number of hundreds of square feet of shafting surface passing a given line in a minute, in much the same manner as the horse power of belting is often calculated. With one or two exceptions the figures in this column are nearly the same throughout, the general average for heavy and light machinery being about .046 HP. per 100 sq. ft.

The horse-power per bearing is nearly as great for light machinery as for heavy, probably on account of the greater speed of the former. The friction horse-power per counter shaft and per belt runs quite uniformly in the two classes of heavy and light machinery, being about three times as much in the former case as in the latter. It seems to the writer that either of these would offer a convenient and reasonably accurate method of estimating the horse-power required to run shafting and belts in ordinary situations.

The results given for the friction horse-power per 100 sq. ft. of belting per minute are more or less approximate, since the average size of the pulleys was rather roughly estimated; but they are as uniform as could be expected. The heavier duty per square foot of belt in the four heavy machinery establishments is partly due to the fact that the belts were thicker and required more power in bending.

The figures in the last two columns were worked out from the useful horse-power or that required to drive the machines alone, more as a matter of curiosity than with any expectation that they would be useful.

The figures for "Useful HP. per machine" are not nearly as uniform as those for shafting, since machines vary much more widely in construction than do line and counter shafts. In fact, it is not possible to give any average or state any rule that would be of value in special cases. The same may be said of the results in the last column, which show that any rule for estimating horse-power from the number of men employed would have a very narrow application.

Conclusions.

One would naturally inquire, after looking at the averages in the table, if it is necessary that from 55 to 65% of the power generated by the engine should be absorbed before the machines are reached. The isolated case of Works No. 13 would seem to answer this question.

One explanation of the large loss by friction in many shops is the fact that economizing in either quantity or quality of oil has at once a favorable effect on the bills, while the corresponding increase in coal and water consumption may be unnoticed or attributed to other causes. This is a case of saving at the spigot and wasting at the bung.

Where the loss is due to a necessarily extended and complicated system of shafting, it would be wise to determine if electrical transmission of the power would not be cheaper in the end.

No doubt it is true that to-day the question of time is more important than that of power, and that, in the endeavor to get the most product per machine and per man, the minor subject of coal and water consumption has been overlooked. This is, however, the age of small economies—economies that would have been laughed at a generation ago, and no manufacturer can afford to neglect the losses shown in these experiments.

It seems to the writer that in ordinary machinery establishments an observance of the following rules might effect a saving that would be noticeable in the annual balance.

1. Use pulleys of large diameter on counters and narrow fast-running belts.

2. Use nothing but the best oil and plenty of it, catching all drip, and either purifying it or using it for some other purpose.

3. Have all the shafting and counters oiled regularly, and do not depend too much on automatic oiling.

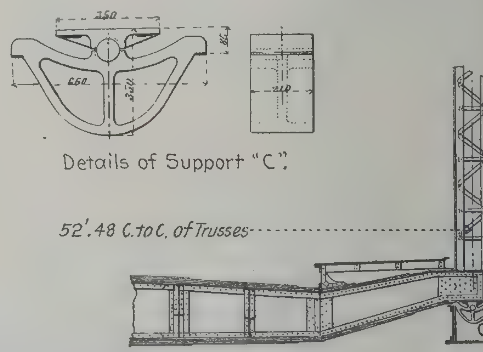

Fig. 2.—Detail of Support for Floor Beam at Vertical Posts.

4. Inspect line shafts from time to time, and see that they are in line and can be turned easily.

Many line-shaft boxes bind at the sides when screwed down, sometimes increasing the turning moment 100%.

TABLE SHOWING RESULTS OF TESTS OF THE LOSS OF POWER BY FRICTION IN 16 MANUFACTURING ESTABLISHMENTS OF CLEVELAND, O.

No.	Nature of work.	Total length of line shaft, ft.	Diam. of line shafts, ins.	Revolutions per minute.	No. bearings.	No. of belts.	Ave. width of belts, ins.	No. counters.	No. machines.	No. of men.	Total I. HP.	HP. to drive machines.	HP. to drive engines and shafting.	P. c. HP. to drive shafting.	Running at what capacity.	Friction horse-power.							Useful horse-power.	
																Per 100 ft. of shafting.	Pr 100 lbs. of shafting.	Per 100 sq. ft. shafting per min.	Per bearing.	Per counter.	Per belt.	Per 100 sq. ft. belting per min.	Per machine.	Per man.
1.	Wire drawing and polishing	1,130	2½ 2¾ 4 6	170	115	89	4	69	...	...	400	243	157	39.2	One-half.	14	.580	.10	1.37	2.28	1.76	.50	....	....
2.	Steel stamping and polishing	580	3 3½	200	68	28	6	27	18	78	74	17	57	77	One-third.	9.84	.352	.059	.84	2.11	2.40	.33	....	....
	Average	...	... ...	...	...	...	..	...	...	...	...	...	...	..	....	11.92	.466	.08	1.10	2.19	2.08	.415	....	....
3.	Boiler and machine work	530	2½ 3	150	46	53	5½	47	43	152	38.6	13.3	25.3	65.6	Two-thirds.	4.77	.205	.04	.550	.538	.477	.10	.310	.877
4.	Bridge machinery	1,460	2½ 3 4	110	142	92	4½	79	69	80	59.2	11.3	47.9	80.7	Nearly full.	3.28	.137	.04	.377	.606	.521	.20	.164	.142
5.	Heavy machine work	1,120	3	190	110	141	4	96	68	300	112	48	64	57	Full.	5.70	.233	.038	.581	.665	.453	.10	.707	.160
6.	Heavy machine work	1,065	2 3 4	180 150 150	114	192	4	152	123	225	168	77	91	54.2	Full.	8.55	.306	.06	.799	.600	.475	.15	.627	.342
	Ave. heavy machine work	....	... ...	...	...	...	..	...	...	...	...	...	...	62.3	....	5.57	.22	.044	.567	.602	.481	.14	.452	.380
7.	Light machine work	748	1½ 1¾ 2 3	135 135 135 150	101	217	3	133	250	200	40.4	19.7	20.7	51.2	Full.	2.75	.276	.034	.204	.155	.095	.04	.790	.099
8.	Manufacture of small tools	500	2 3	114	58	335	3	314	313	226	74.3	34.3	40	53.8	Full.	8	.400	.09	.689	.127	.119	.06	.109	.452
9.	Manufacture of small tools	990	2½ 1¾	175 136	102	217	3	202	258	100	47.2	22.7	24.5	51.8	Full.	2.49	.233	.03	.240	.121	.113	.04	.881	.227
10.	Sewing machines and bicycles	2,490	2 6	150	274	521	3	403	454	400	190	82	108	56.9	Full.	4.36	.430	.05	.397	.269	.208	.09	.180	.204
11.	Sewing machines	1,472	2 3 4	160 160 125	184	484	3	435	179	350	107	32.5	74.5	69.7	Full.	5.08	.134	.034	.406	.172	.154	.05	.181	.093
12.	Screw machines and screws	1,800	2 2¼ 2½ 3	180	180	486	3	392	428	320	241	127	114	47.3	Full.	6.33	.381	.05	.633	.291	.235	.09	.296	.396
	Ave. light machine work	...	... ...	...	...	...	..	...	...	...	...	...	...	55.1	....	4.83	.309	.048	.428	.189	.154	.062	.406	.195
13.	Steel wood-screws	674	1½ 2 3	175 160 175	96	131	4	89	392	140	117	100	17	14.5	One-fourth.	2.53	.109	.02	.178	.191	.130	.04	.256	.717
14.	Manufacture of steel nails	988	2½	200	74	187	3	175	184	58	91.6	45.9	45.7	49.9	Full.	4.62	.278	.035	.615	.260	.244	.07	.251	.792
15.	Planing mill	165	3	267	19	45	6	40	53	8	39.2	10.6	28.6	73	Full.	17.34	.729	.08	1.52	.715	.636	.08	.200	1.326
16.	Light machine work	275	2	175	37	48	4	27	30	..	8.28	4.26	4.02	48.6	One-half.	1.46	.138	.015	.109	.749	.084	.02	.142	....

A NOVEL FRENCH HIGHWAY BRIDGE.

We reproduce herewith from "Le Genie Civil," the general elevation and several details of a highway bridge of French design which is somewhat novel in one or two features. This structure is located in the city of Paris, and carries an important street over the tracks of the Orleans Ry. The conditions required that the dimensions and number of supports, or piers, coming in the railway yards should be as small as possible, and also that the street level should be raised no more than

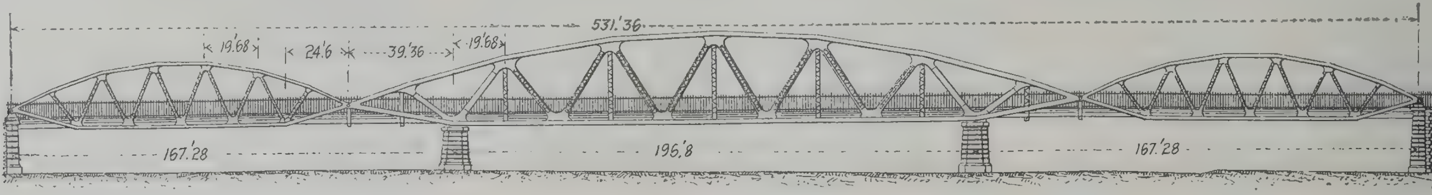

FIG. 1.—GENERAL ELEVATION OF HIGHWAY BRIDGE OVER ORLEANS RY.; PARIS, FRANCE.

was absolutely necessary to give head-room to the trains passing under the bridge.

Fig. 1 is a diagram elevation of the bridge as constructed. As will be noticed, the trusses of the center span are continuous over the piers and carry the inner ends of the side spans. The loads coming on the center span outside of the supports or piers produce, of course, stresses in the members of that span contrary in character to those produced by the loading between the piers. In the fewest words, the bridge is practically a continuous girder bridge, and the principle of the continuous girder, as far as the stresses are concerned, is applicable to the center trusses. The design goes further, however, and attempts to secure, besides the reduction of stresses peculiar to the continuous girder, also freedom from the danger of settling piers, by making the connections of the side and center girders flexible pin connections. The general character and purpose of the design is plainly indicated by these statements and need no further explanation except, perhaps, to state that the lack of rigidity which would naturally be expected on account of the flexible joint has not been shown in the completed bridge, probably on account of the floor being a solid iron plate floor and also being placed well below the joint.

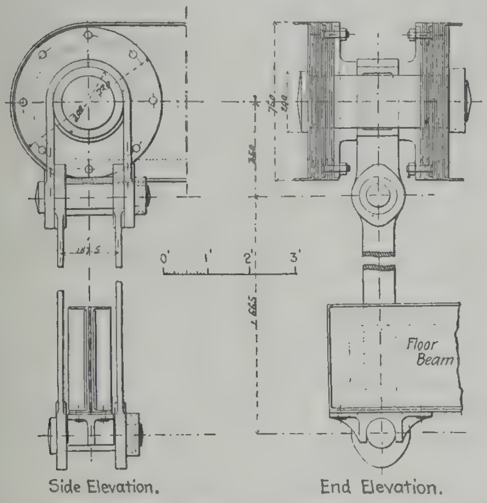

Fig. 3.—Floor Beam Hanger at Junction of Side and Center Spans.

The top chord of all the trusses is polygonal, and the bottom chord is straight, except at the end panels, where it bends up to meet the top chord. Both bottom and top chords are box girders, made up with plates and angles, and all the web members are latticed channel shapes, made up of plates and angles. The trusses are spaced 52.48 ft. apart, c. to c., and provide for a 32.8-ft. roadway and two 8-ft. sidewalks. Floor beams are placed at each panel point and also at the foot of the verticals in the center span. The manner of supporting the floor beams at these vertical posts is shown by Fig. 2, and Fig. 3 shows the hangers carrying the floor beams at the junctions of the side and center spans. This last illustration also shows quite clearly the character of the pin connection at this point.

This bridge was designed and constructed by the Department of Public Works of the city of Paris, M. de Tavernier, Chief Engineer.

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PROGRESS IN THE MANUFACTURE OF IRON AND STEEL IN AMERICA.*

Prior to 1838 the manufacture of pig iron was in a primitive condition, that metal being practically all made in charcoal furnaces, producing from 15 to 30 tons per week, and was converted into wrought iron in the old-fashioned charcoal fires, and was shaped into blooms for the rolling mill, and into bars for the smith, by a helve hammer. The furnaces, forges and mills were all driven by water power, and were kept in order by what was sometimes called a forge carpenter, or millwright. At this time the mills were all geared, the shafts being square, hexagon, or octagon, according to the fancy of the millwright; the wheels were secured on the square shafts by wooden blocks, and in them were driven thin iron wedges; the segments of the wheels were secured to the center in the same manner; the rolling houses were all set on wood. All this crude machinery the millwright was called upon to keep in good running order; consequently he became an important man.

In 1840 the use of anthracite coal and coke in blast furnaces was commenced. This required a much higher pressure of blast. Previous to this time the blowing cylinders had been made out of wood, the pressure of blast being very low, not exceeding 1½ lbs.; hence a great improvement in blowing machinery became necessary.

In 1842 puddling began to come into more general use, and puddling trains had to be built, and better merchant or bar trains were now required; they were all geared and gave much trouble. The machinist now had to be called in to help keep things in shape, and he soon took the millwright's place, and laid the foundation for the mechanical and metallurgical engineer.

In 1845 the rail mills were being built, and stronger and better workmanship was required. These mills were all geared, but the shafts were generally turned up, and wheels all bored out, and fitted up in a much better manner, which required more skill and better workmen. Puddling now became an important branch of the iron business, and the Old Harry was generally to pay to get the balls in proper shape; to do this mills were using the old Welsh hammer. Numbers of squeezers were tried and failed; finally the Burden squeezer was invented, and adopted by the mills generally, and to this day is the best machine that has ever been devised for the purpose.

In or about the year 1848 "boiling" came into use, which was a great improvement over ordinary "puddling," and gave a new impetus to the trade. From 1848 to 1856 there was no great change or marked improvements made in the business. In 1857 the three-high rail mill was successfully introduced, and in a very short time practically revolutionized the manner of rolling rails. From this time on all the new mills that were built were driven direct, without gearing, and much stronger and better in every way. It was during this time that the great changes and improvements were being made in rolling-mill and blast-furnace machinery, and also in machine-shop tools of all kinds, which enabled much better work to be turned out than had been previously possible; and this was an advance for the mechanical engineer, and prepared him for the great work that he was soon to be called on to accomplish.

In 1864 the Bessemer process was introduced, and it soon became evident that it would in a short time revolutionize the iron business. Its introduction and perfection will ever remain one of the most interesting and important epochs in the whole history of the iron business.

In order to show what the Bessemer process can do in coal and labor, as compared with puddling, the former can produce in 10 minutes ten tons of steel ingots, with a consumption of 1 ton of coal. It will require a puddling furnace ten days, with practically three men, to produce a like amount of puddled iron, and will require about 20 tons of coal. The puddling is a hard, laborious and exhausting occupation. With the Bessemer it is care and attention only, but that it must have.

We left the blast furnaces in 1840, making 15 to 20 tons per week, and produced in that year 286,903 gross tons. In 1895 we have furnaces producing between 2,000 and 3,000 tons per week, and others building that are expected to make much more. The total output in 1895 was 9,446,308 gross tons, which exceeds the quantity made by any other nation.

It was the marvellous increase in the production of iron and steel which took place after the year 1865 that gave such a remarkable impetus to the engineering trades. The demand for Bessemer pig iron caused new blast furnaces to be built of much larger size than formerly. The blowing engines were required to be of much greater capacity and more powerful. The material used in the construction of these furnaces stimulated other branches of business, in many instances beyond their capacity. When the Bessemer process came into use blooming mills had to be built, new rail mills, billet mills, and plate mills; in fact the introduction of Bessemer rendered the old iron rolling machinery practically useless; consequently new, heavier, and more powerful mills had to be erected.

The rail mills, with one exception, are three-high, and fitted up with tables arranged for automatically handling the work, and they are equipped with every facility that will quicken and cheapen the handling of the material. In 1866 the Siemens open-hearth furnace for making steel was introduced, but it was some time before it came into general use; the Bessemer for quite a while held it in check. To-day it occupies an important position, and, in connection with the Thomas basic process, one of the great metallurgical inventions of the age, is sure to become a strong competitor of the Bessemer process. When I allude to the Siemens open-hearth furnace I do not mean that their form of hearth and ports should be strictly adhered to, as there are other styles of furnaces which have their advocates; among them are the partial revolving hearth, which so far has shown good results, and it certainly has advantages over the fixed hearth. What I refer to is the Siemens regenerative principle, which is truly scientific and yet perfectly simple in its construction, and so far is the only method by which the metallurgist has been able to secure the heat necessary for making steel on the open-hearth plan; and all steel-melting furnaces, of whatever form the hearth has been constructed, use the Siemens regenerative principle. Much as I admire the Bessemer process and well know what can be accomplished with it, yet, if the users of steel insist on lower phosphorus, it will have to be made in the open hearth, and by the Thomas basic process, as the ores that will make steel of high grade by either of the acid processes are, so far as known, quite limited; and the Thomas basic Bessemer requires high phosphorus, as the pig iron should have at least 2%, and this is more difficult to obtain in quantity than the low is for the acid processes. Steel can be made in the open hearth, on acid lining, quite low in phosphorus, but at a greater cost, as you must start with first-class material, while the basic might be called a kind of scavenger. I do not say this in a disparaging sense, but, on the contrary, a material that is perfectly useless (so far) in either of the acid processes, can be utilized, and a fairly good steel can be made out of it, by the basic process, and it is this quality which makes it such an important improvement in the science of metallurgy. It is, however, like all other processes; if you want to make a good article you must have the proper material to start with. Now, while it is being rapidly introduced in many parts of the country, I think it proper to say that there are large users of steel of high quality that will only use the acid open hearth.

There are several other forms of steel-making furnaces, among which are the Pernot and Ponsard; both of them were designed for more rapid working. The former has an inclined rotating hearth, which keeps the metal in motion, and is supposed to work more rapidly than the fixed or stationery hearth. The later (Ponsard) is in its construction very similar to the Pernot, it being designed to work more rapidly than the Pernot, and introduces blast same as Bessemer, thereby combining the two processes by blowing the metal partially, and then finishing it by the Siemens process. Both systems use the Siemens regenerative principle.

Having given you a very brief account of the progress of the iron and steel industry from its infancy up to the enormous production in 1895, I shall now endeavor to show the wonderful changes that have been made in machine tools and shop practice.

I look back to my early days in the shop, now nearly 60 years ago, and call to my mind the equipments of the shop in the way of tools, and compare the facilities for making drawings of to-day with those at that time, when the complete outfit consisted of a board, a carpenter's square, a pair of compasses (as we then called them), a bevel, a lead pencil and a piece of chalk, and a jack plane to prepare the board for another drawing. After a time we adopted the plan of making models in skeleton, full size, especially when any motion was to be worked out, and also made, when it was possible, all the drawings full size; when too large to admit of this we would make important sections full size, and this practice I am not ashamed to follow at the present time, as it has many advantages.

The small shop tools for a lathe consisted of a hook tool with a sharp tit on the bottom to hold it on the rest (which was made of soft wrought iron); the tool was made out of a steel bar about ½ by ¾-in., generally put in a wooden stock some 2½ ins. in diameter, with a handle on the lower side. In addition to the tool just described, there was a finishing tool made in the shape of a spike-head, cutting edge on both sides, one to do the cutting or finishing, and the other to keep it in position on the rest; it also had a wooden handle, but of different construction from the handle of the hook tool, as it was held against the shoulder instead of under the arm; next was a chaser, and last, as usual, was the "doctor," to cure in a measure "drunken threads," which frequently occurred. The small tools consisted of a pair of outside and an inside pair of calipers, a file, and a steel straight-edge (home-made), 12 ins. long.

Now let us for a moment note the equipments of a modern machine shop for comparison. First, they have the great drawing room, and a good corps of men well skilled in their art, and are equipped with everything that is essential for producing work correctly and with rapidity, having special small tools for all purposes. The accuracy with which their round gages are fitted up is such that a machinist of 50 years ago could not possibly realize how it could be done.

The Bethlehem Iron Company has four lathes in use, all of the same pattern; one of them is used for what is called a cutting-off lathe, and frequently employs twelve tools, six on each side, made out of the best steel that can be had, size 1 in. by 6 ins., and are forced to cut all they will stand. These lathes have had work in them weighing over 190,000 lbs. They have planers that have finished castings that each weighed 165 tons, and the finishing of nickel-steel armor-plate requires tools of great power and special design.

In speaking of the manufactured products of iron and steel, I shall take up first the subject of forgings made of iron. These were originally made out of fagots (bundles of iron bars) heated in a reverberatory furnace, and welded and shaped under a hammer which was generally too light; the force of the blow did not reach the centre, and the result was that forgings of any considerable size were unsound in the middle. This occurred to such an extent that, in my early connection with machinery, I discarded forged shafts entirely and substituted cast iron melted in an air furnace, and continued to use it, with one single exception, until we learned how to make, heat, forge, and treat steel in such a manner as to practically get it solid and free from internal strains, and was ready to recommend it as the proper material for shafts and miscellaneous forgings.

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*Presidential address of John Fritz, delivered at the annual meeting of the American Society of Mechanical Engineers (slightly condensed).

I shall now refer to the single exception which I have before alluded to, believing a brief description of the shafts, and giving the reason why I used wrought iron and steel in place of cast iron, which had served me so well for a period of nearly fifty years, will be both interesting and instructive to you all, as it was to me at that time. First, the reason for using wrought iron and steel in place of cast iron was, I wanted a three-throw crank for a three-cylinder engine, and had to use a built-up crank; at that time a solid forged crank of such dimensions as was needed could not have been made in this country. The stroke of the engine being short, reduced the distance from center of shaft to the center of crank pin to such an extent that I was compelled to reduce the diameter of the shafts to the smallest size consistent with safety in order to get sufficient metal between the holes in the crank to give the required strength. Steel at that time being more expensive than wrought iron, it was economy to use iron when it would answer the purpose. I concluded to use steel for the main shaft and the first crank pin, and for the others wrought iron. Not having at that time any overflow of confidence in either forged iron or steel shafts, and being anxious to get the best that could possibly be had, I consulted a friend who was using steel as to where was the best place to go for the steel shaft and crank pin, and took his advice and so ordered them. The iron shafts and crank pins were from what I considered at that time, the best forge plant in the country.

Having had some previous experience in a small way with both metals, and the results not being altogether lovely, I thought it prudent to see in what condition the metal in the center of these forgings was. In order to show this, a hole about 4 ins. in diameter was bored through the center of them all, seven in number, and all were unsound in the center; in the iron the imperfections ran longitudinally, and the 4-in. hole practically cleaned them out. The steel shaft, which was about 14 ins. in diameter and some 12 ft. in length, proved unsound in the 4-in. hole, and showed serious imperfections in the form of large cracks or openings running, as it were, circumferentially on the inside of the shaft; the hole was enlarged to about 6½ ins. in diameter, and some of the imperfections were still visible. The position of the shaft was such when in use that, should it give way, it would not be likely to do any serious damage, so we concluded to use it. When the hole was bored through the steel crank pin it showed so badly that we split it in two lengthwise. It was full of cracks, some of them extending almost to the outer edge. Its condition was frightful to a person who was contemplating the building of a large plant for the purpose of making steel forgings, as I was at that time.

My experience in making steel, in heating, rolling, and forging, had already convinced me that it would require great skill, and still greater care, to prevent imperfections in the interior of steel forgings, yet I was not prepared to witness anything approaching the condition which the splitting of this forging revealed. The chemical analysis, as I remember, was fairly good. There had been some blow holes in the ingot, as there is in too many of them.

To my mind the trouble was almost entirely due to two causes: first, the ingot had been put into a hot furnace and heated up too rapidly, pulling the center apart, causing internal ruptures; secondly, by being forged under a light hammer, in all probability using steam on top of piston, which gives a quick stroke, and does not give the metal time to flow, or the force of it to reach the center of the ingot, consequently elongating the outside more rapidly than the interior; and the imperfections, whatever they may be, are always the weaker parts, and the effect of the blow on the outside elongates them, as it were, by pulling them apart more rapidly than the sound outside of the ingot; consequently the imperfections were greatly augmented.

Mr. W. F. Durfee, in a paper read before the Franklin Institute on the "Conditions which Cause Wrought Iron to be Fibrous and Steel Low in Carbon to be Crystalline" —and a most admirable paper it is, and one which every maker and user of steel should read, and study, in regard to unsound ingots—says:

> It is a common opinion that one of the reasons why steel forgings are often found hollow in the interior is the failure to work them under a sufficiently heavy hammer, but no hammer, not even the hammer of Thor, can do more than aggravate the evil of internal ruptures of ingots in steel.

This is well said, and is a truth that cannot be gainsaid. It was due to imperfect or unsound ingots, lack of knowledge in heating, in forging, and also the want of proper skill to treat the forgings properly, after they were made, that caused so many failures in the early days of its manufacture, which made many people think and believe that there was some mysterious uncertainty in the metal, consequently they discarded its use altogether; and to some extent this impression is still in existence, and, to my surprise, only a short time since quite a prominent engineer said to me that he was still using wrought-iron shafts on account of the uncertainty of steel forgings. To those persons who were using steel low in carbon, for various purposes, I would urge the use of a higher grade of steel, well knowing it would answer their purpose better; but was answered by saying that it required too high a grade of skill to utilize it; they must have a material that any one could handle, consequently the steel was so low in carbon that it was no better than iron, and in many instances not as good. My own early experience having fully convinced me that nearly all the failures were due to the use of improper kind and grade of steel, being too low in carbon, and in most instances so high in phosphorous and sulphur that nothing but failure could be expected, yet it was useless to attempt to convince them that a higher-carbon steel of proper analysis would answer their purpose. They said no; we are going back to iron; we know what that is, and we can trust it. I was told that a machinist had let a locomotive crankpin fall off his shoulder on the shop floor and it broke in two pieces, and I could readily imagine that a condition could exist that would render it liable to break from the most trifling cause. I also was told that in pinching a locomotive back and forth in the shop, in order to set the valves, that a steel crank pin was broken, and many other mysterious cases, as the laymen called them, were reported. At all events the general condition of steel forgings was such that it was not safe to use them where loss of life might result from failure.

I have already alluded to phosphorous and sulphur as most deleterious elements in steel. There are, however, still some people who contend that its presence to an extent not in excess of 0.12 will do no harm in low steel, and I have been told quite recently that a person who posed as a mechanical engineer and a steel maker, endorsed that position. He may be both, but I will take this occasion to put myself on record by saying that I have no use for it in any shape or form whatever, and by keeping it low you can increase the carbon, which is in the right direction for good steel.

Having shown you something of the character, of steel in its early days, and its failures, and the disrepute into which it fell, let us suppose the mechanical engineers, who at that time were the men who had charge of the practical part of the steel business, would have said that steel was no good, and dropped it, and said we will go back to the old concrete of metal and cinder again, it is good enough, then where would we have been to-day? But they did nothing of the kind, and let me tell you the mechanical engineer of that day was not made of that kind of material, for the engineers who, in face of the prejudices of a continent, advocated the substitution of steel for iron, were men who regarded obstacles and prejudices as things which were made to be conquered. He having been on many occasions placed in much the same situation in other lines, had gone far enough to see that there was a valuable germ in it for the future, and, if properly cultivated, was sure to produce great results. What did he do? Took off his coat, called to his aid that all-important adjunct to steel makers, the chemist, and then went to work as he had done many times before when things looked equally discouraging, saying this looks to be a great thing, and we will put it through, and produced the grandest material for construction purposes that the world has ever known, and, as I said before, which will enable engineers to solve great constructive problems, that, but for the improvements in the art of steel making, could not have been accomplished.

The subject of hollow forgings being one in which the mechanical engineer is more or less interested, I will give a brief description of the process, and how the ingot is prepared. Having already told you that the metal is subjected to pressure while in a fluid condition, I will now commence with a cold ingot. It is first examined externally, and if there are no imperfections visible, it is then put into a powerful lathe, and after the proper discard is cut off it is then cut to the proper length, that being determined by the final weight of the forging it is intended for. Next it goes to the boring mill, and is bored out to a size corresponding to the diameter of hole in finished forgings. You now have the ingot (or such part as you want) in the best possible shape for examination; and this is not all, for the center of the ingot is always the most undesirable part of it, and the boring of the hole gets it out of the way entirely. We now have it in the most desirable condition possible for the heating furnace, where it next goes, and it is in the heating that it is exposed to its greatest danger, and where skill and the greatest possible care are required, and it must be charged in a cold furnace, which should be a preheating furnace, and heated up slowly until the heat reaches the center; it is then taken to the forge furnace, and heated slowly and regularly (in order to prevent internal strains), until it reaches the proper temperature for forging. The higher the carbon, the more care is required, especially in the first heating, it being the crucial test, and where the damage is generally done, and if once done, it cannot possibly be repaired. When it is finally brought up to the proper heat it is taken to the press, and a mandrel is put in, and the forging commenced, and this part of the operation requires skill, sound judgment and great care to see that it is worked at the proper heat, and in a manner that will not produce any undue internal strains, and in irregular forgings special care must be taken in shouldering down and in working up flanges or projections, in order to prevent "fins," or excrescences, from forming, that may unnoticed work into the body of the forging. One of the great advantages of hollow forgings over solid is that by boring out the center of the ingot the metal is reduced to less than one-half the thickness of the solid forging, and by using the press, the action being slow, the ends of the forging are convex, showing that the force of the press had reached the center of the metal, while the hammer strikes a quick and sharp blow, affecting the outside of the metal to a much greater extent than the inside or center, consequently the end of the forging is concaved, showing at once the superiority of the press over the hammer. There are other advantages in the use of the press for forging purposes, but time will not permit a proper description of them.

The first shafting made was in 1888. The tensile strength of the steel was about 60,000 lbs., and elongation about 28 or 30% in 2 ins. At that time but little attention was given to the elastic limit or the contraction of area, which is now considered important, especially the latter.

I shall now give you the result of some physical tests in order to show the progress that has been made. First I will give one test of iron as a starting point, it being up to the introduction of cheap steel, the metal of the world. I can only give you the one test, it being the only one available at this time, but it is more than a fair one for comparison of a wrought-iron shaft with one of steel, for no such results could have been obtained from wrought-iron shafts as formerly made. The tests were taken from a puddled bar reworked car axle. The tensile strength in the different test bars taken from this axle vary between 44,000 and 45,000 lbs., the elastic limit between 18,000 and 23,000 lbs., the elongation between 21 and 27%, the contraction of area between 40 and 48%. Compare this with some results obtained in hollow-forged, oil-hardened, and annealed nickel-steel shafting, the physical properties of which are: tensile strength, 95,000 to 100,000 lbs.; elastic limit, 60,000 to 65,000 lbs.; elongation, 20 to 25%; contraction of area, 55 to 60%. It is safe to assume that in shafts of any size a nickel-steel shaft as above would have three times the elastic strength of a wrought-iron shaft, and taking into consideration the fact of hollow forging with judicious proportioning of inside and outside diameter, it would be possible to make a nickel-steel shaft of one-quarter the weight of a wrought-iron shaft, and obtain the same elastic or working strength. The greater contraction of area shown by the nickel steel proves it a safer material against shock, as the greater the contraction the greater will be the amount of local distortion that can take place without rupture. This is clearly shown by the old but still reliable bending test, which is always in proportion to the contraction of area, and not to the elongation, as most commonly supposed.

This nickel-steel test is no fancy one gotten up for show, but was taken from the forging, and was the test the work was actually accepted on, and was taken from a prolongation of the forging of a shaft 17 ins. diameter, and the hole was 11 ins. diameter. You will notice that the shaft which this test was taken from was specially treated by oil-hardening and annealing. While I am fully aware that there are many persons, and some of them high in authority, that doubt the propriety of such treatment, yet when the work is in a proper shape to receive the treatment, and it is made with intelligence and care, my experience has fully convinced me that this special treatment produces the best possible results, and for many purposes it is indispensable. Steel can be made higher in tensile strength and elastic limit than the test referred to, but to some extent it will be at the expense of extension and contraction of area.

Under ordinary conditions the elastic limit is about 50% of the tensile strength. In order to increase this proportion special treatment of the forging is resorted to. The elongation and contraction of area are also increased by treatment, especially the latter, so that with the elastic limit and contraction we have a safe index as to the condition of the metal, and as these two properties vary much less with the length and diameter of test bar, they are more valuable in comparing results from varying sizes of test bar. As the carbon in steel increases, the variation, due to work reduction, becomes less, while that of annealing becomes greater. The variation obtained by treatment increases rapidly with increasing carbon.

Steel .45 in carbon showing:

Tensile Strength.	Elastic Limit.	Elongation.	Contraction of Area.
90,000	45,000	15	40%
By oil-tempering:			
96,000	55,000	18	50%

The above are about the best figures to be used in forging ordinary work. If higher or lower strength is required, it may be obtained by varying the carbon. If increased strength and elastic limit are required, without sacrificing toughness, it may be obtained by using nickel steel.

As illustrative of the advantage of the use of higher carbon steels may be cited the piston rods of steam hammers, especially those of large size, where the strains were found too severe for the softer steels to stand them for any length of time, proving beyond question the value of considering the effect of the fatigue of metals, rather than a rupturing force of sudden application. In view of the above well-known facts it must seem strange that many progressive builders of steam engines still continue to use soft steel rods as an alleged means of safety. In this instance it seems fair to congratulate the bicycle-maker as the first to recognize the value of the development in the manufacture of steel, with all its salient advantages, with regard to combining strength with lightness.

The modulus of elasticity being constant in both high and low carbon steels, cases may arise in structural work where the higher steels, owing to the greater care necessary in working, with the consequent increase of cost, may offer no compensating advantage over the use of softer steels.

In conclusion, the modern practice of steel-making has, in the hands of the mechanical engineer, the metallurgist, and chemist, wrought wonders in producing a material which in quantity, physical qualities, and cheapness, would have been regarded as utterly impossible half a century ago when steel rails, beams, angles and plates were not thought of, and steel was regarded as a luxury of the material of the working artisan. The labor of the men of iron and steel have so cheapened their products that to-day we are enabled to use steel for the commonest purposes as well as for the most expensive articles produced by the skill of the mechanic. No article is too humble to be made of it, and no structure so grand and important as to refuse its services; it is demanded in the frying-pan as well as in the vast bridges and viaducts, as well in the housewife's needle as in the great leviathans that have made the ocean but a span of less than a week; thus we find steel asserting its value through every walk of life, and extending to every clime, linking lands in that bond which grows broader and stronger with the years, till even now we can see, if but dimly, on the horizon the promise of the linking of nations in the universal brotherhood of mankind, and bringing the longed-for era of eternal peace.

TRIAL OF STEAM JACKETS ON A LOCOMOTIVE ENGINE.*

The object of this experiment was to ascertain the advantage gained by jacketing the cylinders of a locomotive engine. The trials were undertaken, and carried out on the Lancashire & Yorkshire Ry. (England), at the suggestion of Mr. John A. F. Aspinall, Chief Mechanical Engineer.

Owing to the fact that these trials were carried out on a locomotive doing its ordinary train service, it was impossible to obtain results as complete and thorough as would have been aimed at had the experimenters been able to make the trials on a special train, the working of which could have been arranged to meet the necessities of the experiment. The trials were of short duration, and the condition of the fires at the start and the finish of each had to be determined by the necessities of the traffic requirements, and could not therefore be varied to suit the wishes of the experimenters. The consumption of steam was obtained with a close approach to absolute accuracy; but the same cannot be said respecting the fuel consumption, owing to the above circumstance with regard to the condition of the fires. The results obtained are therefore not such as will enable any definite conclusions to be drawn as to the value of the steam jacket on locomotives, but they are nevertheless interesting and valuable.

The experiment was made on a passenger locomotive, No. 1093, during its regular work of taking the 7.30 a. m. express train from Manchester to York, a distance of 76½ miles, and returning with the 3.0 p. m. express from York to Manchester. Both engine and tender are the ordinary standard pattern of this railway. The engine is of the eight-wheel type, the driving wheels being 7 ft. 1 in. diameter and the truck wheels 3 ft. 0½ in. The cylinders are inside and horizontal, with their valve chests on the top. The engine wheel-base is 21 ft. 6½ ins., and the total wheel-base of engine and tender 41 ft. 1½ ins. The weight of engine and tender when empty is 56.287 tons, and when in working order 70.925 tons, the tender carrying 1,800 gallons of water. The boiler is of steel, 4 ft. 2 ins diameter and 10 ft. 7⅜ ins. long; the fire-box shell of steel, and the fire-box of copper, 6 ft. long, 4 ft. 1 in. wide and 5 ft. 10 ins. high. There are 220 tubes, 1¾ ins. outside diameter. The heating surface in the tubes is 1,108.73 sq. ft., and in the fire-box 107.68 sq. ft.; total, 1,216.41 sq. ft. The grate area is 18.75 sq. ft., the ratio of heating surface to grate area being 65 to 1. The fire brick arch in the combustion chamber is about 2½ ft. long. The height of the chimney above the fire grate level is 10 ft. The cylinders were originally of the normal pattern, 19 × 26 ins. For this experiment they had been bored out and fitted with cast-iron liners, which reduced the internal diameter to 17½ ins., thus providing a body jacket of ⅜-in. space. The front cylinder covers were fitted with external covers, the space between the two forming a steam jacket. The back covers, however, were imperfectly jacketed by fitting over them, as close to the actual covers as possible, an annular wrought-iron ring with an inner and outer cover, the space between the latter two forming a jacket space. The external surfaces of the end jackets were much exposed, and not well covered. The proportion of the clearance surface jacketed is only about a quarter of the whole, and this is mainly due to the cover jackets; of the back ends, therefore, a large part is hardly jacketed at all, in the true sense of the word.

Four trials were made, lettered A, B, C, D, on Sept. 18 and 19, 1894; A unjacketed and B jacketed on the 18th; C jacketed and D unjacketed on the 19th. A and C were made on the runs from Manchester to York, and B and D on the return runs from York to Manchester. On each trial the weights of coal and feed-water consumed were measured, and readings of the various gages were taken, and the position of the reversing gear was noted. Indicator diagrams were obtained, and in trials C and D samples of the furnace gases were collected from the smoke-box below the exhaust pipe.

Samples of the coal were submitted to Mr. Charles J. Wilson for determining the calorific value in a calorimeter. The mean value from his tests was 14,200 thermal units per pound of dry coal, equivalent to an evaporation of 14.7 lbs. of water from and at 212° F. The coal was placed on the tender in sacks holding 200 lbs. each; and the time of emptying each sack upon the foot-plate was noted, as well as the total weights. An attempt was made to have the fire in the same condition at the end of each run as at the start; but it was difficult to carry out this arrangement, since the trials were made during ordinary runs, and could not be allowed to interfere in any way with the regular working of the traffic. The grades at the two ends of the journey are different, and different fires were therefore needed to ensure adequate steam at the beginning and end of each run. The ashes and clinkers from the smoke-box and fire-box were weighed off at the end of each run, but those in the ash pan were weighed only at the end of each double journey. As each trial lasted only about two hours, errors introduced by variation in the condition of the fire might be thought to bear rather a large proportion to the total coal consumption; but, bearing in mind the rapidity of consumption, amounting to about 50 lbs. or 60 lbs. per sq. ft. of grate per hour, this was probably not the case. The actual coal consumption per indicated horse-power per hour of steaming time in the four journeys was respectively 2.87, 3.07, 2.73 and 2.79 lbs.

The difficult operation of collecting the gases while going at express speed was carried out by Mr. Michael Longridge. They were drawn off through a ¼-in. copper pipe, and then through a rubber pipe into a gasometer containing water, whilst a branch pipe led to a collecting bottle filled with mercury. After drawing off all the air in the pipe connections, the cock on the branch was opened, so that part of the current of waste gases passing to the gasometer could be diverted and collected by displacement over mercury in the collecting bottle. During the outward journey C much trouble was experienced, owing to the heavy chimney-blast; but in the return journey D everything worked quite satisfactorily. The mean results of the three analyses made from the sample collected on each journey are the following volumetric percentages: Trial C, carbonic acid, 12.85%; oxygen, 4.15; carbonic oxide, 0.80; nitrogen, 82.20. Trial D, carbonic acid, 15.10; oxygen, 1.97; carbonic oxide, 0.85; nitrogen, 82.08%. The feed-water was measured by means of a Siemens water meter on the pipe between the tender and the injector. It was originally intended to have a means of making direct measurement of the feed-water. The meter was read at the time of starting from each station, and thus a fair approximation to the rate of consumption was obtained, as well as the total quantity. The overflow from the injector was caught and allowed for. After the trials were over, the meter was sent to University College, London, and tested there by Prof. Beare at rates of flow similar to those in the trials. The error was somewhat variable, but the meter was found to be registering on the average 2.6% too low. In order to be able to correct for differences of level in the boiler, the quantity passing through the meter to raise the level in the gage glasses one inch, for each inch in their height with the engine standing under full steam, was determined by Mr. Donkin after the trials.

The jacket was drained into three small tanks carried upon a temporary staging on the front of the engine; one measurement was made for the two body jackets together, another for the two front covers, and a third for the two back covers. While standing at York on each day radiation tests were made, by measuring the quantity of steam condensed in each pair of jackets with the engine standing, all hot; these lasted 2½ hours on the first day and 1½ hours on the second. The following were the results obtained:

Condensation of steam in jackets, lbs. per hour.

	—While running.—		—While standing.—	
	Sept. 18, B.	Sept. 19, C.	Sept. 18.	Sept. 19.
Two body jackets..	267	241	35.0	26.7
Two front covers...	123	103	16.0	13.7
Two back covers...	65	55	12.0	15.8

The times of passing all the stations were noted, and also the times during which the steam was shut off, in order to determine the actual running time and the actual steaming time in each trial. Whenever a set of indicator diagrams was taken, a note was made of the boiler pressure, of the pressure in the jackets, of the position of the reversing gear, and also of the gradent and mileage.

Indicator diagrams were taken simultaneously from both ends of each cylinder. The springs of the indicators used were not tested for errors, since these would not affect the comparative results of the four trials. Unfortunately no counter was fixed for the trials, as had been intended. The speed in miles per hour was continuously registered by a Boyer speed recorder upon a paper wound on a drum which was driven from the rear truck axle. If this instrument recorded correctly, the circumfrence of the driving wheels being known and all slip neglected, the revolutions per minute of the driving wheels can be calculated. An attempt was made to count the revolutions at the time the diagrams were being taken; but it was found impossible to do this correctly at the high speeds. After much deliberation, it was decided to make a series of tests of the Boyer recorder, by driving it at known speeds, in order that any errors in the diagram it recorded might be ascertained. This was afterwards done by Mr. Donkin.

Comparing trials A and C, both from Manchester to York, the jacketed trial C shows a consumption of 24.49 lbs. of steam per I. HP. per hour against 26.70 lbs. for the non-jacketed run A, or a saving of 8.3% by jacketing. Comparing trials B and D, both from York to Manchester, the figures are 24.48 lbs. and 24.87 lbs. respectively, or a saving of 1.5% by jacketing. Comparing the figures for coal consumption in trials A and C, the jacketed trial C shows an economy of 0.14 per HP. per hour, or practically 5%, the increased consumption per train mile on this run being accounted for by the greater load hauled; the load was 8% greater in C than in A, the average speed being nearly the same in both runs. Comparing trials B and D, however, the jacketed trial B is distinctly less economical, the coal consumption being 0.28 lbs. greater per HP. per hour than in the non-jacketed trial, or 10% more; and the consumption is also greater per train mile. In these two trials, while the weight of train hauled was the same, the speed was nearly three miles an hour greater in the non-jacketed run D, with a correspondingly much increased horse-power.

A WATER POWER PLANT WITH ELECTRIC TRANSmission, in which the water power is developed under a head of 1,000 ft. is in process of construction near Jackson, Cal., by the Blue Lakes Water Co., of 202 Sansome St., San Francisco.

THE NEW UNITED STATES NAVY is fully discussed in the annual report of Secretary of the Navy Herbert. Congress has authorized the present administration to build 28 vessels with an aggregate tonnage of 65,886 tons; of these, 5 are first-class battleships, and 16 torpedo boats. As to the increase of the navy he says that on June 30, 1893, we had in commission 30 vessels aggregating 62,820 tons; on June 30, 1896, we had 40 ships in commission, aggregating 122,528 tons, with 8,165 men and 1,378 apprentices. On Dec. 1, the "Brooklyn" and "Puritan" went into commission, bringing the total tonnage up to 137,859 tons. During the last four years the following guns have been manufactured: 70 4-in., 71 5-in., 6 6-in., 45 8-in., 1 10-in., 8 12-in., and 12 13-in.; and at the present date there are 196 guns in course of manufacture, ranging from 4 to 13-in. In addition to the above, 100 3-in. field and boat guns are on hand. Secretary Herbert recommends the immediate building of three battle-ships of 23 ft. draft, for use in the Gulf and at harbors in the North not admitting vessels of deeper draft, and also 12 more torpedo boats. He advocates the increase of the steam engineering staff to 250, the present limit, and proposes to save money by laying up heavy ships in ordinary, with only sufficient crew to keep them in working condition.

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The account of a test of a locomotive with steam jackets on its cylinders, which is given on another page of this issue, is of interest because it is a record of an experiment in a field almost or quite untouched rather than because of any definite results obtained which show either the value or the absence of value in this application of the steam jacket. The trifling gain shown by one comparison is as inconclusive as the small loss shown by the other. It is to be doubted, in fact, whether any road test of a locomotive could be relied upon to give reliable results as to the economy or waste which a steam jacket might cause. American experience goes to show that accurate results in short time tests on a locomotive are only to be obtained by tests of the machine on a stationary plant, such as that which the enterprise of Purdue University has established, or that of the Chicago Northwestern Ry.

As to whether a steam jacket might be expected to effect a fuel saving on a locomotive or not, opinions will doubtless differ very widely. On the one hand the locomotive has a high ratio of expansion and a wide range of cylinder temperatures which would favor economy by the steam jacket. On the other hand the loss of heat from the exterior surfaces of the cylinders would be much greater than in stationary engines, and would continue while the locomotive was standing still. The jacket water would doubtless have to go to waste, too, instead of being returned to the boiler, as in stationary practice. Still, we do not see why there are not quite as good chances of good results in this as in many other of the new departures proposed for improving the locomotive, and we hope some American engineer or railway company will make a trial of the scheme.

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The serio-comic water war in Jersey City has been resumed, but with little prospect of an early termination. A contract has been awarded by the Street and Water Commissioners, as noted in our news columns, to the East Jersey Water Co., but the rival bidder and some of the citizens are reported as sure to fight it in the courts, should it receive the approval of the various city authorities, which still have to pass upon it. The main legal objection to the award thus far made is that it is for a single pipe line, whereas the specifications call for two or more conduits. The contestants seemed to have overlooked the fact that the specifications call not only for "either two or three pipes," but also that these must be "of equal capacity." The defeated bidder proposed one 35,000,000 and one 15,000,000-gallon conduit. The successful company made two bids, one for a 50,000,000-gallon conduit and the other for two 25,000,000-gallon conduits. Neither the one single pipe line nor the two of unequal capacity comply with the plain provisions of the specifications, and the two of equal capacity are distinctly at variance with the apparent intent of the specifications.

These specifications emphasized the fact that the city wanted two distinct advantages, or what it considered as such, offered it: (1) More than one conduit, as a safeguard against accident to the supply; and (2) a choice between buying works with capacities of 35,000,000 and 50,000,000 gallons, respectively. To this end the plural, "conduits," is everywhere used throughout the specifications, and it is stated, first, that the contractor must provide storage and "conduits" with a capacity of 35,000,000 gallons; next that he must increase these, on demand, to 50,000,000 gallons, and that, speaking of the "conduits," "when so increased where metal pipes are used, there shall be either two or three pipes of equal capacity." Finally, the bidder was required to name a price at which he would sell to the city works of either ot the capacities named. Obviously, the only way in which all these conditions can be met is by building two 17,500,000-gallon conduits at the start, to give 35,000,000 gallons of carrying capacity, and then adding another one of the same size, in case the city ordered the plant increased to 50,000,000 gallons. A 35,000,000-gallon pipe at the start fails to give the city the safety which it thought would result in having two conduits; and either a single 50,000,000 or a double 25,000,000-gallon line, built at the outset, deprives it of the full advantage of the lower cost of a 35,000,000-gallon supply. This advantage may or may not have been more fancied than real, but the specifications demanded it and the unsuccessful bidder was governed accordingly, put in a bid for two pipe lines instead of one, in case the works were to be increased to 50,000,000 gallons, and now finds himself the highest bidder on this basis, although the lowest for a 35,000,000-gallon plant. The successful bidder names the same figure for the smaller as for the larger plant, and thus the city gains nothing by its efforts to make it easier for it to become the owner of its water supply. On the basis of buying water by the million gallons, the successful bidder is the lowest one on all the quantities involved, but the difference would be only 80 cts. per million gallons when the full 50,000,000 gallons was required, and might well have been on the other side, and greater in quantity, had the specifications plainly said that bids were wanted on a single 50,000,000-gallon conduit.

If the plain language and intent of the specifications is to be regarded, it appears to us that the Rockaway & Hudson Water Co. is fully justified in its claim that the award to its rival is illegal, being based on conditions more favorable than the specifications admit. But the only advantage the Rockaway Co. can reap from upsetting the award to its rival seems to be a possible new opportunity to bid on the contract, since its own proposals are also at variance with the specifications.

Perhaps more amusing still, to people outside of Jersey City, is the fact that while this matter is in dispute the East Jersey Water Co. will be furnishing Jersey City with a temporary supply of water at $43 per 1,000,000 gallons, or $8 more than the average price it would receive under the permanent contract. Unless some new arrangement is made between the company and Newark, the former cannot continue the temporary service after 1900, but a modification was made in the specifications before the last call for bids, giving contractors three instead of two years to build works, so if it found it advantageous to do so, the East Jersey Water Co. could take care that its permanent supply was not ready until the last extra dollar had been secured from the temporary supply contract. This all shows most excellent business management on the part of the company, but the ways of the city authorities for years past have been inexplicable, when viewed from the standpoint of those who believe in able and honest city government.

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England is apparently going wild over the passage of the Light Locomotive act, which now permits a mechanically propelled vehicle to travel faster than "four miles per hour" over British highways, and does away with the old enforced necessity of sending a man with a red flag ahead of all such vehicles. About the middle of last month a parade of motor cars was organized in London to celebrate the so-called Emancipation act; and as measured by public enthusiasm, great crowds, speeches, etc., the demonstration was a veritable triumph. About thirty or forty motor cars participated in the race, for race it was, says London "Engineering," in spite of all efforts to make it a procession. These cars represented every type that had stood the test of previous trial, and a number that either worked badly, or would not work at all, "owing to the dense crowds." Practically all of the cars taking any active part in the exercises were propelled by oil engines, giving out clouds of vapor and the rank smell of benzine. They steered well as a rule; but they were very much at fault in starting off; generally going ahead with a rush, after a succession of preliminary "bucks," and break-downs in some detail were frequent. "Engineering" editorially describes the whole demonstration as a farce, and warns its readers that despite the blatant prospectus of the motor-car promoter, a vehicle of this type, of practicable form and fit to be used by the thousands as a substitute for horse-drawn carriages does not yet exist. Some years of patient study and experiment are yet needed to develop the acceptable motor-carriage; and meanwhile the innocent public had better abstain from investment in enterprises of this class, for the "boom" will surely be followed by a most decided "slump." It is satisfactory to know that the people of the United States are less sanguine of the immediate use of motor-carriages than are the English and French, and the American promoter makes so little progress at home that he goes to England to sell stock in his new and crude device. Like every other revolution in methods of transport, time and experience are required to develop the new idea and to make the road motor a practicable machine fit for every-day use; and in this country especially the improvement of the surface of city streets and country roads must precede any very extensive use of the mechanically propelled carriage.

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Philadelphia might have had a pure water supply, in place of its present foul one, many years ago if half the energy wasted to further the schemes of speculative promoters for its improvement had been devoted to a sensible and honest attempt to solve the problem in a scientific and business-like way. Just now there is much agitation over a proposed contract with the Philadelphia Water Supply Co. This concern offers to enter into a 50 years' agreement to relieve the city of the burden of delivering water to its reservoirs in return for 60 per cent. of its gross water receipts. The water is to be brought from the Delaware River, after filtration, through two conduits of 175,000,000 gallons capacity each. The city is to distribute the water and collect the water rates, maintaining them through the whole 50 years of the contract at the same figures as are now charged. Curiously enough, the Council's Water Committee is seriously considering this proposition to contract with a private company, notwithstanding the fact that both branches of the City Council have just passed a bill providing for a $3,000,000 loan for a filtration plant, or plants, to be built by the city.

Aside from some highly objectionable details of the proposed contract, in themselves sufficient to condemn it, the general principle of turning over to a company any part of the water supply system of a great city is a bad one. We will not further discuss this scheme at present, but leave it to faithful and intelligent public officials, and an enlightened press and people, who will doubtless dispose of it as they have of similar proposals in the past.

A NOTABLE DEPARTURE IN MACADAM ROAD CONSTRUCTION.

We have several times pointed out in these columns a fact which many of our readers are, we know, learning by experience, that a macadam road is far from being a durable highway. In the "good roads" agitation which has gone on for a decade or more, there has been a certain tendency to hold up the macadam highway as a panacea for all ills and an absolutely perfect system of road construction. Unfortunately this is by no means the case. A broken stone covering for a highway, if it is made thick enough to be reasonably durable, must of necessity be a somewhat expensive system of construction, in first cost. In eastern New Jersey, where trap-rock is abundant and can be generally secured with a very moderate haul, the cost of a 16 ft, macadam road with a telford bottom may be set on the average at about $5,000 per mile. Roads which cost such a sum are out of the question in purely agricultural districts, except possibly for much traveled highways. In Northampton County, Pa., the County Commissioners are about to build some samples of good road construction in several different towns of the county for the purpose of interesting the people and the township authorities in good road construction. But the committee in charge of this matter strongly recommended that the sections of improved road proposed to be built should not cost more than $1,500 per mile, as the township authorities would not accept more expensive prices of construction as good examples for them to follow. The difficulty in making good examples of macadam road at this figure will be apparent, we presume, to our readers.

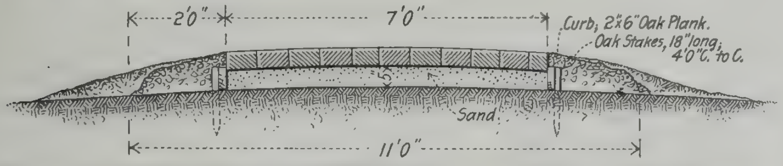

FIG. 1.—CROSS-SECTION OF COMBINED BRICK AND MACADAM ROADWAY AT MONMOUTH, ILL.

Designed by J. E. Miller, Engineer and County Surveyor; Brodine & Dungan, Contractors.

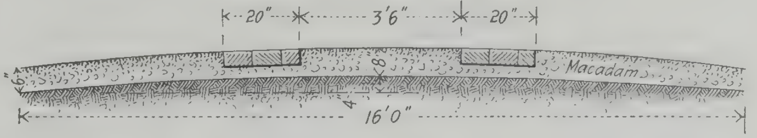

FIG. 2.—CROSS-SECTION OF PROPOSED 16-FT. MACADAM ROADWAY WITH PAVING BRICK TRACKWAY IN CENTER.

The fact of the case is (and the people who pay for road construction appear to be aware of it, if "Good Roads" advocates are not), that a macadam or telford road will not pay except where there is traffic sufficient to warrant its construction.

It may be asked, What is this amount of traffic? We can best explain by an example. Suppose that a certain highway can be left as a dirt road and will cost to keep in repair $50 per mile per annum. Suppose that a narrow macadam covering can be laid on this highway for $2,000 per mile and can be maintained for $150 per mile per annum. Then with interest at 5% there will have to be a saving of $200 to the traffic that passes over this mile of road in a year, unless the macadam road is to be a losing investment.

It is plain from the above that wherever the natural soil is fairly good for roadmaking, or wherever gravel is to be had, a highway must have a very considerable amount of traffic in order to make macadam pay.

On the other hand, as we said at the outset, when we come to roads which have a heavy traffic, and especially where the traffic is largely of heavily loaded wagons, the macadam road proves itself surprisingly shortlived. We are aware that there is a great difference in macadam roads, that some stone proves much more durable under heavy traffic than others, and that such local conditions as the effect of frost, the amount of rainfall and of sprinkling have an important influence. But none who carefully study macadam streets about a city suburb, or better still, upon a much traveled highway where the traffic follows parallel lines, can fail to appreciate the rapid wear that takes place on even the best macadam roadways. The result is that only for a few months while such a road is new is it in first-class condition.

In Jersey City a few days ago the Street and Water Board adopted a resolution directing their Chief Engineer to prepare no more specifications for macadam pavements until further notice. The reason for this action is given by the Jersey City "Journal" as follows:

> This action is the outcome of careful deliberattion on the part of the Commissioners, and is due to their conviction that macadam pavements in this city have not been a paying investment. They have not lasted long enough. They are not practical, it is claimed, for a city with so much heavy traffic as has Jersey City.
>
> Arlington, Bayonne and Garfield Aves. were macadamized only recently. Already those thoroughfares have been so badly cut up by heavy trucks that the Street and Water Board last week had to pass an ordinance to prohibit the passage of heavy vehicles on those streets unless provided with wide tires.

The fact of the rapid wear of macadam roads has led to various suggestions to improve them by embedding lines of rails in their surface. We reviewed various schemes of this class in our issue of May 7, 1896. As we then pointed out, there are numerous difficulties in the way of such schemes.

What appears to us a much more hopeful plan for an improved highway construction has recently been tried at Monmouth, Ill. It consists, briefly, of a combination of brick pavement and macadam road. The accompanying cut (Fig. 1) shows a cross-section of this road taken from the "Monmouth Daily Review," from which we take also the following particulars as to the method of its construction:

> The ground was prepared for it by grading and being allowed to stand for two months. It was treated to an occasional scraping so that it would pack evenly, and when the contractors were ready to lay brick it was as hard and even as a floor.
>
> The first thing was setting the curbing. This was made of 2 × 6 in. oak plank, set 7 ft. apart, and held by oak stakes 18 ins. long, and put down every 4 ft. Inside this was put a 5-in. bed of sand. This was evened up and the single course of No. 1 paving brick, made by the Galesburg Paving Brick Co., was put down. They were set on edge, and make a fine roadbed. Outside the curb 2 ft. of the crushed rock was laid, graded up to make an easy approach. This makes a road 11 ft. wide, and the finest in the land. The earth road on each side was graded and worked, making it in all 40 ft. wide and affording tracks on each side for use in dry weather.

We learn further that 3,000 ft. in length of this road was built during the past season. The contractors, Brodine & Dungan, who did the work, received for it $2,650 or 88.3 cts. per ft. The ordinary macadam roads in the same locality, 9 ft. in width, cost 70 cts. per ft., and have to be made with the country limestone of the vicinity, as harder stone is not available. Under these circumstances it may well be believed that the brick roadway will show great superiority over the stone roads.

But it seems to us that this new departure is of interest to other sections besides those where good macadam is not to be had while paving brick are cheap. Would not the laying of a strip of brick paving in the center of almost any macadam road be an improvement worth at least careful consideration?

The much easier traction upon the brick would not only be in itself a benefit to those using the road, but would cause the traffic to follow it almost entirely, especially the loaded wagons, which effect the most wear and do the most injury to a macadam road.

But in localities where there is a long freight haul on paving brick, the expense of even a 7 ft. strip of brick in a road might be prohibitory. In such localities the scheme is worth considering, it appears to us, of laying two parallel narrow strips of paving brick through the middle of a macadam road, as illustrated in the accompanying cross-section. These strips might be 16 to 20 ins. in width and of such gage that vehicles of all classes could follow them as they would a line of rails. The decreased traction on such a surface would be practically as great as if steel rails were laid in the macadam, as has been proposed, and if properly laid they would wear a very long time under any traffic where a macadam road is justifiable at all.

The details of construction, such as the foundation under the bricks, the construction of the macadam at their sides and between them, the filling between the bricks, etc., would vary with local circumstances and with the teachings of experience; but they need not be considered in a study of the merits of the scheme generally.

It appears to us that this combination of brick and macadam is the most promising plan for the improvement of suburban streets and country roads of heavy traffic that has appeared in a long time, and deserves consideration by every engineer who has to do with macadam roads. There are thousands of miles of city streets where the abutting owners can ill afford the assessments for the cheapest of block or asphalt pavements, and on the other hand the traffic is such that the maintenance of present macadam streets is a heavy burden. Cannot the needs of such cases be met by placing a brick roadway in the middle of the street and covering all the rest of the width between curbs with broken stone?

Again, there are thousands of places where a short piece of roadway is subjected to a very heavy traffic. Such roads occur around factories, mills, mines, quarries, railway stations and many other places. In many of these places an ordinary dirt road is in use, and teams are hauling over it loads not one-fourth as large as they could haul over a hard surface. In many other cases stone roads have been laid and are effecting a great saving over the old dirt roads, in cost of haulage, but are expensive to keep in repair under the heavy loads that pass over them. For such places as this the plan of using paving brick to take the heavy wear appears to be especially advantageous, and deserving of extended adoption.

It may be pointed out also in this connection that such a strip of brick pavement as is here proposed would make an admirable road for cycling, and the influence of that important body of agitators for road improvement might well be exerted in favor of this proposition.

LETTERS TO THE EDITOR.

Corrections for Vertical Curves.

Sir: In setting the type for the "Table of Corrections for Vertical Curves," given on page 346 of your issue of Nov. 26, the printer got the decimal point in the wrong place in column headed 250 for algebraic differences of grades of 1.1 to 1.8, inclusive. Instead of 0.2, 0.3, 0.4, etc., the types should have read .02, .03, .03, .03, .03, .03 and .04.

Yours truly, J. C. Nagle.

College Station, Tex., Dec. 2, 1896.

(A proof of the table referred to was sent to Prof. Nagle and returned without this error being noted. Accidents like this will happen in spite of all precaution, but are none the less annoying when they do occur.—Ed.)

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Concerning Skew Arches.

Sir: In Engineering News of Oct. 22, in a criticism upon my work on "Segmental and Elliptical Oblique and Skew Arches," I am astonished to find that your reviewer has completely overlooked the very things he says "is the only part that would warrant a new treatise on a rarely applied art; in this country at least."

If the reviewer will kindly look at Plate I. again, he will find the very templates he asks for, given in what some think profuse detail, with the mode of applying them clearly illustrated, and their construction fully described in chapter 3, page 7; and in chapter 5, page 12.

he will find full and complete instructions as to the use and application of every template given on Plate I.

Yours truly, George Joseph Bell,
County Surveyor & Bridge Master.
Carlisle, England, Nov. 13, 1896.

(In justice to Mr. Bell it is admitted that our reviewer did overlook the text and illustrations referred to; and the only excuse for so doing is the limited treatment of both. To an expert, familiar with the detail described, they are doubtless sufficient; but it is still contended that for use in this country, where few have any practical knowledge of skew arch construction, the author would have made a more useful book had he been fuller in this part of his text and given more detailed dimensions to his illustrations of templates. With this exception, however, it is undoubtedly the best, as it is the latest treatise on this art.—Ed.)

◆

Moment Tables for Cooper's Specifications.

Sir: The following is a table of moments and shears calculated for the locomotives given in the 1896 Specifications of Mr. Theodore Cooper. Their accuracy may be easily tested by noting that the moments, or shears, about corresponding concentrations of any two systems are in the same ratio as the numbers 27, 30, 35 or 40 of these systems.

Yours truly,
John H. Sayres.
Brooklyn, N. Y., Nov. 6, 1896.

Moment Tables for Cooper's 1896 Specifications of Railway Bridges.

		Distance.		Class							
				E 27.		E 30.		E 35.		E 40.	
	Wheel.	Betw'n drivers, ft.	From head train, ft.	Shear at n — th wheel.	Moment ab't (n + 1) wheel.	Sheer at n — th wheel.	Moment ab't (n + 1) wheel.	Sheer at n — th wheel.	Moment ab't (n + 1) wheel.	Sheer at n — th wheel.	Moment ab't (n + 1) wheel.
1st engine.	Pony	8	8	13,500	108,000	15,000	120,000	17,500	140,000	20,000	160,000
	First driver	5	13	40,500	310,500	45,000	345,000	52,500	402,500	60,000	460,000
	Second driver	5	18	67,500	648,000	75,000	720,000	87,500	840,000	100,000	960,000
	Third driver	5	23	94,500	1,120,500	105,000	1,245,000	122,500	1,452,500	140,000	1,660,000
	Fourth driver	9	32	121,500	2,214,000	135,000	2,460,000	157,500	2,870,000	180,000	3,280,000
	First tender	5	37	139,050	2,909,250	154,500	3,232,500	180,250	3,771,250	206,000	4,310,000
	Second tender	6	43	156,600	3,848,850	174,000	4,276,500	203,000	4,989,250	232,000	5,702,000
	Third tender	5	48	174,150	4,719,600	193,500	5,244,000	225,750	6,118,000	258,000	6,992,000
	Fourth tender	8	56	191,700	6,253,200	213,000	6,948,000	248,500	8,106,000	284,000	9,264,000
2d engine.	Pony	8	64	205,200	7,894,800	228,000	8,772,000	266,000	10,234,000	304,000	11,696,000
	First driver	5	69	232,200	9,055,800	258,000	10,062,000	301,000	11,739,000	344,000	13,416,000
	Second driver	5	74	259,200	10,351,800	288,000	11,502,000	336,000	13,419,000	384,000	15,336,000
	Third driver	5	79	286,200	11,782,800	318,000	13,092,000	371,000	15,274,000	424,000	17,456,000
	Fourth driver	9	88	313,200	14,601,600	348,000	16,224,000	406,000	18,928,000	464,000	21,632,000
	First tender	5	93	330,750	16,255,350	367,500	18,061,500	428,750	21,071,750	490,000	24,082,000
	Second tender	6	99	348,300	18,345,150	387,000	20,383,500	451,500	23,780,750	516,000	27,178,000
	Third tender	5	104	365,850	20,174,400	406,500	22,416,000	474,250	26,152,000	542,000	29,888,000
	Fourth tender	5	109	383,400	22,091,400	426,000	24,546,000	497,000	28,637,000	568,000	32,728,000

The Accident to the Painter's Scaffold on the Brooklyn Bridge Station.

Sir: Your editorial in issue of November 19th with reference to a damage suit resulting from an accident in the erection of the New York terminal of the New York and Brooklyn Bridge, in that it supposes carelessness on the part of the contractors "taking things for granted," requires, in our opinion, an answer, and the further inference that this hook broke off short under a static load was not proved to be the case. In fact we think very few engineers could study the circumstances attending the case and arrive at that conclusion.

In the first place, similar cornice hooks, made of the same shape, from iron of the same size (1¼ ins. diameter), obtained from the same source, had been used on the building, having been tested previously to being put in use, and their continued use, as well as tests made after the accident on one of these hooks, "showed that the shape and dimensions of the hook were sufficient." The evidence produced in the trial of the case shows that when the scaffold fell to the roadway, one of the cornice hooks remained hung in the gutter at the eaves, but the falls by which it was secured to the scaffold over-reeved and the line ran entirely through the blocks. It was also shown that this end of the scaffold had been secured to the side of the building by a light hand line, fastened to an eye-screw, which had been screwed into the woodwork, to keep the scaffold from swaying, and that a corresponding hand line at the other end of the scaffold was in process of being so secured. The second cornice hook was lying in the street, broken in three pieces, with the falls intact. It was also shown in the trial that an eyewitness had seen the end of the scaffold at which the falls ran out, descend first, that the fall at a certain point was checked temporarily when the other end, at which the cornice hook was broken, fell, the whole scaffold then dropping to the street. This evidence points very conclusively to the fact that the workman who was killed had failed to properly secure the falls intended to be used for raising and lowering the scaffold at his end, and that after it had become loose and fallen a few feet, the hand line used to secure this end of the scaffold to the side of the building came into play, retarding the fall of this end, at the same time upsetting the scaffold laterally, and throwing the cornice hook at the other end out of the gutter, which hook, falling to the street, was broken in three pieces, as stated above.

No attempt is here made to deny the fact that the iron in this hook was either cold-short or had been overheated in its original manufacture, but we do deny that the use of double refined iron, 1¼ ins. in diameter, known to have been procured from a reputable firm, and carefully tested and inspected under a rigid specification for high test iron, was unduly "taking things for granted."

That the jury gave a verdict for the plaintiff shows simply that their sympathy was stronger than their ability to appreciate the facts which were originally responsible for the loss of life, but does not disprove them.

Yours respectfully, Levering & Garrigues.
552 and 554 West 23d St., New York, Dec. 1, 1896.

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The Advantages of a Tunnel for the Newtown Creek Crossing.

Sir: The communication from Mr. Albert H. Scherzer, published in your issue of Dec. 3, 1896, calls attention once more to the problem which the authorities of Kings and Queens Counties have before them for solution; namely, how best to carry the highway traffic across Newtown Creek from Vernon avenue, in Long Island City, to Manhattan avenue in Williamsburgh. Mr. Scherzer points out very clearly the elements of the situation and the absurdity of bridging the river at the present level of the street, and his arguments if carried to their logical conclusion seem to the writer to indicate that a tunnel would be the only complete solution of the problem. With viaduct approaches and a bascule bridge which must be lifted for a portion of the river traffic any way, the problem is yet incompletely solved, but a tunnel under the Long Island R. R. tracks and the river would provide for continuous, safe and uninterrupted travel at all times, both by land and water.

On July 23, last, Mr. Frank Miller and the writer presented to the Newtown Creek Bridge Committee a design for such a tunnel and an approximate estimate of its cost, accompanied by a brief description of its main features and advantages, the substance of which you published in connection with various bridge designs in your issue of Nov. 5, 1896. We pointed out that a tunnel of ample capacity could be constructed without using prohibitory grades, that the railroad tracks would thereby be crossed below grade, that the cost of maintenance would be very small compared to the cost of maintaining and operating any kind of a bridge, that travel would be absolutely uninterrupted both by land and water, and that considerable dock space would be made available which is not so now.

Matters have progressed so far now that the Bridge Committee does not of course consider the question open for discussion. But to the citizens and taxpayers who are to foot the bills and suffer the consequences, the problem will always be open for discussion until actually solved. Suppose at the coming session of the Legislature a law should be passed abolishing all grade crossings in the State of New York; with a new bridge at the present street level, it would be rather awkward either to elevate or depress the highway sufficiently in a distance of 250 ft. to make a satisfactory crossing. On the other hand the expense of elevating or depressing the tracks would be a serious matter for the railroad company, involving a change of elevation of the yards and terminal. To avoid the former the municipal governments could increase their present bridge appropriation to an amount sufficient to build a tunnel under both river and railroad, now, once for all; to avoid the latter the railroad company could augment the present appropriation to an amount which would be sufficient to build the tunnel. The Long Island R. R. people would no doubt willingly contribute substantially to a scheme reducing their liability to accidents and relieving them from the running expense of guarding a dangerous crossing.

But this is not all. As Greater New York becomes greater and other East River bridges are completed, travel along the water front will increase with the natural increase of business, and will follow the line of least resistance. This route should be made the line of least resistance in the interest of property in the manufacturing district of Williamsburgh and in the business portion of Long Island City. The street railroad companies, whose cars now wait sometimes half or three-quarters of an hour at a time for the opening and closing of the drawbridge, and have an additional wait at the railway crossing, ought willingly to make a substantial contribution to a plan by which their traffic would be continuous and uninterrupted at all times. The situation is now and has been for some time, such that a man whose business requires him to make the trip from Long Island City to Williamsburgh within a limited time cannot depend upon this route at all. The 23d St. & Greenpoint Ferry carries considerable traffic which geographically belongs to the Long Island City & 34th St. Ferry, but does not take the shortest route on account of the uncertainty of this Vernon Ave. crossing to Williamsburgh. This state of affairs will not be materially improved by putting any kind of a new bridge in place of the old one. Besides this, the shipping interests ought to be considered, since the business of the locality is as much affected by the interruption of the water traffic as by that of the land traffic.

Taking it all in all, the writer ventures to say that a careful investigation and comparison of all the solutions of this problem thus far proposed, will show that a tunnel, if properly financed, offers the best and most satisfactory return in the long run for the capital invested.

Yours truly,
Wm. W. Crehore, Assoc. M. Am. Soc. C. E.
New York, Dec. 8, 1896.

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Proposed Standard Specification for Portland Cement.

Sir: In view of the article by Mr. Lesley published in your issue of Sept. 24, which criticises the proposed specification for Portland cement advanced by the writer, it appears necessary that a few further facts be brought out to place this discussion in its proper light before the public and define the position assumed by me in advocating such a specification.

I again reiterate the assertion that the requirements of the American Society of Civil Engineers are indefinite and inadequate, and what engineer who has had experience in the testing of cements will not bear me out? What public testing laboratory follows all the requirements and is governed by the recommendations of the American Society of Civil Engineers? Take for instance the provision into which the personal equation of the operator enters so largely for filling the molds with mortar or cement. In this country we have no apparatus like Dr. Bohme's hammer which regulates the amount of pressure exerted in forcing the cement into the molds. It is a well-known fact that the results of cement testing are governed largely by the skill of the operator and the locality of making the tests. Laboratory tests are more accurate and show more nearly the true value of a cement than tests made on the work.

Could any of the distinguished engineers enumerated by Mr. Lesley answer the question he propounds, whether the construction of colossal bridges, buildings, reservoirs, aqueducts and tunnels, railways, etc., since June 21, 1895, has been done with cement of second grade?

Mr. Lesley seeks to draw the attention of these engineers to the assertion made by the writer that the American Society's specifications are indefinite and inadequate, by insinuating that the work was improperly done with second grade cements. In the first place, this question is most ridiculous on its face. What bearing can it have on the question at issue, Portland cement specifications? Surely no engineer would be rash enough to attempt an answer. Has all the above mentioned engineering work been done with Portland cement? Supposing it has, in order to support Mr. Lesley's question, has all the cement been tested? Here are two facts which should be known before any engineer could attempt an answer. Assuming that Portland cement was used and tested, it is a fact, even Mr. Lesley must admit, that "second grade" cement would pass if such a requirement as a neat tensile strength of "300 to 350 lbs." were used, which he says "will give good results." The second grade Portland cements made by other manufacturers besides Mr. Lesley are guaranteed to stand 300 lbs. neat in seven days. However, the absurdity of such a question is apparent when it is generally known that a large part of all the large engineering work done in this country in the past 11 years was constructed of so-called American cements (Rosendales and "Improved" cements) while a very small percentage of the Portland cement used was tested. Where specifications do exist, notably on railway work, the testing is not always carried out scientifically; the requirements may be there, but the cement is not systematically tested to see if it passes the limits. This is certainly the case with the railways cited by Mr. Lesley and whose requirements will be found about what he thinks give good results. On the other hand the higher requirements are those on municipal work where the testing is more thorough and exacting.

Now taking up in detail the 21 specifications, giving the requirements for tensile strength only, which he cites as from leading engineers in this country and wherein his last article says they are not refuted. The first, second, nineteenth and twentieth should be thrown out and not considered at all, for they give arbitrary values for the U. S. Govt. Lighthouse Engineers and Army Engineers, as though all offices had the same requirements. All of the railways come under the remarks made above and show low requirements, while the rest are those from cities and being used on municipal engineering, the testing is more rigid while the requirements are higher.

In first class cities, well equipped laboratories are to be found, either public or connected with the cities' departments of public works, which test and inspect cement to be used on work in their vicinity. On the other hand railways, especially those quoted by Mr. Lesley, have no laboratories where competent persons are employed to test cements. In the first case the requirements must be low or, with the inexperienced operator, the very best cements would not pass the tests; while on the other hand, tests made by laboratories obtain all there is in the cement and would allow a second grade cement to pass a low specification.

From the specifications quoted below, with the names of the engineers and architects and structures for which the cement was used in this city, it will be seen that the requirements advocated by me are not novel or excessively high, as Mr. Lesley would lead your readers to believe. These specifications are in use on all the structures lately erected and in process of erection by the engineers and architects quoted, and were not made for any one piece of work. The cement manufacturers or dealers bid on them knowing the requirements and that all the cement was to be tested at a laboratory.

Frank Miles Day & Bro., Philadelphia, Pa.

Buildings—Houston Hall (University of Pennsylvania), Horticulturel Hall, Medico-Chi College Amphitheatre, American Baptist Publication.

Specifications:

Chemical Composition—The Cement must show less than 2% of sulphuric acid, and less than 2½% of magnesia.

Fineness—95% shall pass a sieve of 4,900 meshes per sq. in.

90% shall pass a sieve of 10,000 meshes per sq. in.

68% shall pass a sieve of 40,000 meshes per sq. in.

Checking, Cracking and Color.—Three cakes of neat cement are to be molded on glass 2 or 3 ins. in diameter, and about ½ in. thick at the center, the edges being very thin. These cakes are to be made from a mixture of the cement and water to the consistency of a stiff plastic mortar.

Cake No. 1 is to be left in the air for the determination of color. The color must be uniform throughout, of a blueish or greenish gray for Portland, and the cake must be free from yellow blotches. The cake must show no signs of cracking or distortion after being kept indefinitely.

Cake No. 2 is to be put in cold water as soon as set stiff enough for the purpose, and to remain there two or three days, when it will be put in water at 200° F. and kept there for 24 or 48 hours. At the end of this time the cake should show no signs of cracking, swelling, blowing or distortion.

Cake No. 3, when hard enough, is to be placed in water and examined from day to day, to ascertain if it becomes contorted, or if cracks show themselves at the edge.

	7 days.	28 days.
Tensile strength—Neat cement......	500 lbs.	600 lbs.
Mortar, 3 to 1....	150 "	250 "

G. W. & W. D. Hewitt, Philadelphia, Pa.

Building—Philadelphia Bourse.

Specifications:

Fineness—85% shall pass a sieve of 10,000 meshes.

70% shall pass a sieve of 40,000 meshes.

Expansion and contraction—A pat of neat cement as soon as it is set, to be submitted to a moist heat and immersed in boiling water for at least 10 hours and must not show any signs of blowing.

	7 days.
Tensile strength—Neat cement................	400 lbs.
Mortar, 3 to 1.............	150 "

Westray Ladd, Philadelphia, Pa.

Building—Newsboys' Evening Home.

Specifications:

Fineness—90% shall pass a sieve of 10,000 meshes.

70% shall pass a sieve of 40,000 meshes.

Checking and Cracking—A pat of neat cement as soon as set hard to be placed in steam vapor for three hours and afterwards immersed in water at 200° F. for 10 hours, when it must show no signs of swelling or cracking.

	7 days.
Tensile strength—Neat cement................	500 lbs.
Mortar, 3 to 1.............	150 "

Jos. M. Houston. Philadelphia, Pa.

Building—Presbyterian.

Specifications:

Composition—All cement must show less than 2% of sulphuric acid, and less than 2.5% of magnesia.

Constancy of Volume—The cement must be mixed with pure water to obtain a stiff mortar and made into pats 3½ ins. in diameter, ⅜-in. thick at the center, and drawn to sharp edge at the circumference. The cement must show no signs of discoloration, cracks or distortions after an indefinite length of time, and after properly set to be placed in cold water for two days and then put in water at 200° F. for 24 hours, and must show no signs of cracking, swelling, blowing or distortion.

	7 days.	28 days.
Tensile strength—Neat cement......	500 lbs.	600 lbs.

P. W. Roos, New York, N. Y.

Building—Mutual Life of New York (10th and Chestnut Sts., Phila., Pa.)

Specifications:

24 hours.—Tensile strength...... ....7 days

300 lbs.—Neat cement.................. ....500 lbs.

3 sand to 1 cement..................150 "

Constancy of Volume—A pat of neat cement as soon as set hard to be placed in steam vapor for three hours and afterwards immersed in water 200° F. for 10 hours, when it must show no signs of swelling or cracking.

Wilson Eyre, Jr., Philadelphia, Pa.

Building.—City Trust & Safe Deposit Co.

Specifications.—Same in all requirements as those of F. M. Day & Bro.

Edgar V. Seeler, Philadelphia, Pa.

Building.—Dental Hall (University of Penna.)

Specifications.—Same in all requirements as those of F. M. Day & Bro.

F. M. Day & Bro., Cope & Stewartson, Wilson Eyre, Jr. (Asociated Architects).

Building.—Archaeological Museum (University of Penna.)

Specifications.—Same in all requirements as those of F. M. Day & Bro.

In all the above specifications the requirement for setting was omitted, as Mr. Lesley does not criticise that provision, while the other requirements are given in full. The general conditions governing the tests are the rules of the American Society of Civil Engineers.

Now from a summary of the foregoing specifications it will be seen that in the chemical composition the requirement for sulphuric acid is the same as advocated by me while the magnesia is ½% lower. The requirements for fineness are all slightly lower, while with one exception the tensile strengths are equal to those advocated by me. Now as to the requirements for checking and cracking, one requires a temperature of 212° F., while all the rest call for 200° F. Thus it will be seen that with the exception of the fineness and percentage of magnesia, which I shall discuss later on, the requirements are about the same as in the specifications he describes as "crude and ill digested." Would the gentlemen I have quoted, among the leading men in the profession in this city, feel flattered were they to realize that their specifications are "crude and ill digested?" Lastly, I think the following will totally disprove what Mr. Lesley would have your readers believe, that the tendency is towards lower requirements and that with such high requirements even the best imported cements would fail. The brands of cements going into each piece of work with the laboratories testing the same, which it is to be presumed passed the requirements, I now give in case Mr. Lesley has not heard of them.

Houston Hall Building; Atlas, Alsen & Heyne cement; Lathbury & Anderson laboratory.

Horticultural Hall Building; Mannheimer & Vorwohler cement; Lathbury & Anderson laboratory.

Medico-Chi College Building; Aalborg cement; Lathbury & Anderson laboratory.

American Baptist Building; Condor cement; Lathbury & Anderson laboratory.

Bourse Building; Alpha cements (foundations and brick work), Mannheimer & Dyckerhoff cement (pavements); Lathbury & Anderson, and Booth, Garrett & Blair laboratories.

Newsboys' Home Building; Alpha cement; Lathbury & Anderson laboratory.

Presbyterian Building; Alpha, Condor and Vulcanite cements; Booth, Garret & Blair laboratory.

Mutual Life of New York Building; Alpha cement; Lathbury & Anderson laboratory.

City Trust Building; Aalborg cement; Lathbury & Anderson laboratory.

Dental Hall (University of Pa.) Building; Condor, Atlas and Dyckerhoff cements; Lathbury & Anderson laboratory.

Archaelogical Museum Building; not selected; Lathbury & Anderson laboratory.

So much for specifications on private work, and with the following specifications for three large pieces of public work for the year 1896, it must be admitted that my specifications are not radically high in their requirements.

Department of Public Works, Brooklyn, N. Y., Wallabout Improvement.

Composition and Ingredients.—All the cement shall be composed of lime, silica and alumina in their proper proportions, be as free as posible from all other substances and contain no adulterant in injurious proportions. The ratio of the weight of silica and alumina to the weight of the lime in the cement shall not be less than 45-100. The cement shall not contain more than 3% of magnesia nor more than 1% of sulphuric acid.

Fineness.—99% shall pass through a sieve of 2,500 meshes; 90% shall pass through a sieve of 10,000 meshes; 70% shall pass through a sieve of 40,000 meshes.

Soundness.—All the cement must be sound in every respect and show no indications of distortion, change of volume or blowing when subjected in the form of pats to exposure in air and fresh and sea water of temperature from 60° to 212°, as follows:

The pats will be made of neat, unsifted cement, mixed with fresh water to the same consistency as stated for briquettes, and will be about 3 in. in diameter, having a thickness at the centre of about ½ in., tapering to about ⅛ in. at the edges. They will be molded on plates of glass and kept thereon during examination.

(a) One or more of these pats will when set "hard" be placed in fresh water of temperature between 60° and 70° for from 1 to 28 days.

(b) One or more of these pats will be allowed to set in moist air at a temperature of about 200° for about three hours. It will then be placed and kept in boiling water for a period of from 6 to 24 hours.

(c) One or more of these pats will be allowed to set in moist air at a temperature of about 100° for three hours; it will then be placed and kept in water of a temperature of 110° to 115° for a period of from 24 to 48 hours.

(d) One or more of these pats may be subjected to any or all of the above indicated tests (a, b and c), using sea water instead of fresh water.

(e) One pat will be kept in the air for 28 days and its color observed, which shall be uniform throughout, of a bluish gray and free from yellow blotches.

A failure to pass test "b" will not necessarily cause the rejection of the cement, provided it passes the other tests for soundness as noted in "a," "c," "d," and "e," and is satisfactory in other respects to the engineer.

Tensile Strength.—Mixed neat with about 25% of water by weight and worked to stiff plastic paste. Mixed with three parts sand by weight and about 12% of combined weight of sand and cement of water to stiff plastic paste.

	24 hours.	7 days.	28 days.
Neat	150 lbs.	400 lbs.	600 lbs.
Mortar, 3 to 1......		150 "	240 "

Board of Public Works, Reading, Pa.—Department of Sewers.

Composition.—Magnesia, not over 2½%; sulphuric acid, not over 2%.

Fineness. — 95% shall pass through a sieve of 10,000 meshes; 80% shall pass through a sieve of 40,000 meshes.

Checking and Cracking.—Two cakes of neat cement to be molded on glass. One to be immersed in cold water, after having set hard, and examined from day to day for surface checking and warping, the other after having been set hard to be immersed in water at 212° F, and allowed to remain in water of that temperature for 24 to 36 hours. Examination of the pat at the end of that time for constancy of volume and checking. Should the pats become contorted or show signs of warping or cracking, the cement will be rejected.

Tensile strength.	24 hours.	7 days.	28 days.
Neat	200 lbs.	500 lbs.	650 lbs.
Mortar, 3 to 1...		150 "	250 "

Department of Public Works, Philadelphia, Pa.—Bureau of Water.

Tensile strength.	24 hours.	7 days.	28 days.
Neat	200 lbs.	550 lbs.	650 lbs.
Mortar, 3 to 1...		200 "	300 "

Hot Water Tests.—All cement shall meet such other additional requirements as to hot water, set and chemical tests as the engineer may determine, the requirements for set may be modified where the conditions are such as to render this advisable.

The Portland cement furnished under the above specifications was used in large quantities for concrete work. In Brooklyn the work consisted in the improvement of the Wallabout Market lands under the direction of Mr. W. E. Belknap, engineer, Atlas cement being used. The Reading, Pa., work consisted of the entire concrete sewer system under the direction of Mr. E. Chamberlain, City Engineer, Atlas cement being used. The Philadelphia specifications embraced the large work on the Queen Lane reservoir, under the direction of Mr. Jno. C. Trautwine, Chief Engineer of the Water Bureau, Alpha cement was used on one section.

A careful study of the above specifications will show Mr. Belknap's to be the same in magnesia and sulphuric acid as I recommend; tests for fineness and tensile strength slightly lower, while the requirements for soundness are much more severe than I recommend. It is to be noted especially under the heading "Soundness," paragraph (b), Mr.Chamberlain's requirements are the same as mine, with the exception of magnesia, in which he is ½% lower. Mr. Trautwine's tensile requirements are higher in both neat and mortar tests for 7 and 28 days than those I recommend.

The above specifications will certainly show that Mr. Lesley in his aim to convince your readers that the tendency is towards lower requirements, has only picked out those specifications which support his criticisms. Now is this a scientific way of criticising this subject? The specifications I have exhibited show some lower and some higher than those I have advocated.

Another point that Mr. Lesley makes in his article of Sept. 21st: He states that "Not a single specification is refuted by Mr. Donaldson, nor its accuracy questioned."

Having assumed they were correct, I did not go over them carefully and consequently made no reference to them in my answer to his first criticism; but I would like now to correct the 7-day neat requirements of both Russia and Belgium from 255 lbs., as stated by Mr. Lesley, to 355 lbs.; to insert a 7-days sand test for France of 113 lbs. and to correct the 28-days sand test from 215 lbs., as stated by Mr. Lesley, to 213 lbs.

Under Mr. Lesley's list of the different countries, giving the requirements for fineness, Roumania is to be found. Now under the list giving the requirements for strength, Roumania is left out, while all the other countries appear. Why is this? It may be well to enlighten the "inexperienced engineers and architects." Under the same government specifications quoted by Mr. Lesley for fineness are the tensile requirements for sand test (3 sand to 1 cement) at 7 days of 142 lbs. and 28 days of 241 lbs.; no neat test being required. It might be well to mention the fact (Mr. Lesley having overlooked this also) that the government of the Roumanian railways requires a tensile strength for the 3 to 1 sand test of 213 lbs. at 7 days and 284 lbs at 28 days,without neat requirements; the latter being higher than any specification quoted by the writer and almost equal at 28 days to the neat requirement of 300 lbs. at 7 days, which Mr. Lesley "thinks will give good results." The requirement of Russia mentioned by Mr. Lesley as 142 lbs. for 28 days sand test, being the lowest of all the continental countries, would also bear an explanation. In all the countries, with the exception of Russia, the normal sand for making sand briquettes passes a sieve of one mesh and is caught on a sieve of another mesh the same as by the Am. Soc. C. E. rules. In Russia the normal sand consists of one part which passes a sieve of 64 meshes per sq.cm. and is caught on a sieve of 144 meshes per sq. cm., and one part which passes a sieve of 144 meshes per sq. cm. and is caught on a sieve of 225 meshes per sq. cm. Thus it will be seen that the normal sand consists of equal parts fine and coarse particles, hence the low requirement.

The facts above stated disprove entirely Mr. Lesley's attempt to convince your readers that the requirements advocated by me are abnormally high and above any others ever used on engineering work; and prove that the general tendency is not towards lower requirements; and that his specifications, as quoted, are inaccurate and misleading.

Mr. Lesley apparently loses sight of the main reason which influenced the writer in preparing the paper published in part in your issue of July 16. In the first place the prime object in writing that paper was to urge the adoption by the U. S. Government of a standard specification for Portland cement and a specified method of testing, which would be applicable to all departments alike. Such a standard, if adopted by this government, would prove beneficial to both users and producers alike; and at the same time would be used outside of government work. In presenting this subject, care was taken to collect specifications from as many offices in the several departments as could be obtained, in order to present the conditions as they now exist and argue from them the need of some such measure in this country. The majority of the European countries have their government specifications, while the United States has not and the defective system was explained in the paper accompanying the specifications prepared by me. The subject was not taken up before the conditions were carefully studied. It was not the purpose to antagonize either the United States Engineers on the one hand, or the cement industry, as championed by one man, on the other. In all some 30 odd specifications were collected, which it would have been impossible to have published in detail, but it is safe to say no two were alike. From some offices no specifications could be obtained, while others had none.

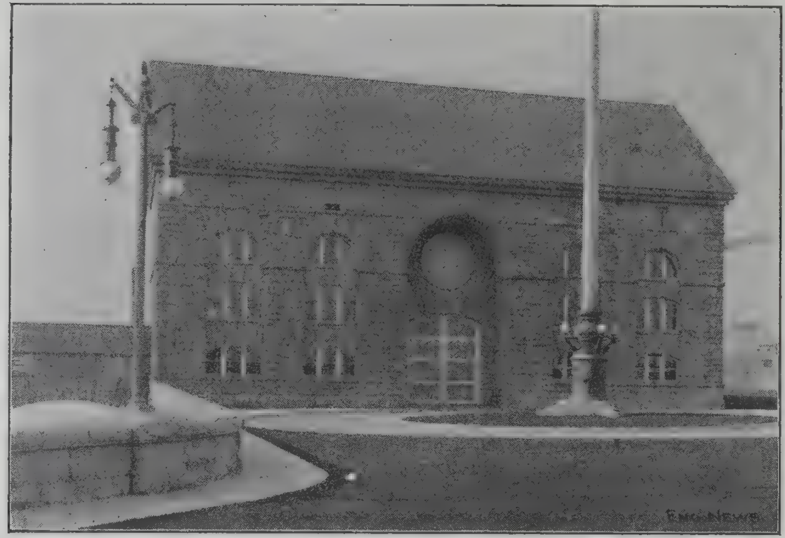

FIG. 1.—POWER HOUSE OF THE NIAGARA FALLS POWER CO.,—END VIEW.

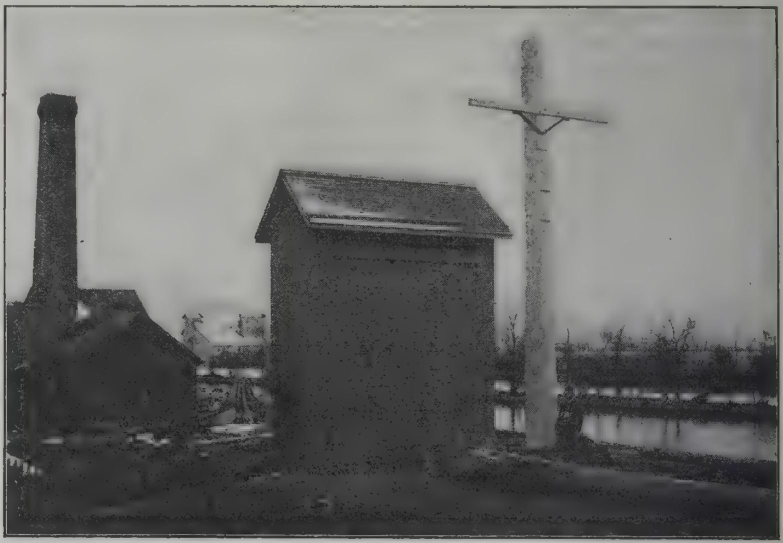

FIG. 6.—TERMINAL STATION AT CITY LIMITS OF BUFFALO, WHERE WIRES PASS FROM POLES TO UNDERGROUND CONDUITS.

In order to show the varied character of the specifications as respects requirements for fineness, checking and cracking and tensile strength, a few are given below. No specifications received contained chemical requirements. The requirements correspond to the order in which the offices are given.

Departments and Offices.

No. 1.—U. S. Engr. Office, Washington, D. C.; Maj. E. L. B. Davis; August 14, 1895.

No. 2.—U. S. Engr. Office, Detroit, Mich.; Col. O. M. Poe, September 28, 1895

No. 3.—U. S. Engr. Office, Duluth, Minn.; Maj. E. B. Sears; January 28, 1895.

No. 4.—U. S. Engr. Office, Chattanooga, Tenn.; Capt. Dan C. Kingman; July 1, 1895.

No. 5.—U. S. Engr. Office, Philadelphia, Pa.; Maj. C. W. Raymond; July 21, and October 15, 1896.

No. 6.—U. S. Engr. Office, Newport, R. I.; Maj. D. W. Lockwood; August 25, 1896.

No. 7.—Rock Island Arsenal, Rock Island, Ill.; Col. A. R. Buffington, July 22, 1896.

No. 8.—U. S. Navy Yard, Mare Island, Cal.; Capt. H. L. Harrison, Commandant; December 27, 1895.

No. 9.—U. S. Navy Yard, Norfolk, Va.; H. F. R. Harris, Paymaster; October 30, 1896.

No. 10.—U. S. Navy Yard, Washington, D. C.; Com. J. A. Howell, Commandant; December 24, 1895.

No. 11.—Office U. S. Light House Engineer, 5th District, Baltimore, Md.; Capt. Erick Bergland; August 22, 1894.

	Fineness.		Sieve. meshes.	Checking and cracking.
No. 1	95%	through	4,000.	No requirement.
No. 2	96%	"	2,500.	Pat. subjected to st'm vapor
	75%	"	14,400.	and immersed in hot water
No. 3	75%	"	10,000.	Pat. immers'd water 212° F.
No. 4	87%	"	10,000.	Pat. immersed in cold water
No. 5	No requirements.			No requirement.
No. 6	"	"		" "
No. 7	95%	through	2,500.	Pat. immers'd water 212° F.
No. 8	90%	"	6,400.	No requirement.
No. 9	97%	"	3,600.	" "
No. 10	90%	"	6,400.	" "
No. 11	95%	"	2,500.	Pat. immersed in cold water

Tensile Strength.

	Neat.			3 sand to 1 cement.		
	24 hrs.	7 days.	28 days.	7 days.	28 days.	6 mos.
No. 1	300[1] lbs.	450 lbs.	700 lbs.	... lbs.	... lbs.	... lbs.
No. 2	... "	400 "	... "	125 "	200 "	... "
No. 3	... "	... "	... "	125 "	200 "	350 "
No. 4	... "	430 "	500 "	120 "	180 "	... "
No. 5	250 "[1]	450 "[1]	... "	... "	... "	... "
	... "	400 "	600 "[2]	125 "	200 "[2]	... "
No. 5	200 "[1]	450 "[1]	... "	... "	... "	... "
	... "	450 "	600 "[2]	125 "	200 "[2]	... "
No. 6	250 "[1]	400 "	600 "[2]	125 "	200 "[2]	... "
No. 7	... "	450 "	... "	140 "	... "	... "
No. 8	... "	1,100 "	... "	... "	... "	... "
No. 9	... "	550 "	... "	... "	... "	... "
No. 10	... "	500 "	... "	... "	... "	... "
No. 11	... "	300 "	... "	80 "	... "	... "

---

[1] In air. [2] Thirty days.

Note—Under the heading Tensile Strength, two specifications are quoted for No. 5, the first was dated July 23, 1896, while the second for the same piece of work was dated Oct. 15, 1896. The rules for the testing are based generally on the Am. Soc. C. E. rules, while notation is made above for air tests. Specification No. 8 requires transverse and compression tests.

A careful analysis of these specifications will bring out clearly these two facts: First—That Mr. Lesley is wrong when he quotes the U. S. Engineers in your issue of Sept. 10, as having one requirement; Second—That he is wrong in stating that the tendency is towards lower requirements. It is ridiculous for Mr. Lesley to assert that my requirement of 500 lbs. neat at 7 days "would lead to dangerous results in work," and equally as absurd to state that "there is a marked swing in the pendulum in favor of the elimination of the boiling test," when so many of the specifications cited by me require it.

Now, it is manifestly clear, from a study of the few specifications quoted above, wherein I have argued, in my "Proposed Standard Specification," for some uniformity among government engineers. It is likewise shown from the number of prominent specifications of government as well as civil engineers that the requirements advocated by me are not abnormally high or novel, as Mr. Lesley would have your readers believe.

In the matter of fineness, specifications certainly show that in the last five years this particular requirement has been raised, due to the gradual realization of its importance from the valuable results obtained, and why should it not be raised even higher? Perfect conditions can only be obtained by eliminating the coarser particles in a cement and thereby increasing the strength. All the advantages derived from fine grinding have been fully brought out in my previous papers, and writing as a manufacturer it is certainly within my province to judge of the capabilities of mills to meet such requirements as are advocated by me. Even Mr. Lesley is constrained to admit that "no careful manufacturer would hesitate to guarantee cement of the fineness he recommends." The whole question of fineness to a manufacturer hinges on the increased cost of production, and if such limits as these advocated by me were advanced by an engineer, Mr. Lesley would hardly raise objections. Certain it is, no consumer would be found among those who objected on the ground of an excessive requirement, for they would be the ones directly benefited. Should some prominent engineer, government or civil, specify limits as high as those advocated by me, it is certain that mills would soon grind fine enough to meet them. On this point also the objections of Mr. Lesley are to be read in two words "extra cost," and while it is admitted that the requirement in this respect is slightly higher than in the majority of specifications, it will not be very long before the requirements in many will equal them.

Taking up the remaining element criticised by Mr. Lesley, chemical composition, my authority for the percentage of magnesia, as explained in your issue of Sept. 10, remains unassailed by Mr. Lesley; while the percentage of sulphuric acid, notwithstanding his futile efforts to twist the meaning of the two requirements, is precisely the same as universally specified. Admitting that the limits for lime and silica are somewhat confined for low limed cements, the limits for iron and alumina combined are the same as those within which M. Le Chatelier says "Portland cements of good quality are to be found" and from the analyses of M. Candlot of the principal cements of France, England, Germany, Belgium and Russia (Ciments et Chaux Hydrauliques; Paris, 1891; pp. 71 and 76) the following number are within the limits advanced by me: French, 11 out of 12 cements; English, 12 out of 13 cements; German, 10 out of 14 cements; Belgium, 6 out of 6 cements; Russia, 4 out of 7 cements. This certainly shows that a majority come within the limits specified by me.

Having only answered Mr. Lesley on the four headings he criticises the proposed specifications on, it certainly will be admitted by the readers of your paper that I have not only "found scientific support," but have produced the same in defending the requirements of my specifications. As to whether they are "crude and ill digested" as Mr. Lesley states, I leave that to the judgment of those of your readers who will carefully go over the facts and proofs presented in this paper in support of my specification and in disputing the arguments of Mr. Lesley.

Before concluding, I would like to bring out clearly a point which has not been considered by Mr. Lesley. The requirements are high and in formulating them it was the purpose to make them high, but to meet this not only a specific manner and method of testing was provided, but it was stated that testing should be done in well equipped laboratories, by competent persons, thoroughly conversant with the subject of cement in both its chemical and physical properties. Testing thus conducted would obtain maximum physical results and the best Portland cements would easily pass the requirements.

Yours very truly,

Wm. J. Donaldson.

503 Betz Building, Philadelphia, Pa., Nov. 12, 1896.

(The demands on our space compel us to rule the discussion on this subject closed with the above letter. Without reference to the special matters in controversy, it may be remarked that each of the parties to the discussion have contributed a large amount of information respecting the specifications for Portland cement in use in a great variety of places, which will be studied with interest, we doubt not, by those of our readers who have cement specifications to formulate.

We may remark as an interesting fact in this connection that at the meeting of the American Society of Civil Engineers, on Nov. 4, a resolution was adopted recommending to the Board of Direction of the Society to take action looking to the preparation of a new standard code for cement testing to replace the one formulated by a committee of the Society in 1884.

Under the constitution the Board will make its report at the next annual meeting, and that meeting may order a letter ballot of the Society as to whether the proposed action shall be taken. Doubtless, the Society, if it takes action, will merely revise its code governing the method of making tests, and will not attempt anything in the way of a standard specification.

It appears to us that the most important point raised by Mr. Donaldson is the desirability and expediency of the adoption of a standard cement specification by the Government or by the Corps of Engineers. Concerning this, it appears plain enough that good results might follow, for example, if the Chief of Engineers were to create a Board to formulate a standard cement specification for use by the various officers of the corps. In the multitude of duties with which an engineer officer is charged, few have time to study all the ins and outs of the subject of cement tests and specifications, and it would be a great aid to good practice, undoubtedly, to have a standard specification at hand, prepared by some of the ablest men in the Department. Such a specification, of course, would need to be very elastic, and would need to contain many alternative provisions from which each officer could select those best suited to his especial work. Cement for use in sea-water, for example, should have certain special requirements, and the most economical grade of cement to use for a given work will vary widely in different localities.

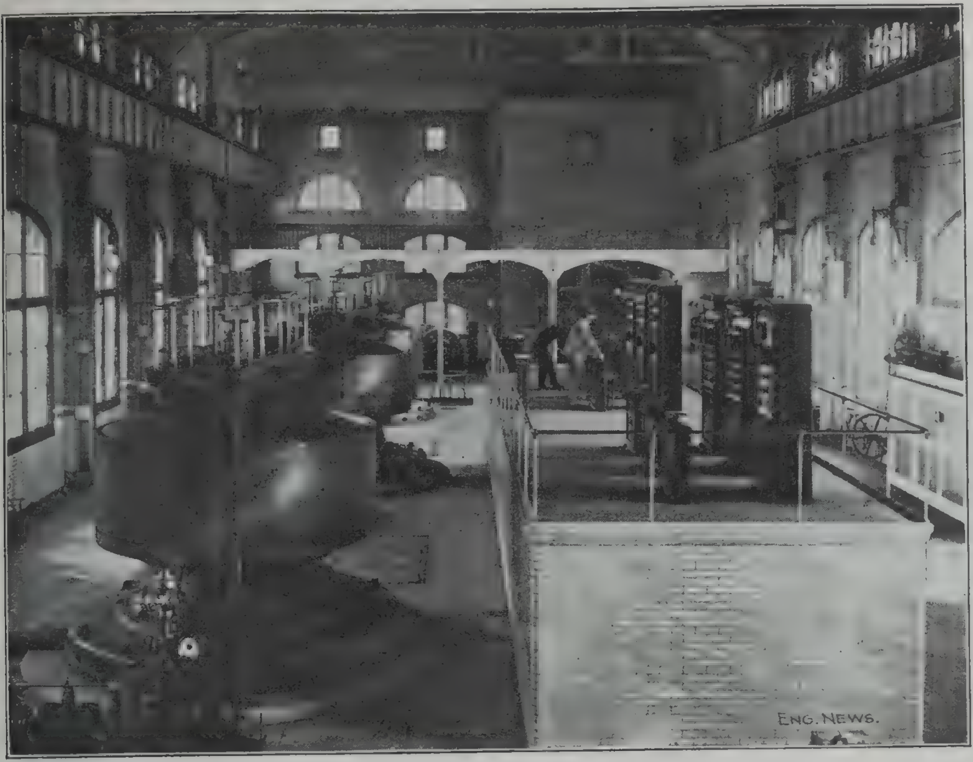

FIG. 2.—VIEW IN THE INTERIOR OF THE NIAGARA POWER HOUSE, SHOWING THE THREE 5,000-H. P. WESTINGHOUSE DYNAMOS NOW RUNNING.

But while we can readily see the benefit of such a standard specification, we would also urge strongly that no action should be taken that would make such a standard specification difficult to change.

May the day be long distant when Congress shall enact a standard cement specification for use in all Government departments! Experience with the old U. S. standard for testing boiler-plate is an excellent illustration of the evil in getting a Government standard adopted in such shape that it cannot be readily amended and kept up with the times. For this reason we should strongly oppose Mr. Donaldson's proposition to have a single standard specification control all Government work. That could not be brought about without Congressional action, which is at all costs to be avoided.

If, however, the present able Chief of Engineers should see fit to appoint a Board to formulate some standard specification, the use of which should be recommendatory, not compulsory, upon the various officers of the Corps of Engineers, we can see how the action might be very beneficial. —Ed.)

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Notes and Queries.

Frank A. Peirce, Greensboro, N. C., wishes to obtain the address of parties experienced in the construction of timber flumes for the transportation of timber. He also asks for any published data detailing the ordinary methods of construction.

THE NIAGARA FALLS AND BUFFALO ELECTRIC POWER TRANSMISSION.

Among the first corporations that contracted with the Niagara Falls Power Co. for electric current from the power house at the Falls was the Buffalo Street Ry. Co. In accordance with that contract there is now being delivered at Buffalo electric current sufficient to develop 1,000 HP. This current is sent over bare wires from the power house at Niagara Falls, a distance of 26 miles. The various power plants at Niagara Falls have been described from time to time in our columns, and are without doubt the most famous of all electric power installations by reason of the vast possibilities of future development.

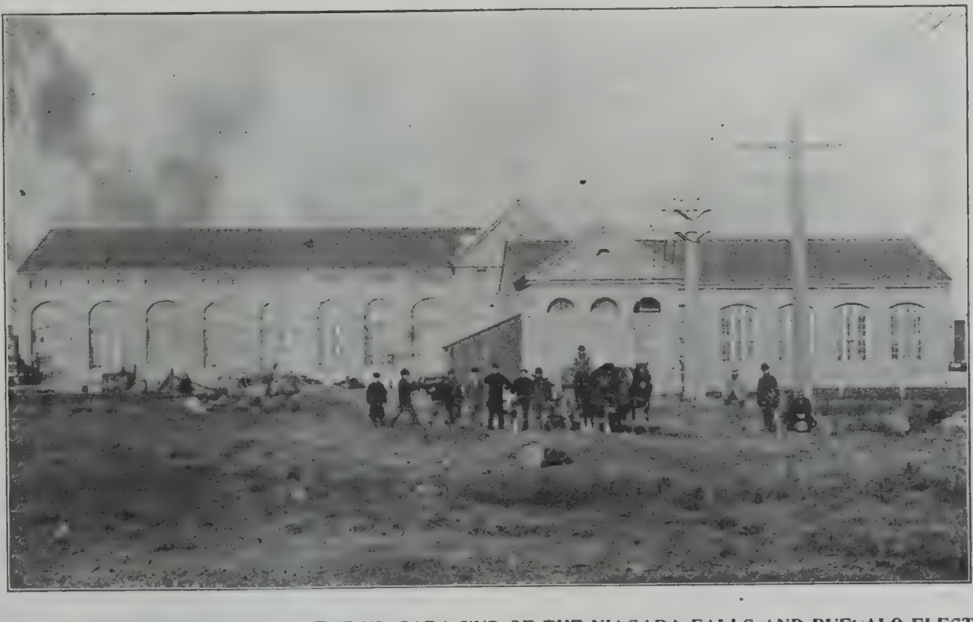

FIG. 3.—TRANSFORMER HOUSE AT THE NIAGARA END OF THE NIAGARA FALLS AND BUFFALO ELECTRIC POWER TRANSMISSION LINE. MAIN POWER HOUSE IN LEFT BACKGROUND.

The current from the Falls is generated by the Niagara Falls Power Co., which transmits the power as far as the city limits of Buffalo. All the construction work in connection with this installation was effected by the Cataract Construction Co., while the distribution, after it has reached the city limits, is in the hands of the Cataract Power & Conduit Co.

The first dynamo of the Niagara Falls Power Co. was started on April 5, 1895, and contracts for power have now accumulated sufficient to absorb the entire output of the three 5,000 HP. generators which were first installed. Work is now in progress on an extension of the wheel-pit and power house which will permit additional dynamos to be placed.

Work on the line for transmitting electric current from Niagara to Buffalo was begun last August by the White-Crossy Co., of 29 Broadway, New York city, which has spared no expense to construct the line in as substantial and durable a manner as possible. The pole line is not a straight one; owing to the objections of land owners to having their farms cut in two, it was necessary to deviate considerably from a direct route, and for a large part of the distance the line follows the property boundary between farms.

For the greater part of the distance the company owns the right of way, a strip 30 ft. wide; for five miles the line runs along the bank of the Erie Canal. There were 21,000 poles required for the work. They are of white cedar, shaved round, and are to be painted. The poles vary in height from 35 to 65 ft., and in diameter from 15 to 30 ins. They are set at distances varying from 60 to 75 ft. in order to eliminate any sympathetic vibrations of adjacent sections of the wires. The holes for the poles were dug from 6 to 8 ft. deep, and wherever the earth was soft concrete was used in setting. At sharp curves six poles were set in pairs (Fig. 5), each pole supporting one end of a double cross arm. The double cross arms are used to distribute the weight of the wire on two insulators instead of one, and to make the turn less abrupt.

Each pole carries three cross arms. The two upper ones are to support the power cables; they are yellow pine, 12 ft. long and 3¼ × 4¼ ins. in section. Each is trussed with an angle iron 1½ × ¼ ins. Each cross arm is designed to carry six cables. At either end of the top cross arm is a steel pin 18 ins. high; along these pins and also on top of the poles will be stretched three barbed iron wires; these will be grounded at frequent intervals and are expected to give protection against lightning. The pin holes in the cross arms are 4 ins. deep with drainage holes. All pins were boiled in linseed oil. The third cross arm is a small one for carrying a private telephone wire, which will be connected with 52 telephones located at intervals on the poles, to be used by linemen.

The insulators weigh 9 lbs. each; they are double petticoated, having two deep annular grooves around the bottom to prevent water or ice from forming an electric connection between the wire and the insulator pins. A groove at the apex carries the wire. The insulator is provided with a gutter running to a point on either side to prevent icicles hanging in such a way as to strike the cross arm.

These insulators were tested to withstand a pressure of 40,000 volts. The test was made by inverting the insulator and partly immersing it in brine contained in a metal vessel. The pin hole was also filled with brine. The terminals of the high pressure current were connected with the metal vessel and with the brine in the pin hole of the insulator. No calibrating instruments were used in circuit, the eye alone being relied upon to detect the passing of current through or across the insulator. The insulators are furnished by the Imperial Porcelain Works, Trenton, N. J.

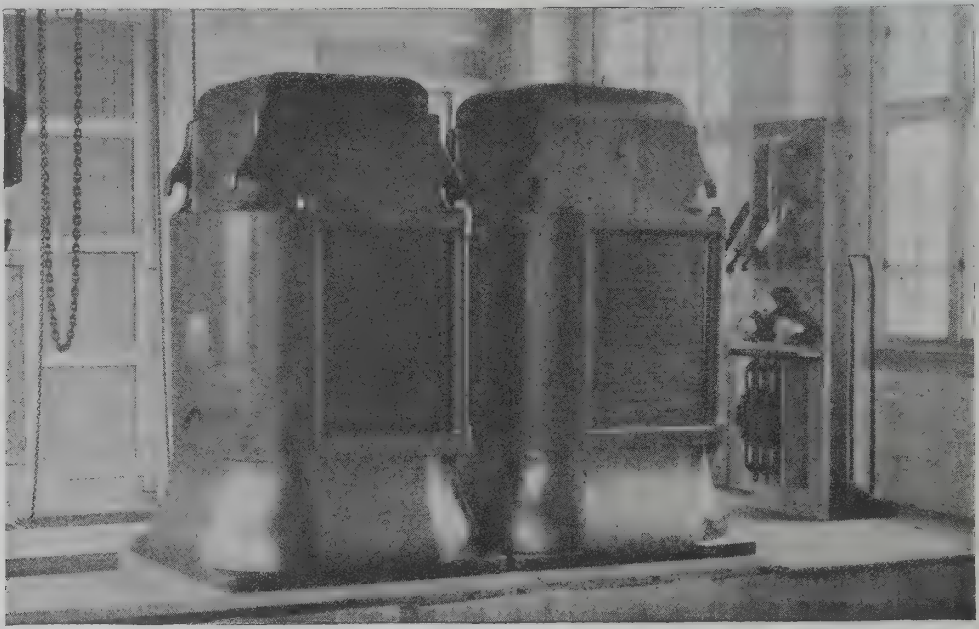

FIG. 4.—STEP-UP TRANSFORMERS, 1,250-H. P. CAPACITY EACH FOR NIAGARA FALLS AND BUFFALO ELECTRIC POWER TRANSMISSION.

General Electric Co., Schenectady, N. Y., Contractors.

In the rush of putting up the line some smaller size insulators were substituted and in several cases where this was done not only the pins but the cross arms have been burned off by the escaping current due to the insufficient insulation.

Looking from the Niagara end, the poles are set so that the outer ends of the cross arms are directly over the boundary line of the right of way; this leaves sufficient room for another pole line on the left. The three cables which are now in position are bare copper wire, each 350,000 circular mils in diameter, made up of 19 No. 10 wires. Each pole supports a weight of about 1,200 lbs. of copper.

The cables leave the generators in the Niagara power house and are conducted in a lead covering across the "Bridge of Sighs" to the transformer house. The step-up transformers are the largest in the world; each of 1,250 HP. capacity, 7 ft. 10 ins. high, with a base 64 × 56 ins. Each transformer weighs 25,000 lbs. The 2,200-volt alternating current from the generators is here raised to 11,000 volts, and changed from a two-phase to a three-phase current. Provision is made in these transformers, as well as in the ones at the Buffalo end, for raising the voltage to 22,000 volts whenever it is wished to increase the capacity of the line. The transformers are cooled by an air blast from a fan driven by a 5 HP. motor. From the transformers three cables pass to the high tension switchboard standing beside them. This switchboard is of marble, and carries three high tension switches, each switch being separated by a marble barrier about 1 in. thick. This partition prevents arcing from switch to switch. The switchboard also carries current indicators and three special fuse carriers. From the transformer house the wires pass through lightning arresters to the first pole of the pole line standing immediately in the rear of the building.

At Buffalo the cables pass from the last pole into a small brick terminal station (Fig. 6), where connection is made through lightning arresters with the underground cables. The lightning arresters are of the Wirt type, especially designed for heavy voltage transmission work, and are single pole. They consist of strips of marble, upon which are mounted eleven cylinders, giving one air gap space 1-32 in. for each one thousand volts, with an allowance of 25% rise in the potential. In the action of the arrester, the large metal cylinders serve to chill the arc, so that, on reversal of the current, the arc is extinguished, no dependence being placed upon any non-arcing property of the metal to put out the arc. In order to limit the current on short circuit, and thus the heating effect, a special solid graphite rod of low non-inductive resistance is used. The arresters are similar to those used on the Big Cottonwood transmission line at Salt Lake City, Utah, which have effectually protected the machinery in many severe storms. The underground wires are rubber covered, taped and sheathed with lead; the insulation was tested to withstand 80,000 volts. The vitrified clay conduit has 12 holes or ducts, each 3 ins. in diameter; but three of these ducts are in present use. The conduit is laid 18 ins. under ground and surrounded on all sides by a bed of concrete 4 ins. thick.

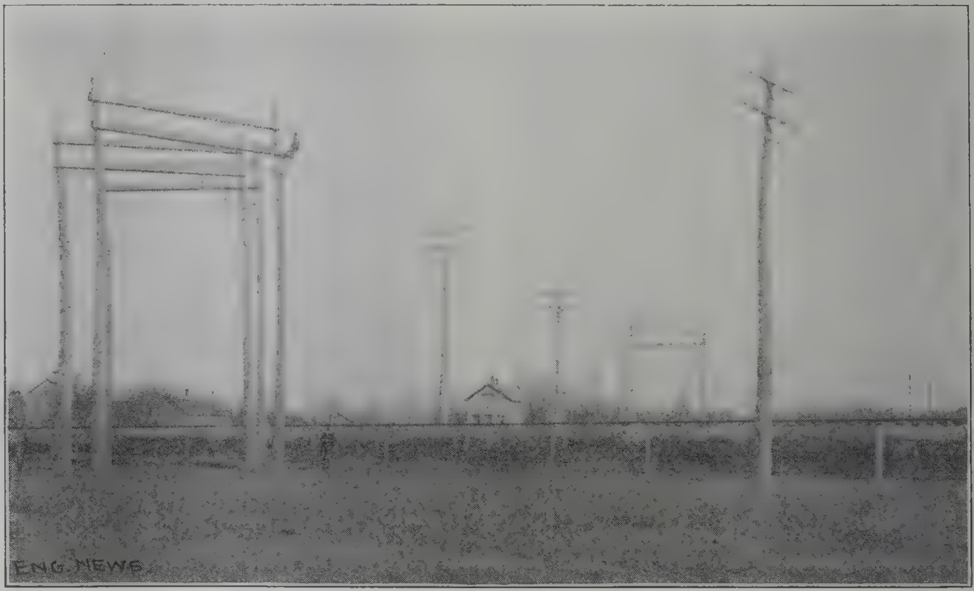

FIG. 5.—A PORTION OF THE POLE LINE FROM NIAGARA FALLS TO BUFFALO.

The White-Crosby Co., 29 Broadway, New York City, Contractors.

The step-down transformers (Fig. 7) are located in a small building adjoining the Buffalo Street Ry. power station. These transformers reduce the pressure from 10,700 to 370 volts; they are similar to the ones at the Niagara end, and, like them, are cooled by an air blast. The 370 volt current is conducted to three rotary transformers in the power house. Two of these are in use, and the third is held in reserve. These transformers are six-pole machines; they convert the 370-volt alternating current into a 500-volt direct current, in which form it is used on the Buffalo Street Ry. The rotary transformers are each 6 ft. 10 ins. high, with a base 36 × 47 ins., and weigh 7,000 lbs. The electrical apparatus has all been furnished by the General Electric Co.

We are indebted to the White-Crosby Co. and to the General Electric Co. for the information from which this article was prepared, and for our illustrations.

THE LATEST CAPE COD SHIP CANAL PROJECT has reached the time limit for depositing its $200,000 with the State Treasurer, as provided by the Massachusetts legislature. The law also provides that plans of location must be filed within six months from June 9, 1896. The preliminary plans have been prepared and approved by the joint board of railway and harbor and land commissioners, but they await the deposit with the State Treasurer before being presented to the Barnstable County Commissioners.

THE ERIE CANAL was closed to navigation on Dec. 1, and preparation is being actually made to enter upon the execution of the plans for the improvement of the State Canals, for which contracts have already been let, aggregating $4,000,000.

THE BOSTON PNEUMATIC TRANSIT CO., on Nov. 30, again received from the Board of Aldermen permission to lay and operate suitable underground pipes for transmitting mail matter, merchandise, etc., through certain streets of that city. Mayor Josiah Quincy, on Oct. 2, returned without his approval a similar order, stating that he believed that no such franchise should be granted without provision in it for a pecuniary return to the city. The present order is based upon an agreement of the company to the following effect: One year after the completion of any line of tubes the company is to pay one-half of one per cent. of the total gross revenue of the company for that year. For each year thereafter the company shall add one-quarter of one per cent., until at the end of the ninth year of its operation it shall pay to the city 2½% of the total gross receipts and continue to pay this sum so long as the tubes are operated. The contract provides that the conduits must be completed by Jan. 4, 1898, under the general supervision of the Superintendent of Streets. As this order conforms generally with the recommendations of the Mayor it will doubtless be approved.

A STEEL RAIL PLANT is projected for Japan. Five Japanese commissioners who are making a tour of the United States and Europe in search of information concerning steel making were in Pittsburg last week visiting the principal works in that city and vicinity. It is said to be their intention to purchase an 8-ton converter and modern machinery for a small steel plant. The commissioners expect to sail from New York for Liverpool on Dec. 12.

THE BRONX PARK BOTANICAL GARDEN PLANS, for New York, are not yet made public, but Prof. Britton, who is to be in charge, says that the general committee on plans has decided that the greater part of the $250,000 to be first raised for the improvement of the 250 acres, set apart in Bronx Park for the garden, will be expended upon the museum building, which is to be built upon elevated ground about 1,000 ft. east of the Bedford Park station of the Harlem Railway. This building will have a front of 304 ft., with two wings each 200 ft. long and 50 ft. deep. Houses for the director-in-chief and head and second gardener will be built east of the Bronx River, and there will also be propagating houses and rain-shelters. The plans provide for a second glass-house, larger than the one above described, to be located south of the Southern Boulevard. These plans are now being completed, and as soon as they have been passed upon by the Park Commission and the Building Department they will be published.

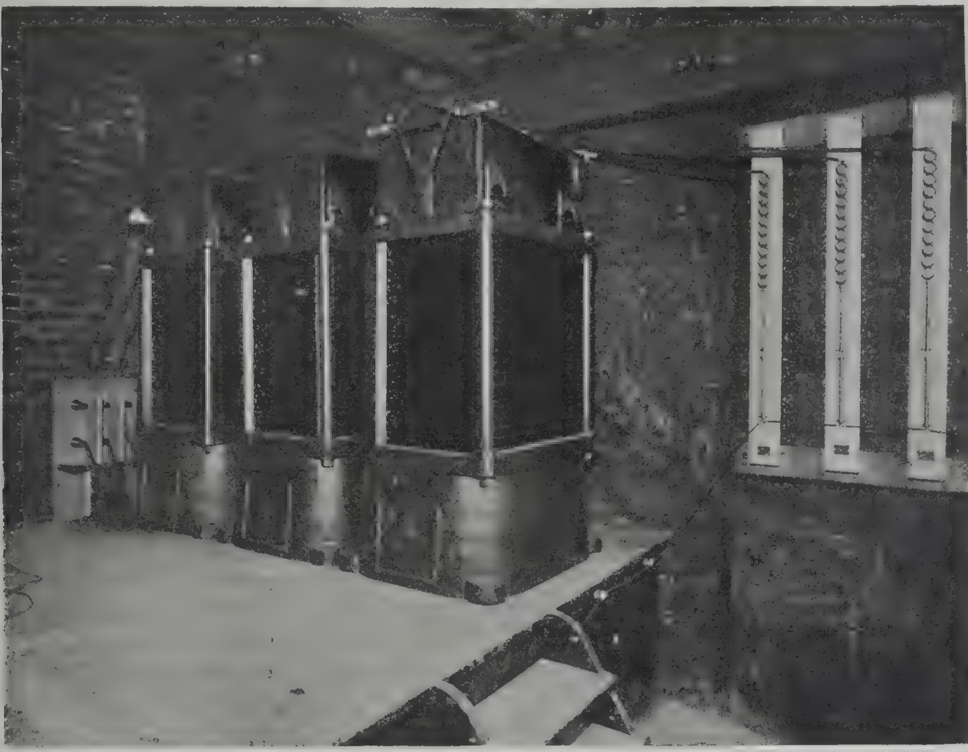

FIG. 7.—STEP-DOWN TRANSFORMERS AT BUFFALO FOR THE NIAGARA FALLS AND BUFFALO TRANSMISSION.
General Electric Co., Schenectady, N. Y., Contractors.

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THE U. S. GUNBOATS "VICKSBURG" AND "NEWPORT" were launched at Bath, Me., on Dec. 5. These are composite boats with steel frames planked below the water line and plated above. Each boat is barkentine rig, with three full decks. The lengths are 168 and 174 ft. on load water line, the extreme beam is 34 and 36 ft., the mean draft is 12 ft., displacement 1,000 tons, and speed 12 knots. The engines are twin-screw vertical triple expansion, with 800 I. HP. and 16, 22 and 36-in. cylinders and 24-in. stroke. The armament includes six 4-in. rapid-fire guns, and four 6-pdr. and two 1-pdr. rapid-fire guns. The crew will include 11 officers and 135 men for each.

◆

THE BOARD OF INSPECTORS OF STEAM VESSELS at New York city is being investigated by a special board of inquiry appointed by Secretary Carlisle. It is charged that the inspectors of the local board have accepted bribes to pass vessels needing repairs.

◆

VITRIFIED SEWER PIPE 36-INS. IN DIAMETER, to the extent of 3,000 ft., will be laid in Montpelier, Ind., in place of brick sewer usual for so large a sewer. The pipe will be made by the Blackmer & Post Pipe Co., of St. Louis, of which Mr. L. W. Post is Vice-President and General Manager.

◆

THE POSTAL TELEGRAPH CABLE COMPANY, says the "Journal of Commerce," is to be purchased by the Commercial Cable Company, with the view of establishing a great foreign and domestic organization. The Commercial is to issue $20,000,000 in 500-year bonds and to exchange $15,000,000 of this, dollar for dollar, for the stock of the Postal Cable Company, with a guarantee of 4%; the balance will remain in the treasury of the Commercial Company and be added to its $10,000,000 of capital stock. The Commercial Cable Company is popularly known as the Mackay-Bennett Cable Co., and it owns three cables between Nova Scotia and Ireland, one from Ireland to Havre, and one from Ireland to Bristol, England; also one from Nova Scotia to New York and one to Brockport, Mass. The third cable to Ireland was completed in August, 1894. The president of the company is J. W. Mackay, and operations commenced in December, 1884. The gross earnings of 1895 were $2,009,738; with $1,215,298 net earnings.

◆

A THIRD ST. LOUIS BRIDGE is being discussed for North St. Louis by the North St. Louis Improvement Association. Some railway officials are said to be interested, but as yet the project is talk only.

◆

THE U. S. PATENT OFFICE, in the fiscal year ending June 30, 1896, received 41,660 applications for patents, 1,641 applications for designs, 2,460 caveats and 2,064 applications for trademarks. The patents granted numbered 22,791, and 11,466 patents expired in the year. The total receipts of the office amounted to $1,307,090, and $209,721 represented receipts over expenditures. The total balance to the credit of the Patent Office, in the U. S. Treasury, is $4,776,479.

◆

THE VACANT PUBLIC LANDS of the United States, says Mr. Francis, Secretary of the Interior, in his annual report, amount to 600,000,000 acres not including Alaska. The actual public domain now amounts to 1,849,072,537 acres. The General Land Office has disposed of 946,000,000 acres up to 1896, with 326,000,000 acres of this granted since June 30, 1883. Since 1862, 162,892,132 acres have been entered under the Homestead Act of 1862. To land-grant railways 83,784,705 acres have been distributed and 1,945,045 acres have been patented to wagon roads. The total area of the four National parks is 3,272,960 acres, and the estimated area of all Indian reservations on the public domain is 84,418,562 acres, with 1,397,691 acers in military reservations. Mr. Francis thinks that 100,000,000 acres of the arid lands could be reclaimed by irrigation.

◆

THE EXPORTS of manufactured goods from the United States for October surpass even the remarkable record for September of this year. The exports of this character advanced from $16,352,356, in September, 1895, to $21,684,734, in September, 1896. The figures for October show an advance from $18,778,817, in 1895, to $23,479,279 in 1896, the highest total for any month in the present fiscal year. The total for the four months, including October, is more than $87,500,000, and if the rate is continued the total of manufacturing exports for the fiscal year will be $263,000,000; the actual total will not fall below $250,000,000 for the year. At the latter rate the exports of this character will be $22,000,000 in excess of the total for any fiscal year on record, and $49,000,000 more than the record for any calender year. The manufacturing exports for 1896 will be 26.47% of the total exports, the highest proportion on record, that of 1895, being 23.14%. The total exports for all kinds for 1896 will be about $882,520,000, only exceeded by the $1,015,732,011 exports of 1892. For the ten months ending Oct. 31, the value of copper ingots exported was $22,094,000, and that of refined oil, $47,979,000, the gain in those two items for the ten months, over 1895, was a little more than $16,000,000. The actual gain in the export of manufactured articles for the same ten months was $60,000,000. The exports of electrical and scientific apparatus advanced from $1,351,460, in the corresponding ten months of 1894, to $2,234,664 in the ten months of 1896. The value of colored cotton exports, for the same period, advanced from $3,120,791, in 1894, to $3,441,670 in 1896; but the export of uncolored cottons advanced from $6,486,299 to $10,322,833 in 1896, and was nearly double that of 1895.

◆

THE PACIFIC COMPANY is the name of a company organized in New York City and incorporated in Virginia with $20,000,000 capital, with the alleged purpose of developing coal mines and building railways in Peru. The officers and directors are as follows President, Harry Keene; Secretary, R. W. Hawkesworth; Treasurer, Jacob Bertschmann. The directors are the three above named and Charles F. Dieterich, Charles Coudert, E. J. Jerzmanowski, Isaac Alzamora, John C. Barron, David S. Walton, Henry T. Scott, Jose M. Yrigoyen, Charles W. Mayer and Appleton D. Palmer. The company's New York offices are in the American Surety Building at No. 100 Broadway. Mr. Keene is President of the Equitable Gaslight Company.

◆

A KITE CARRYING A TELEPHONE WIRE over obstructions was successfully experimented with by Mr. Wm. A. Eddy, of Bayonne, N. J., on Dec. 6. The wire was sustained by three large kites. A lantern was attached to the outer end of the wire, and when it reached a height of 500 ft. was lowered by being paid out through a pulley suspended from one of the kites. When it reached the earth ground connections were established at each end of the wire and both telephone and telegraph messages were sent through it. The obstructions which the wire passed over included three lines of trees, two roadways, a line of telegraph and one of telephone wires and a house. Signals were exchanged for over an hour, and the kites and wire were then drawn in.

◆

DOORS OPENED BY ELECTRICITY when a person steps upon the wire door mat have been placed at the entrance of the new city market, at Springfield, Mass. An electric motor using a 110-volt current furnishes the power for winding up a coil spring and closing the door, and the circuit is broken by stepping upon the mat, releasing the spring which opens the door. The inventors are Oliver H. Hicks and Robertus F. Troy, of Chicago.

◆

A BOILER COMPOUND or water purifier for locomotive and other boilers, which has thus far shown very favorable results in actual use, has been tested on the Cleveland, Cincinnati, Chicago & St. Louis and the Wisconsin & Michigan railways. The chemicals which enter into its composition are given as follows: $Ba\ C_3\ H_6\ O_3$, $Ca\ C_3\ H_6\ O_3$, $Ba\ Cl_2$, and $Ca\ O\ H_2\ O$, but the relative proportions of each in the mixture are secret. As marketed the mixture is in the form of powder and is to be added to the water, either hot or cold, in the proportion of about ¼-lb. per 1,000 gallons. It is claimed to be non-corrosive and to have no injurious effects upon the packing, and, of course, to prevent scale and rust. The makers are Engle & Co., of Chicago, Ill.

ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

In our last week's issue we gave a report of this meeting down to Wednesday afternoon, Dec. 2. The list of members and guests present increased until the adjournment on Friday afternoon, when it numbered 538, making the meeting the largest probably that has ever been held by any engineering society in this country. On Wednesday evening a reception and conversazione was held at Sherry's. This was the only distinctively social event of the meeting. Thursday morning's session was devoted to the reading and discussion of papers. The first was entitled "Experimental Investigation of the Cutting of Bevel Gears with Rotary Cutters," by F. R. Jones and A. L. Goddard. The authors describe the operations required in cutting bevel gears with rotary cutters in a milling machine. The only uncertainty in these operations is that of revolving the blank from its original or central position through such an angle that the cutter shall pass through the pitch point of the larger end of a tooth, and at the same time cut just enough off the smaller end to allow the gear to mesh with its mates without further dressing of the teeth.

By a series of experiments with an apparatus which they designed for the purpose they determined the amount which the blank should be revolved for a number of different sizes and shapes of gears. The results are given in the paper and will be of interest to machinists and others concerned in the production of bevel gears.

The next paper was presented by Mr. J. A. Laird, and was entitled

"The Calibration of a Worthington Water Meter."

The meter tested was a Worthington made entirely of brass, for hot water, and bought for testing purposes. It was used to measure the feed water during the two 30-day duty tests on the Allis engines at the Chain of Rocks pumping station, St. Louis.

The method of making the tests is described and illustrated. It consisted in delivering the water passing through the meter into two tanks supported on platform scales, each holding about 1,000 lbs. The errors of the meter for each day are as follows:

Computation of Meter Error.

Date	Jan. 18.	Jan. 19.	Jan. 20.	Jan. 21.		
Per cent. of error.....	+ 1.6	+ 0.1	+ 1.4	— 0.5		
Jan. 22.	Jan. 23.	Jan. 24.	Jan. 25.	Jan. 26.	Jan. 27.	Jan.28.
— 1.1	— 1.6	— 1.67	— 1.3	— 1.4	— 1.2	— 0.5
Jan.30.	Jan.31.	Feb. 1.	Feb. 2.	Feb. 3.	Feb. 4.	Feb. 5.
— 1.8	— 1.5	— 1.9	— 0.9	— 1.0	— 1.2	— 1.7
Feb. 6.	Feb. 7.	Feb. 8.	Feb. 9.	Feb.10.	Feb.11.	Feb.12.
— 1.2	— 1.6	— 1.0	— 1.0	— 1.2	— 1.8	— 2.0
Feb.13.	Feb.14.	Feb.15.	Feb.16.	Feb.17.	Feb.26.	Feb.27.
— 2.1	— 2.1	— 1.7	— 1.3	— 1.1	+ 0.7	+ 0.2
Feb.28.	Feb.29.	Mar. 1.	Mar. 3.	Mar. 4.	Mar. 5.	Mar. 6.
+ 0.6	+ 0.1	— 0.6	+ 0.3	+ 0.5	+ 1.1	+ 0.7
Mar. 7.	Mar. 8.	Mar. 9.	Mar.10.	Mar.11.	Mar.12.	Mar.13.
+ 1.1	+ 1.1	— 1.1	+ 2.5	+ 1.1	+ 1.2	+ 1.8
Mar.14.	Mar.15.	Mar.16.	Mar.17.	Mar.18.	Mar.19.	Mar.20.
+ 1.5	+ 1.2	+ 1.2	+ 1.3	+ 0.1	+ 0.3	— 0.2
Mar.21.	Mar.22.	Mar.23.	Mar.24.	Mar.25.	Mar.26.	
— 0.2	— 1.3	— 0.7	— 0.6	— 0.7	— 0.9	

"The Contraction and Deflection of Iron Castings," was the next paper read, and was by Mr. Francis Schumann, of the Tacony Iron & Metal Co. He described a method of calculating approximately the deflection of castings of different shapes which is caused by the unequal contraction of its several parts. We shall shortly publish an abstract of this paper. It is, as far as we know, the first attempt to predict by calculation based upon the known shrinkage of a test piece what will be the shrinkage of a large casting, and what will be the extent of the deformation produced by such shrinkage. The paper led to considerable discussion, some of the members taking exception to some of the author's statements. The discussion covered a wider range than that of the problems presented in the paper, and showed that the whole subject of cast iron and its vagaries is one of great interest to many members of the society. It is proposed to make "The Physics of Cast Iron" a special subject for papers and discussions at the meeting to be held in Hartford next spring. The following papers were then read and discussed briefly: "A 200-ft. Gantry Crane," by John W. Seaver; "Friction Horse Power in Factories," by C. H. Benjamin; "Washing of Bituminous Coal by the Luhrig Process," by J. V. Schaeffer. We print the second of these papers in this issue and the other two will be printed at an early date.

Thursday afternoon was left free to the members to visit industrial works or to otherwise employ their time as they saw fit. Many of them remained at the rooms "for social and professional chat," as it was expressed in the programme. On Thursday evening another session was held for the reading and discussion of papers. The first was by Mr. F. A. Halsey, on

"Some Special Forms of Mechanical Computers."

This paper described several forms of the special circular slide rules invented by Mr. Wm. Cox, of New York, several of which have been illustrated and described in Engineering News. We quote the following extract from the paper:

> These computers are simple mechanical devices in the nature of special circular slide rules, designed for the solution of certain more or less complicated formulas, each computer solving but the one formula (or in some special cases two) to which it is adapted. They are in this respect unlike the ordinary slide rule, which is, in a sense, a universal instrument. On the other hand, the slide rule covers only operations involving multiplication, division, squares, and square roots and their combinations, while these instruments can be made to handle any powers or roots or trigonometrical functions. Problems involving more than four factors, when solved by the slide rule, must be attacked piecemeal, whereas the computers may be made to solve at once problems containing any number of factors.
>
> They are provided with different logarithmic scales, similar to those on the slide rule, but with the important difference that each scale represents one definite factor in the formula, and is made sufficiently long to cover all probable values of that factor, so that positive quantities as 8, 80, 800, etc., are read off without chance of error, thus overcoming the slide rule difficulty of locating the decimal point.

The next paper was presented by Mr. M. P. Wood, of New York city, and was entitled

"Rustless Coatings for Iron and Steel."

This is the fourth paper which he has presented to the society on the same subject. The following is an abstract:

> The reported case of the corrosion of the floor beams in the old New York "Times" building, occurring, as it were, almost under one's feet in the short interval of 35 years, and in the hereinafter reported case of one of six days appear to be an unanswerable argument of the dangers of using the oxide of iron in any form for the protection of metallic structure from corrosion.
>
> This argument may be reinforced by the query, What is or what will be occurring to the metallic portions of the many sky-scrapers that are in process of erection in our own and other cities at the present time, under great dissimilarity as regards temperature, humidity and other climatic conditions, but of one characteristic sameness—viz., being sealed in solid masonry or other coverings beyond the ken of inspection?
>
> Inspection of these buildings now in progress, as well as those lately erected, reveals possibly a slight improvement in general over the conditions apparent two years ago; but the improvement is a hollow mockery, and will bear fruit for repentance ere many years have passed. These structures, though more carefuly painted than those erected before, with more and heavier coatings of some kind of stuff called paint, do not appear in a single case to have received any attention or consideration as to the condition of the metallic surfaces before applying the protective coating beyond a possible sweep with a dirty broom to get rid of the rough dirt from the workshop yard, and a possible wipe with a piece of old sacking to remove the grease due to machining processes. Anything like a washing down of the parts with soda-ash or lye-water to remove the grease, and then pickling with weak acid to remove the mill scale, and a subsequent washing with lime water to neutralize the acid bath, warming the work before painting it, and care to apply the paint only on clear, bright days, when no sweating can occur, or applying the paint in warm paint-rooms; it is safe to say that not in a single case out of the many skeleton structures of our modern sky-scrapers can this be found to have been the procedure. Not only this, but in the minor parts of the structure, where the light grillage and ornamental partitions should at least claim these precautionary measures to be used, and where the question of weight and complexity of parts could not arise to cause a decision on the side of Cheap-John methods.
>
> In previous papers on "Rustless Coatings" read before this society, attention has been called to a few of the many cases of destructive corrosion that are apparent to the most casual observer, viz.: The Niagara Falls and Brooklyn Suspension Bridges (Transactions A. S. M. E., Volume XV., pp. 1044-1046); the Victoria Tubular Bridge across the St. Lawrence River at Montreal, Can. (Volume XVI., p. 410), and the Firth of Forth Cantilever Bridge, Scotland (Volume XVI., p. 407); the elevated railway and viaduct constructions of the Metropolitan Railway lines in the city of New York, and the evidently wrong conception from the beginning of what was necessary for the protection from corrosion of these costly structures, so that their life could be measured by the lapse of centuries instead of decades.
>
> "Engineering," July 31, 1896, pp. 157-158, reports from a paper read by Mr. Hector Macoll, of Belfast, before the Institute of Mechanical Engineers (before referred to) an interesting case of the Unusual Corrosion of Marine Machinery due to the presence of oxide of iron pigment.
>
> On Dec. 24, 1895, the steamer, "Glenarm," carrying a cargo of about 650 tons of "burnt ore," struck on a rock in the Sound of Mull, and was at once beached in Scallaster Bay, where the sea stood a little over her after-deck, at low water, and close up to her bridge deck at high water. After having been submerged six days, she was pumped out and raised. On examination the machinery was found to present an extraordinary appearance; all wrought-iron work was deeply and roughly corroded, and planed cast-iron work rendered so soft as to be easily cut with a knife. These unusual effects were undoubtedly caused by the cargo of "burnt ore." Every 100 tons of cargo contained as much sulphate of copper as would, if available, dissolve nearly 32 cwt. of metallic iron. The burnt ore might also contain a small quantity of free sulphuric acid, which would combine with the soda of common salt in the sea-water and set free hydrochloric acid, and the latter would rapidly act upon copper or brass.
>
> On the condition of affairs being discovered, the engines and boilers as well as the hull were at once opened up for survey. The general condition of the engines was that wrought-iron work had been penetrated by corrosion to a depth of about 3 32-in., and planed cast-iron so softened that ⅛ in. had to be taken off before a hard surface was regained. Surfaces in bearing contact, or with oil between them, and all painted surfaces, were completely preserved.
>
> The condition of both boilers looked serious. The front end plate of the main boiler was considerably wasted; the furnaces, which are of the spiral, corrugated type, had corrosive scores running in the direction of the corrugations; and the tubes were covered with a deposit of what appeared to be pure metallic copper. In the end, however, after careful drilling and gaging, it was found that an unexhausted margin remained in all except the tubes. These were all found to be seriously corroded in both boilers, and every tube was therefore cut out and renewed; after which the boilers were satisfactorily tested.
>
> The cause and effect are so closely related that all doubts as to the cause are set at rest. As stated in previous papers read before this society, the corrosive agent is found in the oxide of iron pigment as usually prepared for the market, and claiming great superiority as to quality by reason of its bright attractive color and purity over other forms of oxide pigments ground from hematite ores, whose dirty brown purplish color indicates the presence of more or less clay and earthy matters, wholly unreliable as a pigment even when mixed with good linseed oil, and whose varying qualities are readily detected in the separate consignments from the same manufacturer or compared with each other. Of the samples from the many concerns turning out this Cheap John material, none are good, all are bad and comparatively useless for the protection of metal, however admirably adapted by virtue of their cheapness to wooden structures, and are a poor investment for them if the merits of a better paint is considered.
>
> How much damage is done to the internal parts of a marine vessel by the use of iron oxide paints with which those portions below water-mark in the holds are usually coated it is hard to realize. Bilge-water is a very corrosive fluid, composed as it is of sea-water mixed with the leakage from fluid cargoes soured by the heat of the hold, the sulphur-water from the furnace, ashes and pyrites in the coal bunkers, mill-scale and paint oxides of copper and iron thrown down in the course of repairs to boilers and hull and seldom if ever removed, continually agitated and washed over the exposed metallic surfaces, and aided by the presence of carbonic acid generated from the conglomerate mass in the confined air of the hold. It is scarcely to be wondered at that the vessel when in the dry dock for the too often extended yearly examination is found in such an advanced stage of corrosion that it is necessary to cut out and renew frames, bulkheads, and other parts so corroded as to endanger the safety of the ship in seaway.

In the discussion which followed the paper some of the speakers showed that their opinions differed from that of the author concerning the value of oxide of iron as a pigment. It was also shown that iron wires taken from suspension bridges after 40 years' service had shown no corrosion if they were properly protected. Dr. C. E. Emery related cases of protection of the inner shells of steamships from corrosion by bilge water for more than 30 years. His remedy is paint, plenty of it, and often repeated. The best painting of the inside of the hull of a vessel is done by a laborer who thinks nothing of the economy of paint, but "daubs it on," and the worst by a skilled painter, whose training has been in the direction of making a can of paint go as far as possible.

The next paper was "A Method of Shop Accounting to Determine Cost," by Mr. H. M. Lane. We shall print this paper in full in an early issue.

It was followed by a lecture by Mr. Harry de B. Parsons, member of the society's committee on Tests of Fire-Proofing Material, on the tests which have been made to date by the committee. It was illustrated by a number of lantern slides. The lecture covered the results given in the committee's preliminary report, which was printed in full in our issue of Aug. 6.

The closing session was held on Friday morning, and was devoted to the reading and discussion of papers. The first was by W. W. Christie, on

"The Efficiency of the Boiler Grate."

The author compiled the result of 108 boiler tests, selected from various sources, and by plotting the relation of the economy to the rate of combustion per square foot of grate surface, arrived at the conclusion that the rate of combustion which gave the highest economy was 13 lbs. per sq. ft. of grate per hour for anthracite, and 23.8 lbs. for bituminous coal. This conclusion was disputed by those who took part in the discussion, and one member showed that a correct plotting of the data given in the paper led to the conclusion that within the limits of 5 and 37 lbs. per sq. ft. of grate the economy was entirely independent of the rate of combustion. This corresponds with what was stated in our editorial on Sept. 24, 1896, showing that in locomotive boilers, between the limits of 60 and 240 lbs. per sq. ft. of grate per hour, the efficiency is independent of the rate of combustion, providing the area of grate is cut down in proportion to the increase of grate, except in so far as at the higher rates of combustion a greater quantity of unburned coal is discharged out of the stack.

The next paper was by Mr. R. S. Hale, of Boston, entitled

"Efficiency of Boiler-Heating Surface."

It was a study of formulas given by Rankine, Isherwood, Clark, Emery and Carpenter, to express the relation between the extent of heating surface and the economy of a boiler, the rate of combustion being taken as constant. By plotting these several formulas, the pounds of water evaporated per pound of combustible being taken as ordinates and pounds of water evaporated per square foot of heating surface per hour as abscissas, it was shown that wide differences existed in the formulas. The author then discussed the effect of radiation upon the economy and plotted a series of curves showing this effect. The results of Mr. Barrus's tests with anthracite coal, taken from his book on "Boiler Tests," were then plotted, and it was shown that while a curve could be drawn representing an average relation of the economy to the rate of evaporation, yet results of the individual tests were very far from this average. The discussion which followed the paper was quite lively, and when printed together with the paper as finally revised for the "Transactions," will probably prove an important contribution to our knowledge on the subject of the paper, or at least it will show how great is our ignorance of the subject and how much remains to be learned concerning it.

The next papers on the list were: "Paper Friction Wheels," by Prof. W. F. M. Goss, and "Steam Engine Governors," by Mr. Frank H. Ball. The first of these papers will be printed in our columns in full, and the second in abstract, at an early date.

These papers were followed by a brief presentation in abstract of a paper of 96 pages entitled "The Metric versus the Duodecimal System," by Mr. George W. Colles. The paper is the most extended and vigorous attack upon the metric system of weights and measures which has appeared in many years. It is divided into two parts: 1, Historical; 2, Argumentative. The title is rather unfortunate, as the author uses the word Duodecimal as meaning the ordinary English system of measures in which the foot and inch are the primary units, while the same word is used by other writers to mean the proposed new system of numerical notation, based upon twelve digits instead of ten. The discussion which followed the presentation of the paper was nearly all in its favor, but a few members pointed out what they considered errors in some its minor statements. The sentiment of the members of the society in general is strongly against the metric system, and especially against compulsory legislation for its introduction. The sentiment of the Council has been shown, as was stated in our last week's issue, by its appointment of a committee to prepare material to be used in opposition to the proposed Congressional legislation to make the metric system compulsory.

The next and last paper was entitled "Aluminum Bronze Seamless Tubing," by Mr. Leonard Waldo. This tubing is an entirely new production of the Pope Tube Co. Samples of various sizes were shown. We shall print an abstract of this paper at an early date.

ENGINEERING NEWS AND AMERICAN RAILWAY JOURNAL.

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A MOTOR CARRIAGE COMPETITION has been arranged for by the proprietors of "The Engineer," London, England, entries for which must be made by the end of March, 1897. The vehicles are to be delivered at the Crystal Palace, Sydenham (near London) in May, for the preliminary trials and examinations by the judges. The competitive run is for a course of 100 miles out and 100 miles back, and will probably be made on May 31. A wise provision made in the rules is to the effect that as the attainment of high speed is not one of the objects sought, no credit will be given for speeds exceeding 10 miles per hour. The points on which the awards will be made are as follows: 1, Distance run without renewing supplies, and freedom from stoppages for repairs, oiling, etc.; 2, Design and workmanship of machinery and carriage; 3, Safety; 4, Simplicity, durability, accessibility, and freedom from smell and vibration; 5, Time of setting to work and ease of starting; 6, Speed (up to 10 miles per hour) and hill climbing; 7, Steering gear and brakes; 8, Weight; 9, First cost and (to a limited extent), cost of working; 10, General efficiency. The prizes offered are as follows: $1,825 for carriage weighing two tons and carrying four or more passengers; $1,750 for carriage weighing one ton and carying one, two or three passengers; $1,750 for carriage weighing two tons and carrying one ton of freight; $780 for carriage weighing one ton and carrying 560 lbs. of freight; $600 for a carriage operated by the vapor of oil or spirit, having a specific gravity lower than 0.8%, or a flashing point lower than 73° F. The full conditions of the competition can be obtained on application to "The Engineer," London, England.

◆

THE BOARD OF TRUSTEES OF THE SANITARY District of Chicago, which has in charge the construction of the great Drainage Canal from Chicago to Lockport, Ill., effected a pretty complete reorganization at the annual meeting, held Dec. 8, 1896. This board consists of nine members, five of whom are Republicans in politics, and four Democrats. The president of the board, who is elected by ballot of the nine members, has for the past year been Mr. B. A. Eckhart, a Republican, and the chairmen of the most important committees, who are appointed by the President, have been Republicans. Previous to December, 1895, these same offices had been held by Democrats, the followers of that party being in the majority. The change in the political affiliations of the members which took place at the general election held in 1895, resulted at the annual meeting in the officers being voted to Republicans as above noted. This action aroused considerable partisan animosity, which has continued in a more or less suppressed state during the past year, and at the annual meeting, held Dec. 8, last, the Democrats of the board, with the aid of one of the Republican members, elected a Democrat, Mr. Thos. Kelley, to the office of President, and affected a complete turnover in the chairmanships of the most important committees. This action has increased the intensity of the partisan feeling between the Republican and Democratic members of the board, and in the Chicago press mutual charges of vicious intent and the administration of affairs to further partisan ends, have been flying broadcast. As far as the officially expressed intentions of the majority now in control of the board go, however, the only radical change of policy thus far voiced is the advocacy in the inaugural address of President Kelley of more attention to securing and promoting the waterway features of the canal. To this end Mr. Kelley advocates that all arrangements made for crossing of the canal by bridges shall provide for the present construction, or, at least, the substitution at will, of swing bridges for fixed bridges, and for the planning of all other work with a view to the use of the canal as a waterway. In this connection it may be noted that a convention of delegates from the Illinois River valley towns through which the discharge of the canal will flow was held at Peoria, Ill., Dec. 10, to effect an organization to prevent any change in the law under which the Drainage Canal is being built, and to check any intention of the Board of Trustees to violate or evade the provisions of the law.

◆

THE CHICAGO DRAINAGE CANAL'S engineering force is to be cut down from 142 to 65 men, the work being so far advanced that their services are no longer needed. The new President of the Board of Trustees, Mr. Thomas Kelly, in his inaugural address, referred to the work yet unfinished, a strip 5½ miles long, from Joliet westward, and also the work remaining to be done on the Chicago River, from the lake to Robey St., where the river connects with the main channel. He said that although the government had signified a willingness to deepen the river by drainage and otherwise, the sanitary trustees would probably have to buy or condemn property wherever necessary to bring about the required flow of 300,000 cu. ft., as provided by law. He strongly urged that a plan be immediately adopted to proceed to this work, which should be started as soon as possible.

◆

THE BOSTON SUBWAY has been leased by the Boston Transit Commission, of Boston, Mass., to the West End Street Ry. Co., for 20 years. The rental is 4⅞% on the cost of construction, which will suffice to pay the interest on the bonds and create a sinking fund to pay on the principal in 40 years. In addition to this, the company is to pay quarterly a sum not less than 5 cts. for each car using the subway in either direction. The track, fans, pumps, electric lights, etc., are to be put in by the company and the entire work of maintenance also done by the company.

◆

ELECTRIC LIGHTING FOR SIGNALS, stations, etc., is said to be in contemplation by the New York, New Haven & Hartford R. R. The plan, as reported, is to have power plants at intervals, furnishing light for stations, yards, signal towers, and signals.

◆

AN AIR COMPRESSOR PLANT for shop work has been put in at the Union Pacific Ry. shops at Cheyenne, Wyo. It will be used for operating machine tools, yard derricks, car cleaning, etc. Similar plants will be put in at the other principal divisional points.

◆

THE USE OF DUMMY COUPLERS for hanging up airbrake hose on freight cars has been abandoned by the Southern Pacific Ry. The company will hereafter receive freight cars at interchange points without "dummy couplings," and will decline on and after Jan. 1, 1897, to receive bills for replacing or repairing such couplings.

◆

TRAFFIC ON THE BROOKLYN BRIDGE has been steadily decreasing since 1893, according to the annual report of the trustees, and the reason given for this is the discomfort due to the work of making the changes in the terminals. The total number of passengers for the year ending Nov. 30, 1896, was 43,996,459, as against 44,564,329 in 1895, the financial decrease being $22,514. The changes are now practically completed, however, and an increase in train service is promised.

◆

A RAILWAY CROSSING FIGHT occurred recently at Kingston, N. Y., in which the officers of both roads set their men an example of argument by force, as is too often the case. A few months ago the Common Council granted the Ulster & Delaware R. R. the right to cross the Strand, and on Sunday morning early the track was laid, crossing the Colonial Electric Ry. tracks. Early Monday morning the latter tore out the crossing, and on Tuesday the Ulster & Delaware R. R. put the crossing back. The electric railway had a car running over its track loaded with employees, and the Chief of Police ordered the motorman to stop by order of the Mayor. He refused and was arrested. The Colonial Co. again tried to tear up the tracks, but the Ulster & Delaware R. R. ran a flat car loaded with bluestone over on the crossing and the workmen were obliged to stop. A mob of about 2,000 people gathered and a riot was narrowly averted.

◆

A FIGHT FOR A RAILWAY FRANCHISE is in progress at New Brighton, Staten Island, N. Y. The Staten Island Electric Ry. Co. got hold of an old franchise for a line on Castleton Ave., and started to build the line without a permit, gangs of men being continuously arrested by the police and replaced by the company. The village trustees have rescinded the franchise and given it to the Midland Ry. Co., and trouble is expected in addition to the inevitable litigation.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision of freight trains Dec. 12 at Welder, Tex., on the Southern Pacific Ry. The eastbound train had orders to wait on the siding to let three sections of a westbound train pass, but the second section was mistaken for the last section owing to a fog which prevailed at the time. There were five men killed, and both engines and several cars were wrecked.

◆

A LOCOMOTIVE BOILER EXPLOSION occurred Dec. 4 near Eagleville, Conn., on the New London Northern R. R. The engine was hauling a freight train at the time, and was derailed by the explosion and went down the embankment. Three men were killed.

◆

A BOILER EXPLOSION in the Wilcox Lumber Co.'s mill at Seville, Tex., wrecked the plant and killed six men.

◆

THE LOSS OF THE S. S. "SALIER," of the North-German Lloyds Line occurred off the coast of Spain, Dec. 7. The vessel struck on sunken rocks near the shore in a fog, and went down with all on board, the number of persons drowned being given as about 300, including passengers and crew.

◆

RECENT EXPLOSIONS OF ACETYLENE GAS serve to call attention to the dangerous nature of this much advertised illuminant. The latest is reported in a press dispatch from Berlin, Dec. 14, which states that an explosion occurred in the workshop of an inventor named Geo. Isaacs who was experimenting with processes of making the gas, and four persons were killed. The explosion on Oct. 17 of a cylinder filled with the liquefied gas in the laboratory of M. Raoul Pictet, the well-known chemist and engineer, has been carefully investigated, and the gist of recent reports from abroad is that acetylene is liable to contamination with certain impurities which render it liable to spontaneous explosion. Acetylene appears to be as dangerous from the physical side as from the financial.

◆

THE QUEEN LANE RESERVOIR SUIT, in Philadelphia, has been decided against the city and in favor of the contractors, Filbert, Porter & Co. The suit was brought by the contractors to secure the payment of $137,071, being the 10% of the contract price usually withheld until work is accepted. The reservoir having proved defective the city refused to pay over the balance, claiming that the contractors had done poor work. The defence seems to have been that the contractors followed the specifications, except where ordered or authorized by the city authorities to depart from them.

◆

THE $3,000,000 PHILADELPHIA FILTRATION ordinance has been indorsed by the director of public works and signed by the Mayor. Before anything will be done in the way of construction a decision from the State Supreme Court will be awaited, to learn whether the proposed loan can be legally made. When this is satisfactorily settled and bonds are issued and sold, the council must pass upon the final disposition of the money, so, altogether, the filtration scheme in Philadelphia is by no means past all dangers.

◆

THE PURCHASE OF THE WATER-WORKS OF DULUTH by the city has been postponed, at least, by a decision in a lower court, throwing out a large number of votes, and thus giving the majority to the opponents of the project. The city is developing a supply from a new source, and proposed, as we understand it, to buy the distribution system now owned by a company.

◆

AN IRRIGATION POLICY for Colorado has recently been outlined in an open letter by Mr. J. S. Greene, ex-State Engineer of Colorado, and now practicing law Pueblo. In brief, he proposes that the state be divided into natural drainage districts. The people of any of these districts might at any time vote to incorporate their district, the corporation so formed having control of the water and land within the district. The plan is in part dependent on the cession of the arid lands to the several states. Grazing lands would be leased for the benefit of the district, and mineral lands would pay royalties, the sale of such lands being prohibited.

◆

A WATER POWER PROJECT for Portage la Prairie, Manitoba, has been proposed. The plan being to build a dam across the Assiniboine River, south of the city. A favorable report has been made by Mr. Geo. H. Webster, C. E., of that city, but no definite steps have yet been taken.

◆

DIVERS FOR FOUNDATION WORK have been employed at the site of the new building on the north side of Liberty St., near Church St., New York city, owing to the amount of water met with.

◆

ELECTRIC POWER FOR DRAWBRIDGES is to be adopted for all the bridges over the Chicago River at Chicago, Ill., replacing the steam plants now required for each bridge.

A TOWER DERRICK FOR ERECTING STRUCTURAL IRONWORK.

The special conditions under which the erection of ironwork has to be done in the construction of the modern type of steel skeleton building have led to the devising of various improvements in detail adapted to this class of work, and we illustrate herewith a somewhat novel form of erecting derrick which has been used on two or three buildings. The general view, Fig. 1, shows the general arrangement of the derrick, which is simply a four-post tower carrying four booms whose range covers the whole area of the building. The fourth boom had not been put in place when the photograph was taken from which our illustration is reproduced. This view shows the derrick as used on the foundations and the two lower stories of the Woodbridge Building, in William St., New York city, and the tower was extended upward as the work progressed, the full height of the derrrick being shown in Fig. 2. The booms are all 60 ft. long, 12 ins. diameter at the upper end, 10 ins. at the lower end and 14 ins. at the middle. They can be lowered to a horizontal position, each boom having thus a reach of 60 ft. and a sweep or range of 270°. The tower was designed to hoist 5 tons on each boom. The contractors for the ironwork of this building were Levering & Garrigues, engineers and contractors, of New York city, to whom we are indebted for photographs and blue prints of the derrick.

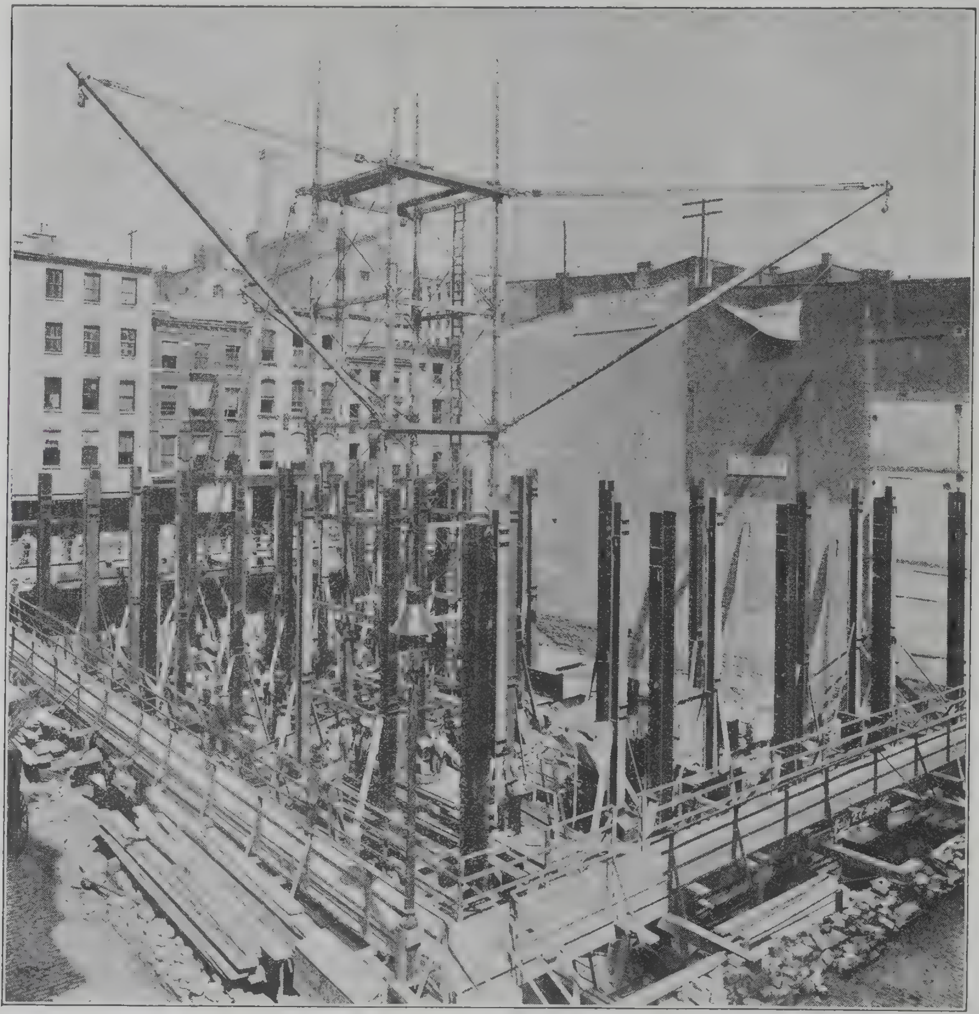

FIG. 1.—TOWER DERRICK FOR ERECTING IRONWORK, WOODBRIDGE BUILDING, NEW YORK CITY.
Levering & Garrígues, Contractors.

BRITISH RAILWAY STATISTICS FOR 1895.

From the general report of the railway companies of the United Kingdom, dated Aug. 10, 1896, and officially presented to Parliament through the Board of Trade, we obtain the following statement relating to the capital, traffic, working expenditure and profits for the year 1895:

The total mileage of British railways at the date of the report was 21,174 miles, of which 9,738 miles were single track; the gain in mileage over 1894 was 266 miles, or 1.3%. The total railway capital, in dollars, was $5,005,551,105, or $236,400 per mile of line operated; the ordinary or common share capital is $1,820,187,025. The total receipts for 1895 were $429,613,510, divided as follows: Passenger receipts, $186,805,810; from goods, $220,174,425; from miscellaneous sources, $22,633.275. The total expenditures for 1895 were $239,383,185, leaving net earnings equal to $190,230,325, a gain of 2.5% over the net earnings of 1894. The receipts per train-mile from traffic were $1.15 30-100, a gain of 0.2% over 1894, and the expenditures per train-mile, exclusive of harbors, etc., were $0.64 64-100; leaving a net earning per train-mile of $0.50 66-100, and a decrease in expenditures of 0.2% per train-mile. The percentage of net earnings on capital was 3.80% as compared with 3.77% for 1894.

The Board considers this showing as satisfactory from every point of view, especially as the small improvement in revenue and net earnings is upon totals which were already the largest on record. In regard to dividends the highest average rate paid, during the last ten years, was 4.32% in 1889; after this date the rate gradually declined to 3.74% in 1893, a rate partly due to the great coal strikes of that year.

From an analysis of the passenger traffic for 1894 and 1895, the following table is prepared:

No. of passengers.	1894.	1895.
First-class	29,821,000	29,990,000
Second-class	60,162,000	58,568,000
Third-class	821,430,000	841,213,000
Total	911,413,000	929,771,000
Receipts from Passenger Traffic.		
First-class	$14,830,000	$15,175,000
Second-class	9,860,000	9,675,000
Third-class	116,380,000	118,980,000
Season tickets	13,240,000	13,800,000
Excess luggage, mails, etc.	28,165,000	29,175,000
Total	$182,475,000	$186,805,000

In recent years the second-class has been abolished on several important lines, and the total decline in this class of receipts has been nearly 27% since 1890. The increase in season-ticket receipts was about 19%. The third-class passenger receipts show an unbroken record of increase for the last 9 years. In 1886 the $90,000,000-mark was just passed, and since that time the actual increase has been equal to 32%. The revenue from third-class passengers now amounts to about three-fifths of the total revenue from passenger traffic.

The receipts from freight, for 1895, were divided as follows: Mineral traffic, $90,880,000; general merchandise, $122,255,000; live stock, $7,040,000; total, $220,175,000. There was a gain over 1894 in these classes of freight of 0.3% in the mineral traffic and 2.7% in merchandise, but a decrease of 3.5% in live stock carried. These sums were earned on the carriage of 240,400,000 tons of minerals and 93,900,000 tons of general merchandise, or a total of 334,300,000 tons, showing a general gain of 3% in volume over 1894. As being of interest in connection with these figures the Board gives the following figures for coal and pig-iron production for the two years:

Item.	1894.	1895.
Coal raised, tons	188,278,000	189,661,000
Pig iron produced, tons	7,427,000	7,703,000
Coal shipped coastwise	17,357,000	16,524,000
Coal exported abroad	31,756,000	31,715,000

The pig-iron production includes that made from foreign ores, and the coal exported excludes that used by steamers engaged in the foreign trade.

The total train-mileage of passenger trains, in 1895, was 184,200,000 miles; for freight trains it was 150,400,000 miles, and the total mileage, including mixed trains, was 338,900,000 miles. The proportion of working expenditure to total revenue, in 1895, was 56%, practically the same as for the preceding year. For many years prior to 1890 this rate remained comparatively stationary at 52 to 53%. In 1890 it rose to 54%, and gradually increased each year until it was 57% in 1893. From an analysis of expenditures for all the railways, in 1895, it is found that these were divided as follows: Maintenance of way, works and stations, $38,300,000; locomotive power, $62,650,000; repairing and renewing rolling stock, $20,100,000; traffic expenses, $74,800,000, making a total of $195,850,000 for the principal items connected with the absolute operation of the railways. The average expenditure per train-mile for all the companies is thus divided:

Item.	1895.
Maintenance of way	10.84 cts.
Locomotive power	17.78 "
Rolling stock	5.72 "
Traffic expenses	21.16 "
General charges	2.96 "
Rates and taxes	4.26 "
Government duty	.38 "
Compensations	
Personal injuries	.18 "
Damage to goods	.32 "
Legal and parliamentary	.36 "
Miscellaneous	.68 "
Total	64.64 cts.

In this connection there is an average decrease of cost of 0.16 cts. per train-mile over 1894. The approximate average cost of coal at the mines, in 1895, was $1.45 per ton, as compared with $1.90 in 1890. The average export price of iron and steel rails, as computed from the quantity and declared value of exports in 1895, was $19.15 per ton, as compared with $27.35 in 1890.

In the analysis of dividends paid in 1895 on $1,820,000,000 of ordinary share capital, it appears that stock to the value of $240,000,000, or 13.2% of the total, paid no dividend. Of the remainder, 29% paid between 5 and 6%; 15.5% paid between 6 and 7%; 11.5% paid between 2 and 3%, and only 0.3% of the total paid between 7 and 8% dividends.

From the general report of the Board of Trade upon railway accidents in the United Kingdom, for 1895, we obtain the following: The total killed by railway accidents was 1,024 and 4,021 people were injured. Of the killed 442 were railway employes and 285 were trespassers; only 83 passengers were killed and 1,109 injured from all causes connected with railways. Of employes 2,654 were injured. The proportion of passengers killed during the year was 1 in 11,202,059, and 1 in 838,387 were injured. In 1894 the proportion was 1 in 7,789,854 killed, and 1 in 780,319 injured. The report details 69 train accidents during the year, four of which were attended with fatal results.

Among employees 16 were killed and 331 injured while employed in coupling and uncoupling trains; 94 were killed and 1,127 were injured in various shunting operations; 86 were killed and 95 injured while working on the permanent way, and 93 were killed and 148 injured while walking on or crossing the tracks. The total number of men employed on the railways of the United Kingdom, in 1895, was 465,112, divided as follows:

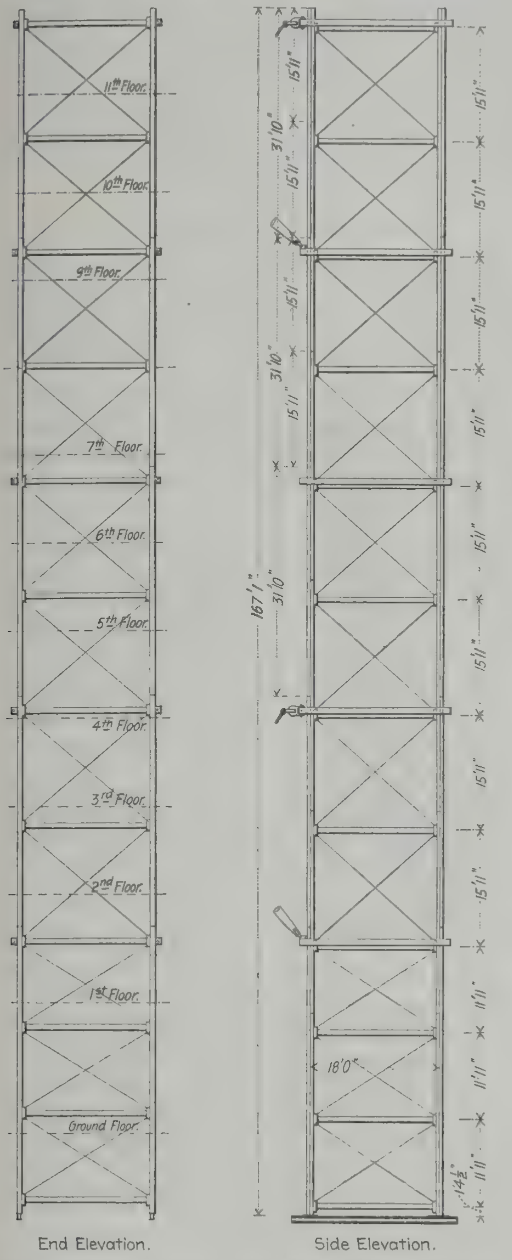

Fig. 2.—Details of Tower Derrick For Erecting Structural Ironwork.

Station masters	7,410
Brakemen and goods-guards	11,881
Permanent-way men	58,781
Gatekeepers	3,292
Engine-drivers	19,281
Porters	45,696
Shunters	7,092
Firemen	19,264
Inspectors	6,805
Passenger guards	6,357
Pointsmen and signalmen	24,381
Laborers	45,882
Ticket collectors	2,795
Mechanics	69,227
Other classes	136,968
Total	465,112

The progress made in the adoption of the absolute block and interlocking system is thus stated in the reports made annually to Parliament. The proportion in which the signal and switch levers had been interlocked on railways was 99.7% in England, 99% in Scotland and 97.7 in Ireland, or 99% for the United Kingdom. The mileage in these several divisions is given as follows:

	Miles	
	Double.	Single.
England and Wales	'9,325	4,472
Scotland	1,314	1,768
Ireland	613	2,534
United Kingdom	11,252	8,774

By a report dated Dec. 31, 1895, it appears that 94% of all passenger vehicles were fitted with continuous brakes complying with some or all of the requirements of the Board of Trade; and the number of passenger vehicles fitted with pipes and connections only was 5%.

* * *

THE WASHING OF BITUMINOUS COAL BY THE LUHRIG PROCESS.*

By J. V. Schaefer, Jun. M. Am. Soc. M. E.**

The composition of fuel is a matter so vitally connected with all commercial and manufacturing industries, that the removal of the impurities in coal has been made a subject of much study and experimental work. Before giving a detailed description of the latest plant built on the Luhrig system the writer desires to consider briefly the nature of these impurities, the means to be employed to remove them, and the advantages of the cleaned coal.

The principal impurities in coal which it is desired to remove are ash in the form of slate, and bone coal and sulphur in the form of pyrites. The larger pieces of slate, bone, and pyrites can be removed by hand picking. Fortunately, all these materials have a specific gravity greater that that of pure coal. It is therefore possible to remove these elements from the small coal by using water in such a way as to float off the coal, which is lighter, leaving the slate, bone, and pyrites to settle. This is the process called washing.

The incombustible matter in coal generally consists of silicate of aluminum and oxide of iron. In blast furnaces the oxide of iron is reduced, but when present in fuel used for generating steam it forms into clinkers on the bars of the furnace grate, resulting in great loss.

Coal ashes often contain about 90% of silicate of alumina. The proportion of silica to alumina is generally ¾ to 2. The latter proportion generally exists in coal with a high percentage of ash. This silicate is almost infusible, and in order to flux it for good working of the furnace it requires an addition of lime.

In blast furnaces on Bessemer iron the slags are generally of the following composition:

Lime, 47%; silica, 38%; alumina, 15%.

The proportion between alumina and lime is about 1 to 3, but if lime be added in the same proportion to the alumina of the ashes of the fuel, the proportion of the bases to the silica will be much greater than in the Bessemer slag. However, to prevent an exaggerated estimate of loss, the lime (in the following calculation) will be only added in sufficient quantity to make the ashes of the fuel as basic as the remainder of the slag produced in the furnace.

Let it be assumed that 22 cwt. of coke, containing:

Carbon, 92%; ash, 5%; moisture, 3%, will produce one ton of Bessemer iron.

The following will show, with this data, what amount of coke will be required when the coke contains:

Carbon, 82%; ash, 15%; moisture, 3%.

The principal elements of the ash being:

Silica, 49%; alumina, 25%; lime, etc., 8%; 22 cwt. of coke with 92% carbon gives 20.24 cwt. of carbon per ton of iron.

Again, 20.24 cwt. of carbon represents 24.7 cwt. of coke when there is 82% of carbon; i.e., with 15% of ash.

The 10% of additional ash in the dirtier coke equals 2.5 cwt., consisting of 1.23 cwt. silica, 0.82 cwt. bases, 0.45 cwt. oxide of iron. The bases take up 0.5 cwt. of silica, leaving 0.73 cwt. to be fluxed by adding lime to the extent of 1.2 cwt., which is equal to 2.2 cwt. of limestone. The total slag due to the extra 10% of ash in the coke will therefore be 3.7 cwt., consisting of 2.5 cwt. ashes plus 1.2 cwt. lime.

	Cwt. Units.
The fusion of 3.7 cwt. of slag requires, according to Bell, 3.7 × 550 =	2,035
To expel the carbonic acid from 2.2 cwt. of limestone requires 2.2 × 370 =	814
To decompose 0.264 cwt. of carbonic acid of the limestone requires 0.264 × 3,200 =	845
Total cwt. heat units	3,694

Taking 4,400 as the number of units developed by 1 cwt. of carbon in the blast furnace, the above will represent 3694 ÷ 4400 = 0.84 cwt. of carbon.

The carbon, therefore, in the inferior coke must be 20.24 + 0.84 = 21.08, instead of 20.24 cwt. Consequently, the coke required with 15% of ash will be 82 : 100 : : 21.08 : 25.7 cwt., or 3.7 cwt. coke for every ton of iron produced, more than coke with only 5% of ash, or about 17% of coke extra.

To this loss must be added the cost of 2¼ cwt. of limestone, which would of itself more than cover the cost of washing. It is evident, therefore, that a great saving can be effected by washing coal to be used for metallurgical purposes.

Connelsville coal contains 0.53% of sulphur. It is considered that any coal which contains in the coke made from it more than 1% of sulphur is not fitted for blast-furnace use. As many coking coals do contain more than 1% of sulphur, it is in these cases absolutely necessary to wash them carefully if they are to be made into coke for blast-furnace use.

The table here given shows a few results which have been obtained by washing coals from different sections of this country, and is interesting in that it shows to what extent ash and sulphur may be removed from coal:

Location.	Ash.		Sulphur.	
	%Unwashed.	%Washed.	%Unwashed.	%Washed.
Sloss, Birmingham, Ala.	10.00	5.80	2.65	1.92
Sopris, Sopris, Col.	22.48	7.20	0.95	....
Big Muddy, Carterville, Ill.	14.25	4.50	1.14	0.97
Blossburg, Birmingham, Ala.	7.68	4.60	2.29	1.48
Mary Lee, Birmingham, Ala.	10.32	6.14	0.89	0.71
Belt, Montana	29.69	7.35	4.32	2.40
Toluca, Toluca, Ill.	18.61	4.92	4.02	2.49
Brazil, Brazil, Ind.	24.32	5.67	....	....
Rogers, Lisbon, O.	12.78	4.90	3.14	1.27
Alexandria, Greensburg, Pa.	10.60	5.00	1.14	0.62
Cherry Valley No. 3, Leetonia, O.	9.88	5.00	3.83	1.72
Comox, Union Bay, B. C.	35.50	8.50	2.15	1.30
Sand Coulee, Montana	25.59	7.25	4.24	1.87
Cokedale, Montana	31.00	5.40	....	....
Crabtree, Greensburg, Pa.	10.60	6.21	1.13	0.617
Athens, Ohio	14.28	6.33	....	....

In a properly conducted washing operation as practised under the Luhrig system, nothing essential to coking is lost. In some of the less thorough systems—if indeed they may at all be called systems—a considerable amount of bituminous matter and pure coal is lost. These losses, however, are inexcusable, and should not be charged to coal washing in general.

Again, the cost of manufacture of coke from dirty coal is greater that that of coke from clean coal. Let us assume that the coal contains 10% of removable ash. As the price of the coke is proportionate inversely to its percentage of ash, it is necessary in this case to maintain a coking plant one-tenth larger than if the coal was washed, in order to produce the same money equivalent.

All that has been stated above applies with almost equal force to coal used under a boiler for generating steam. In the process of burning, the iron, sulphur, etc., in the removable dirt, together with the fixed incombustible matter in the coal, melt together and form a vitrified mass on the grate bars, called clinker. This greatly impedes the passage of air between the bars and causes imperfect combustion. Moreover, when the bars are covered with a firmly adherent mass of clinker they are no longer cooled by a current of cold air, and so become heated, and "burn out." To compensate for these losses an extra amount of fuel must be provided, the cost of which and the cost of removing the ash and repairing grate bars, are items that make the desirability of washing very apparent.

The cost of transportation on a dirty coal is also an element well worth considering In a coal having 18% ash there is probably 10% that might have been left at the mine by a process of washing. In many cases as high as 70% of the price a consumer pays for coal goes for railroad transportation; 7%, therefore, of the price the consumer pays goes for transporting the very thing he doesn't want—a product worse than useless, as it spoils his fire, burns out his grate bars, and costs money to haul away from his ash pit. As this 10% of removable ash can be washed out at the mine at a cost of two to five cents per ton, the transportation charges on it alone will pay for the cost of washing and the shrinkage in volume due to washing. As this washed coal will have 11% greater calorific power the consumer can pay such a price for it as will leave a liberal margin of profit for both consumer and producer. This readily accounts for the fact that wherever it has been introduced washed coal has found a ready market. Parties who once try it are nearly always converted to its continued use.

A thorough system of washing involves the careful separation of the coal into different sizes—No. 1 and No. 2 nut, No. 3 and No. 4 pea, and sludge. It is a universally accepted fact that the best results are obtained by using coal of a uniform size. Therefore the smaller sizes of washed coal often make a much better fire than the run-of-mine or lump coal that has previously been used at a higher price. The much higher efficiency of an evenly graded nut coal over lump coal and the increasing use of mechanical stokers are facts which, in the writer's opinion, will soon compel the coal producer to prepare his steam coal for the demand of the market by crushing and washing. By using the sludge or intermediate product (this term will be fully explained later) it is often possible for a mine operator to use under his own boilers the product for which he has no market, and sell or coke all the remainder.

Freight charges and low prices for small coal often combine to produce conditions where the slack coal becomes a very troublesome affair. It cannot be sold, so it must be hauled to the dump at a cost of considerable money, and often it becomes even there an intolerable nuisance by its firing and clogging streams. In many cases where these conditions exist, a washing plant will convert this expensive slack pile into a marketable product which will make a showing on the other side of the ledger.

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*From a paper presented at the New York meeting of the American Society of Mechanical Engineers.

**The Link Belt Machinery Co., Chicago, Ill.

Again, much small coal is often left in the mine because it does not pay to hoist it. This, of course, means just so much of the coal territory made unproductive. It has been found profitable to hoist this and, by washing, make of it a marketable coal.

The washing of coal is, properly speaking, a process, not a single operation. There is involved in it such an arrangement of various elevators, conveyors, jigs, etc., etc., with respect to their individual and related uses and to their environment that they will work in harmony with each other and handle coal and water to the best advantage.

For fuel purposes, coal must not be broken into fine pieces more than is unavoidable. To this end bar screens and all dumps which tend to break the coal should be avoided, and in their places should be used shaking screens and rotary dumps. The pit cars should be dumped into a hopper at the head of the screen in such a manner as to allow the coal to flow gently on to the upper end of the shaking screen. On this screen the hand picking can be done.

For coking coal it is usually necessary to put in crushers and disintegrators. This is especially true of those coals that are low in volatile matter. When the coal must be reduced to a fine state before coking it should be washed first and disintegrated afterward. If all the product of the mine is coked, and the slate and pyrites occur in large pieces in the lump and egg-coal sizes, these sizes should be hand-picked before going to the breaker, where they are broken to nut-coal size before going to the washer.

All water that has been used should be clarified so as to be used over again. As it takes about a ton of water to wash a ton of coal, there are few localities where it is possible to obtain a sufficient quantity of water to allow it to flow away after being used. Indeed, when it is possible to do this it is not desirable, for the reason that much coal is thus lost, and the damage done to streams by the deposits of fine coal and refuse are apt to cause expensive litigation. The water carrying fine coal should be allowed to settle, the clarified water being used over again, and the fine coal or sludge being saved for coking or for use under the boilers. The water carrying refuse should be treated in the same way, and the refuse, drained of its water, dumped on a pile on the mine property. When these precautions are observed a very small stream of fresh water, usually not over 2½-in. pipe, suffices for washing purposes.

The perfection of the process of coal washing is due almost entirely to the efforts made in this direction by Mr. Carl Luhrig, of Germany; but others have labored in this line, and it will be of value in getting an understanding of the perfection of the Luhrig system to review in a cursory manner some of these other efforts before passing on to the description of a Luhrig washery.

Among mechanical appliances for the washing of coal probably the most primitive consists of a long wooden trough divided by low cross dams at intervals. This sluice is given such an inclination that the water has sufficient force to float the coal over the dams, while the heavier pieces of slate and pyrites are retained and removed at intervals with a rake.

Another appliance consists of an inverted cone-shaped receptacle. Water is forced into this tub near the apex at the bottom, and flowing out at the top it floats over the coal, allowing the slate and pyrites to settle and be removed at intervals by means of valves. In order to facilitate the separation, stirring-arms are put in the tub to keep the water and coal agitated, and so aid the separation.

A percussion table has been used with some success. It consists of a shallow wooden chute or table about 8 ft. long and 3 ft. wide, with sides 6 ins. high. This is made slightly concave upward and suspended by rods in an almost horizontal position. The bottom consists of a sheet of galvanized iron; above this, about 1 in. clear, is a false bottom made of wooden riffles. These riffles are placed close together, with a space of 1-32-in. between, and have their upper edges, pointing toward the higher end of the table, sharpened by the insertion of a piece of sheet metal. This table is allowed to fall forward, and then is thrown back violently against a bumping post. As the coal and water in a mixed stream flow on to the higher end of this table, the upward bumping action throws the heavier particles, which settle down so the riffles can act on them, up and off the higher end of the table, while the clean coal and water flow off the lower end. The receptacle between bottom and false bottom being filled with water, aids the separation and allows the removal of the finer refuse.

All of these appliances have been used with some success, but they are all wasteful of coal and water, their results on different coals cannot be assured in advance, with any reasonable degree of certainty, and they have never been developed into any complete system. Nothing but a running stream will supply the trough washer with water. The inverted cone is tolerably effective with the larger sizes of coal, but inefficient in dealing with smaller sizes and dust. The percussion table requires such careful watching to keep the supplies of coal and water balanced that it is very difficult to keep regulated. The form of the table also requires changing to suit different coals, and as this can only be determined by actual experiment the installation of such a plant proves very troublesome.

By far the best results that have been obtained have been reached by means of various forms of the old Hartz ore jig. The jig consists in general of a box divided vertically into two compartments from the top to a point below the water line. In one of these compartments a plunger plays up and down. The other compartment is closed near its bottom by a screen. Coal is placed continuously on the screen near the partition and water is forced into the back of the other compartment below the plunger. The action of the plunger imparts a pulsating motion to the water, which, acting upward through the meshes of the screen, lifts the lighter parts, allowing the coal to flow out of the front of this compartment near the top, while the slates pass out at a point lower down.

Mr. Luhrig conceived the idea of using pieces of broken feldspar on the screen when fine coal is to be washed. This has proven very successful on fine coal. The refuse which in this case passes out of the bottom of the jig has to pass through the interstices of the feldspar in a tortuous way, and the pulsating water has thus abundant opportunity to act on the mass and lift out the lighter particles of coal.

These jigs have been made in various ways, represented in this country by the so-called Deischer, Stutz, and Stein washers, all the same in principle, but differing in essential details from the Luhrig jigs. It must be kept in mind, however, that success in coal washing does not depend so much on individual machines and appliances which can be made in any good machine shop as it does on the process and the system upon which the whole plant has been built and is operated. The nature of the coal must in every case be taken into account, the purposes for which it is to be used, and the plant designed accordingly. It follows that every plant is different, and imitation of previously carried out plans is generally faulty and disappointing. It is therefore advisable to place the design of washing plants into the hands of an expert who, by training and experience in this particular line of work, is qualified to so systematize and arrange the plant to meet existing conditions as to produce the best results.

The perfection of the Luhrig system of coal washing was the life work of Mr. Luhrig among some of the most dirty and difficult coals of Europe. The system, after being perfected in Germany and covered in its essential details by letters patent, was introduced into England and Scotland, by the Messrs. Merry & Cuninghame at their collieries. Its work at these places was so effective and so far in advance of the results obtained by other processes of washing that it is now almost exclusively used in Great Britain.

Messrs. Cuninghame & Co., controlling the Luhrig patents in the United States and Canada, have introduced the system into this country, and have built successful Luhrig washeries at Carterville and De Soto, Illinois; Belt, Montana; and Union Bay, Vancouver Island. A six-hundred ton plant for coking coal is now building at Greensburg, Pa., for the Alexandria Coal Co.'s Crabtree mine. (Here follows a detailed description of this plant.)

Special attention is called to the following features of this plant: First, the extreme and careful grading into eleven different sizes, and washing each size in a jig especially made and adjusted for it. Second, the washing of the nut coals before crushing to take out the intermediate product. Third, the arrangement of the whole plant with a view to minimizing labor, three men only being required to run it. Fourth, the effective arrangement for settling the water, and the automatic and continuous removal therefrom of sludge and refuse, clarifying the water, and saving all the fine coal dust. Fifth, the effective arrangements for drying the washed coal.

When the matter of washing the Crabtree coal came up for consideration a sample of the coal was selected by the representative of Cuninghame & Co., great care being taken to have the sample represent as nearly as possible the average run of the coal. Part of this was hand-washed, and analyses made of both the washed and unwashed portions. The following results were obtained:

No of sample.	Size.	Kind.	Ash, %	Sulph., %	Phos., %
1	⅛-in. to ⅜-in.	Unwashed	10.35	1.098	0.032
2	" " "	Washed	6.88	0.604	0.025
3	1-16-in. to ⅛-in.	Unwashed	10.60	1.139	0.027
4	" " "	Washed	6.213	0.617	0.025
5	Under 1-16-in.	Unwashed	12.400	1.606	0.033

Specific gravity of bone coal...... .... 1.39%
Specific gravity of pure selected coal.............1.27%
Fixed ash in pure selected coal.................. 2.54%

A previous ultimate analysis of a sample of this coal gave the following results:

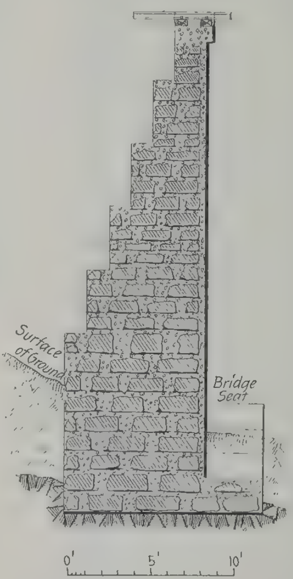
	Bone %.	Pyrites %.	Slate %.
Moisture	1.150	....	....
Vol. matter................	26.900	....	....
Ash......	21.080	....	....
Sulphur..	0.549	28.28	1.098
Fixed carbon..	50.321	....	....
Phosphorus	0.072	0.05	0.017
Sp. gravity	1.552	....	....

It is expected that the washing of the coal at this place will be so thoroughly done that the ash in the coke made from the washed coal will be below 10%, and the sulphur below 1%. That this may be confidently expected will be readily apparent when we consider the wonderful results achieved at Union Bay, B. C., where the ash is reduced from 35.5% to 8.5%. The fixed ash in this Comox coal is 7.8%, thus showing that the coal washed to within 1% of the fixed ash in the coal.

The Luhrig system, though comparatively new in this country, is no new thing. Over 200 plants are in daily use in England, Germany, Austria, and other parts of the world, all doing good work. Several of these plants have capacities of 175 tons per hour each. Such is the control which an expert operator has over the results that the Messrs. Cuninghame & Co. are enabled to fully guarantee beforehand the exact results which will be obtained in washing any coal by this process.

STONE FILLED CONCRETE PIER.

The construction of the Cascade bridge, at Burlington, Iowa, was ordered on June 15, 1896, and the work was completed on Sept. 15, 1896, in 92 days. The plans were made in the City Engineer's office, with Mr. Emmet Steece, Assistant City Engineer, in direct charge, and from Mr. Steece are obtained the following details concerning this work.



Section of Concrete Pier for Cascade Bridge, Burlington, Ia.

The piers and abutments were to be built entirely of concrete, and this was done after ordinary methods, except for the last abutment alone. All except this abutment were finished by Aug. 15 and work was commenced on this abutment on Aug. 17. But as it was desired that all work should present the same appearance and the time for placing the metal work was near at hand, it became necessary, for this particular abutment, to devise some means of hastening the work of construction. The previous plan of operation was too slow, as depositing and tamping concrete in 6 to 8-in. layers consumed time; and to attempt to increase the depth of the layers was to endanger the good character of the work. In this emergency Mr. Steece suggested the method here illustrated, and the abutment was completed in 7 days.

The method adopted was as follows: Concrete, made of 1 part cement to 2½ parts of sand and 4½ parts of broken stone, was first deposited in a 4-in. layer. Upon this bed were laid, in a full bed of mortar, wetted rough stone, with the points and projections alone broken off; the spaces between these stones were not less than 6 ins. wide nor less in width than two-thirds the thickness of the thickest stone at the joint. The concrete was then rammed into these spaces and the whole was covered with another layer of concrete not less than 4 ins. thick. In this manner from 40 to 50 cu. yds. of concrete were deposited in a working day of ten hours by a force of 28 men.

The cost of this masonry per cubic yard was as follows:

Item	Quantity	Cost
Saylor's Portland cement, ...	0.82 bbl. at $2.60	$2.14
Sand	0.22 cu. yd. at $1.00	.22
Broken stone	0.52 cu. yd. at 94 cts.	.49
Water		.07
Labor	$1.50 per day of 10 hours	1.19
Large stone	0.38 cu. yd. at 63 cts.	.24
Foreman		.09
Total cost per cubic yard		$4.44

The total cost of the 278.2 cu. yds. of masonry was $1,235.21, though this cost does not include the excavation nor the lumber used in the forms; the latter were employed again in the construction of sidewalks and box drains in the immediate vicinity. The broken stone had to be hauled two miles, and the charge for hauling alone is given. The city owns a quarry near the bridge site; but as there was no crusher near it would have cost $2 per cu. yd. to quarry the stone and break it by hand. With a more reasonable cost for the materials Mr. Steece believes this work could have been done for about $4 per yard. The work looked well, though the labor was unskilled; a competent foreman alone being necessary.

This method of reducing the cost of concrete work by imbedding in it large stone, is, of course, not novel; as it is often employed in the construction of dams and other large concrete structures. it was done to a large extent in the building of the Vyrnwy dam for the Liverpool water-works. From the thickness given to this retaining wall, by Mr. Steece, it must be assumed that it is intended to well ram and consolidate the back filling. Even then the thickness is less than a good masonry wall would call for.

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GANTRY CRANE OF 200-FT. SPAN AT THE STRUCTURAL IRON YARD OF THE CAMBRIA IRON CO.*

By John W. Seaver, M. Am. Soc. M. E.**

In the latter part of the year 1895, the Cambria Iron Co., of Johnstown, Pa., decided to construct a storage and loading yard for their proposed new structural mill at Johnstown, Pa., and invited several engineering firms to submit estimates and designs for a plant to handle the material that it was intended to store and load in this yard.

Among the firms invited to submit proposals, that with which the writer is connected took up the matter at once, and gave it a great deal of very careful study. The yard it was designed to cover—400 by 800 ft.—was so large that it was evident from the beginning that unless some very economical form of construction should be proposed, the expense of covering the area would be very great. There are several methods by which the desired object can be attained, and each plan was carefully considered and its objections and advantages compared.

A very simple way of covering any area is by the use of stationary derricks with swinging jibs. This, while probably the cheapest construction, is at the same time the most objectionable, on account of its requiring a large number of derricks to cover the surface. In fact, swinging derricks cannot be arranged so as to cover the whole yard, as there is necessarily a considerable area around the foot of the derrick that is unavailable. These objections caused this plan to be dismissed.

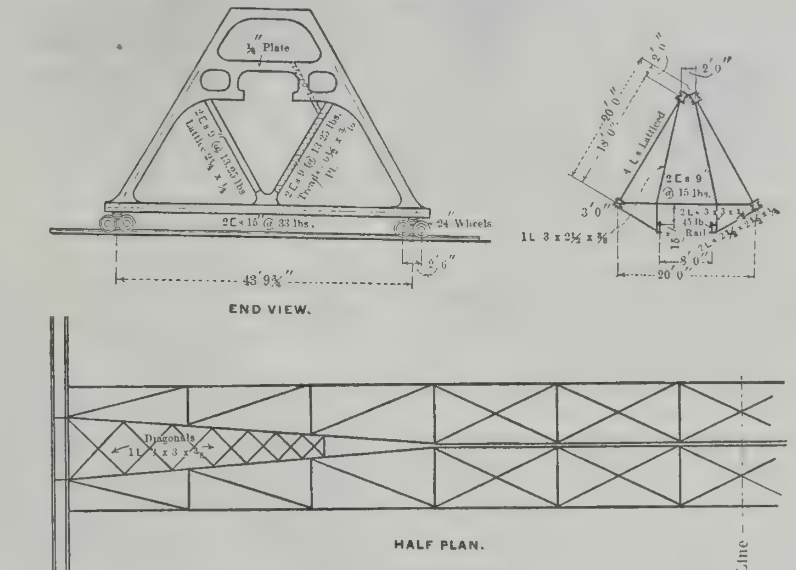
The next plan that was considered was a system of surface tracks, between which the material to be stored would be piled, and on these tracks a number of locomotive cranes could be placed. Two of the objections against the plan of the stationary derrick system could very properly be raised against the second plan with even greater force, as the tracks upon which the locomotive cranes would travel would occupy a very large portion of the yard. The locomotive cranes would be very expensive, and their range of length of jib is quite limited.

A third form of construction, and one that seemed to offer several advantages over the first two plans, consisted in a series of overhead tracks, running parallel to the length of the yard, and mounted on these tracks were to be a number of overhead traveling cranes of the ordinary type. Against this plan could be urged the fact that the supports themselves would take up more or less room, and the foundations, columns and stringers for these supports would be very expensive, and it was proposed to make the cranes of exceptionally long span (100 ft. centers of supports). This span would make the overhead ties or bracing very expensive. Dispensing with the overhead bracing would necessitate the columns supporting the overhead tracks to be sufficiently rigid in themselves to maintain the tracks in perfect alinement, and, in addition to this, they would require exceptionally heavy and good foundations and anchorages. The cranes themselves would be expensive, and, should the surface of the whole yard be covered, which would necessitate four cranes, each 100 ft. span, it would mean the employment of four operators—one for each crane. These were the principal objections to the overhead crane system, but they were deemed sufficient to cause the rejection of this plan in favor of the "gantry" crane system.

This plan contemplates the use of two traveling cranes, each 200 ft. span, running upon tracks on the surface of the ground, parallel to the length of the yard, so that the two cranes cover the whole surface, with the exception of three spaces, one 5 ft. wide down each outside edge of the yard, and one 10 ft. wide down the center. There is one line of track down each outside edge and two lines of track down the center. It was proposed to mount the cranes upon end frames or legs, making them what are commonly called "Gantry Cranes," and to make the legs or end supports of sufficient height to allow a train of cars, with men on top of same, to pass freely underneath. For this purpose the clear height from the top of the rail to the underside of the stringer that the crane trolley traverses was fixed at 20 ft., and as the height from the surface of the yard to the top of the rail is 14½ ins., a clear height from the surface of the ground to the underside of the crane of 21 ft. 2½ ins. is obtained.

The magnitude of these proposed gantries caused the matter to be most carefuly considered, both by the Cambria Iron Co. and the Wellman Seaver Engineering Co. After a thorough examination of the plan proposed by the latter they were awarded the contract.

The firm, before submitting their proposal for this crane, very carefully considered all the various forms of cranes, both of the regular traveling and the gantry types that are at present in use, and, after a thorough investigation of the different types, decided upon a form of construction that they believe to be entirely original. It consists of two main girders of the Pratt type, with vertical posts and diagonal tension braces, the bottom chord being straight, and the top chord parallel to the bottom chord for about one-half its length, and then inclining to the end posts of such an angle that the depth of truss at the ends is one-half that at the center. These two main trusses are framed together at an angle of 60°. The top chords have their parallel portions connected with splice and tie plates. The bottom chords are parallel to each other, and separated a distance of 20 ft. The main trusses are 18 ft. deep at center and 9 ft. deep at the ends.



MAKE-UP OF STRUCTURAL FRAMEWORK OF 200-FT. GANTRY CRANE.

This peculiar form of construction gives the arrangement of the main trusses the appearance of a steep-hipped roof, very long in proportion to its height. A cross section at the center is that of an equilateral triangle, and the cross section of any point between the end posts and where the top chords join each other is that of a trapezoid. Suspended beneath the bracing that separates the bottom chords is a runway for the crane trolley to travel on. This runway consists of riveted I-beams, with T-rails secured to their upper flanges.

The stringers are very rigidly braced to the chords of the main trusses, not only at the panel points, where they were suspended, but also at the middle of each panel.

The horizontal bracing between the trusses consists of a series of floor beams, firmly riveted to the posts of the trusses, and forming the struts of the lateral system.

The diagonal members consist of angle irons riveted to wing plates secured to the trusses and floor beams, these wing plates being bent to conform to the angles of the floor system and the trusses. To prevent any cross strains of the struts resulting from the live load (the weight of the stringers and trolley), it is taken directly from the stringers suspenders up to the top of the posts of the main trusses by means of diagonal suspender angles. These angles also form posts for the attachment of a line of hand railing.

Resting on top of the floor beams are two lines of channel irons parallel to the main trusses. These channel irons form stringers for the foot walk, which extends the full length of the crane. The walk is made of two thicknesses of pine plank with tar paper between. The floor beams also carry the pillow blocks for the main shafting. At the ends of the crane, and in the plane of the trusses, are carried down riveted legs, or supports of box form. These legs are firmly braced to the bottom chords of the main trusses, with large plate iron brackets, well stiffened with angle iron flanges. The legs are also braced to each other crosswise of the crane, with a system of horizontal and diagonal braces, with a stiff tie-beam at the foot of the legs.

The width c. to c. of the trucks supporting the crane is 43 ft. 9¾ ins., forming a wheel base for the crane of a little more than one-fifth of the span, which is sufficient to square the crane on the tracks.

The end frames are formed of plates and angles, arranged so as to present a smooth end surface, the corners of the openings being filled in with curves of large radii.

The top chords are made of two channel irons with a cover plate on top, and latticing on the bottom. The bottom chords are made of two channel irons, latticed on top and bottom, so as to afford no room for lodgment of moisture; this point being carefully kept in view throughout the construction.

The vertical posts of the trusses each consist of four angle irons latticed together. The diagonal members of the trusses are each formed of two angle irons riveted at their intersection. Particular care was paid to the connections of all members.

The loads and strains adopted for this crane were as follows: A live load for trolley equal to 20,000 lbs. To this was added, for impact, 25%, or 5,000 lbs. The weight of the trolley was estimated at 23,000 lbs.—making a total of 48,000 lbs. distributed on four wheels, spaced about 9 ft. centers, bringing a reaction upon each stringer support of 18,000 lbs.

To still further provide for any sudden application of a live load, it was assumed to be equal to 22,000 lbs. applied at any panel point of bottom chord of each truss.

This is largely in excess of any load that will come upon the crane; but it was considered advisable to use it, in view of the fact that the load might catch, thereby bringing a greatly increased weight upon the trolley.

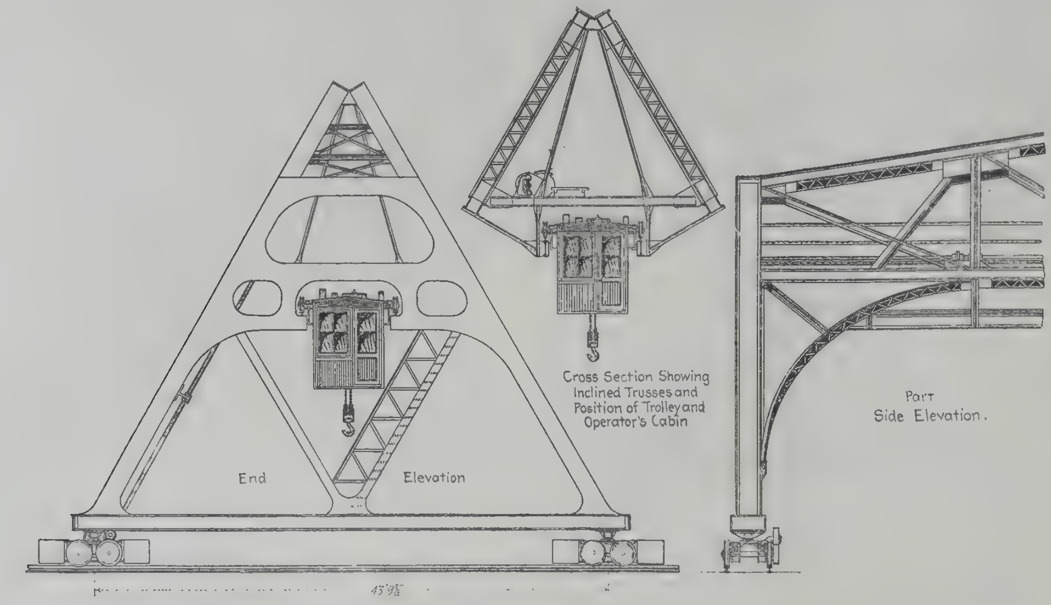
**The Wellman-Seaver Engineering Co., Cleveland, O.

*A paper presented at the New York meeting of the American Society of Mechanical Engineers.

The dead load, weight of trusses and floor, was assumed at 88,000 lbs. per truss, or 8,000 at every point of bottom chord of each truss.

In order to provide for a very large factor of safety in the bottom lateral system, a wind pressure of 20 lbs. per sq. ft. was assumed, or a load of 5,000 lbs. at each panel point of bottom chord. To resist these combined loads, the following limitations of strains were adopted:

For live loads: Tension	12,000	lbs. per sq. in. net section
Shear	6,000	" " " " " "
Compression	10,000	" of gross section
Bearing, rivets and bolts	12,000	" per sq. in.
For dead load: Tension	15,000	" " " " net section
Shearing	10,000	" " " " " "
Compression	12,000	" " " " gross sec.
Bearings, rivets and bolts	15,000	" " " "


Cross Section Showing Inclined Trusses and Position of Trolley and Operator's Cabin
Part Side Elevation.
End Elevation
45'9½"

END ELEVATION AND PART SIDE ELEVATION OF FOOT OF CRANE.

In all the compression members a proper reduction of the strains was made in all long members, so as to insure the same general factor of safety throughout, and the strains in the bottom lateral system were still further reduced to 10,000 lbs. per sq. in. in tension and 8,000 lbs. per sq. in. in compression. All of these strains are largely in excess of what the writer would recommend for an ordinary crane construction; but the ratio of dead load to live load is so great that it was necessary to observe the greatest possible economy of material to avoid the crane being so heavy that it would be impracticable.

The truss members were not all proportioned to comply exactly with the areas that the above limitations of strains called for. They were never made of less sections, and in several cases the section was increased in order to obtain the necessary stiffness. This will account for the seemingly largely increased area of some of the members over that required by theory.

The minimum speeds of the various motions of the crane are as follows: Traverse of main bridge, 200 ft. per min.; traverse of trolley, 400 ft. per min.; hoist with full load, 20 ft. per min.

The crane rests upon four trucks; each having four steel tired double flanged wheels, 24 ins. in diameter. The wheels are keyed to steel axles, 5 ins. in diameter. The gage of the track is 3 ft. 6 ins. centers of rails. The journals are 5 ins. in diameter, 7 ins. long, fitted with bronze bearings carried in cast-steel oil-boxes, with ample provision for lubrication. The wheels on one truck at each end are connected by means of a system of shafts and bevelled gear wheels. The gear wheels are steel castings, and are of extra heavy design throughout. The shafting from one truck to the other is 4 ins. in diameter. The couplings are all rigid flanged couplings, tightly keyed to the shafts, and fitted with turned bolts of a tight driving fit. The main shaft, extending the length of the crane, is carried in universal bearing pillow-blocks of very heavy design. These pillow-blocks are bolted to the cross-beams of the floor system, with packing pieces between them and the beams, and are lined up perfectly true and level. The thickness of the packing pieces vary to suit the requirements of each individual pillow-block.

The end bearings, where the main shaft is geared to the diagonal shafts that connect it to the trucks at each end, are carried by compound boxes, so that it is impossible for the main and angular shafts to get out of line.

Special care has been taken with all the bearings to provide ample facilities not only for the lubrication, but for the inspection and removal of any part. For most of the bearings compression grease-cups have been supplied, in addition to the usual lubricating holes and reservoirs.

The top of each truck carries a steel socket or cup, and in this socket is placed a hard steel ball, 6 ins. in diameter.

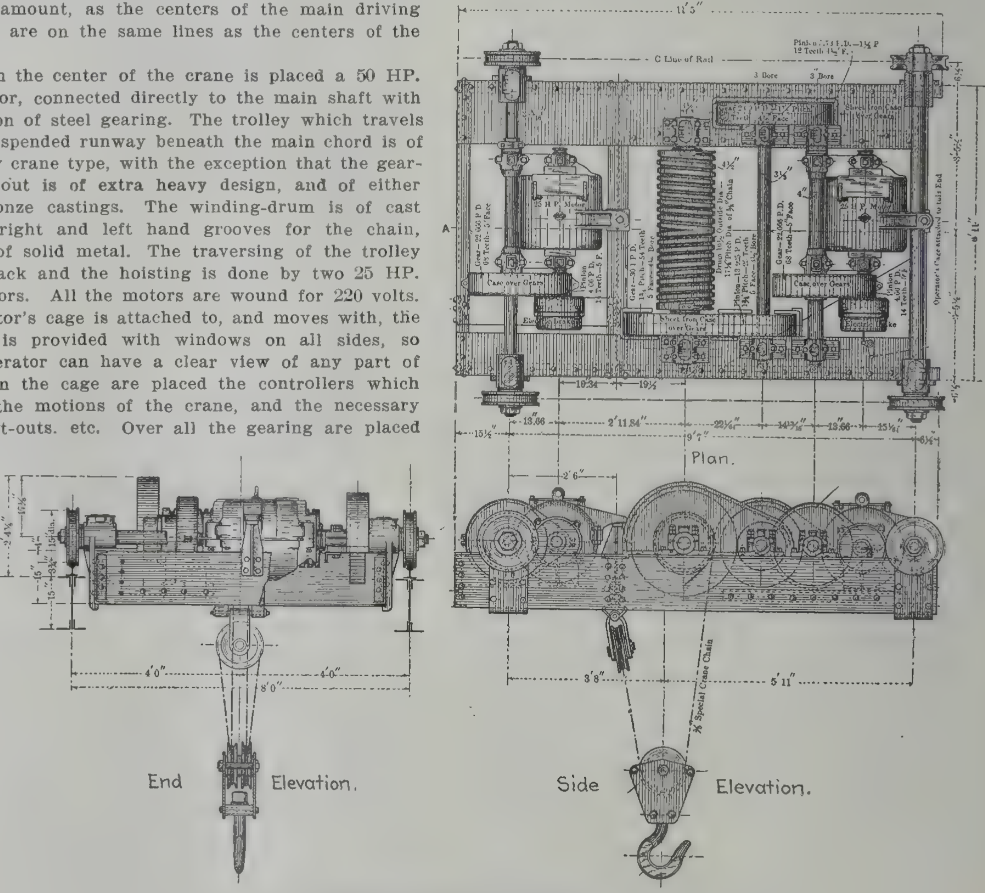
The bottom of the end supports are also provided with corresponding cupped sockets. The ball rests in a slightly elongated groove; the major diameter of the groove being crosswise to the center line of the truck, and the minor diameter being parallel to the track on which the truck rests. By means of this elongation of the groove, the ball is allowed a slight motion at right angles to the center line of the track on which the truck travels, and this permits of the expansion and contraction of the main girders of the crane. It also allows the trucks upon which the crane travels to be slightly out of alinement, as the balls form universal joints between the trucks and the crane. The arrangement of the gearing connecting the driving shafts to the trucks is such that the vibrations of the trucks around the centers of the balls do not disturb the alinement of the gearing to an appreciable amount, as the centers of the main driving spur wheels are on the same lines as the centers of the balls.

Directly in the center of the crane is placed a 50 HP. electric motor, connected directly to the main shaft with one reduction of steel gearing. The trolley which travels upon the suspended runway beneath the main chord is of the ordinary crane type, with the exception that the gearing throughout is of extra heavy design, and of either steel or bronze castings. The winding-drum is of cast iron, with right and left hand grooves for the chain, milled out of solid metal. The traversing of the trolley upon the track and the hoisting is done by two 25 HP. electric motors. All the motors are wound for 220 volts.

The operator's cage is attached to, and moves with, the trolley. It is provided with windows on all sides, so that the operator can have a clear view of any part of the yard. In the cage are placed the controllers which govern all the motions of the crane, and the necessary switches, cut-outs. etc. Over all the gearing are placed coverings or housings that are readily removable, the coverings being arranged to exclude all moisture or dust. The motors are also encased.

Attached to each truck are two snow-plows, or guards, made of plate stiffened with angle irons. These snow-plows are easily removable, so that access can be had to any part of the trucks.

The end frames are so arranged that should it be desired to transfer a load from one side of the yard to the other, both cranes can be brought in line with each other by means of removable stops on the trucks, and the trolley from either crane run directly through the end supports and on to the track on the other crane.



DETAILS OF CRANE TROLLEY.

THE BUSINESS WISDOM AND RESPONSIBILITIES OF THE ENGINEER.*

About twenty years ago a railway in Illinois became insolvent and a receiver was appointed to take charge of its affairs. To reduce expenses the receiver began by reducing the number of employees, and the first to go, as usual in such cases, was the engineer and all his tribe. For a number of years the road was operated in a cheap, hap-hazard sort of way, when it was sold to an Eastern syndicate, who took immediate steps for reorganization. and I was appointed engineer in charge to rebuild the road. My first work was to thoroughly inspect the entire property and determine what was immediately necessary to make it safe for traffic and also remunerative. I found that the roadbed, bridges, buildings, etc., had deteriorated beyond redemption, that the whole line must be rebuilt. At this time the road had been for about five years in the hands of a receiver, a lawyer.

I labored hard and faithfully for six years, putting the entire road and its branches into first-class condition, and under its excellent management it has so remained to this day. For my services I received about $12,000.

The lawyer remained with the road some years longer than I did. When it passed out of the hands of the master-in-chancery, by which act the office of receiver was abolished, the court ordered that the lawyer be paid from the proceeds of the sale of the road the sum of $125,000.

Now, I do not cite this as a disparagement to lawyers, but as an example of the generally recognized value of a lawyer's services, and it also demonstrates the tenacious grasp with which a lawyer holds upon all properties which he is called upon to control and manage.

This railway property deteriorated under his management. He placed few betterments upon it. Had he employed a competent engineer, much of the deterioration could have been prevented and expensive repairs avoided, besides the traffic would have been heavier and the earnings thereby increased. There were many engineers in the country (most of them out of employment at that time, for it was shortly after the great panic of 1873) who were thoroughly competent to handle the property in a very economical and remunerative manner, making it far more valuable than it proved to be when sold to the Eastern syndicate, and none of them, had the position been offered them, would have refused it at a salary of $2,500 annually. Yet, for all this, the lawyer was paid ten times more

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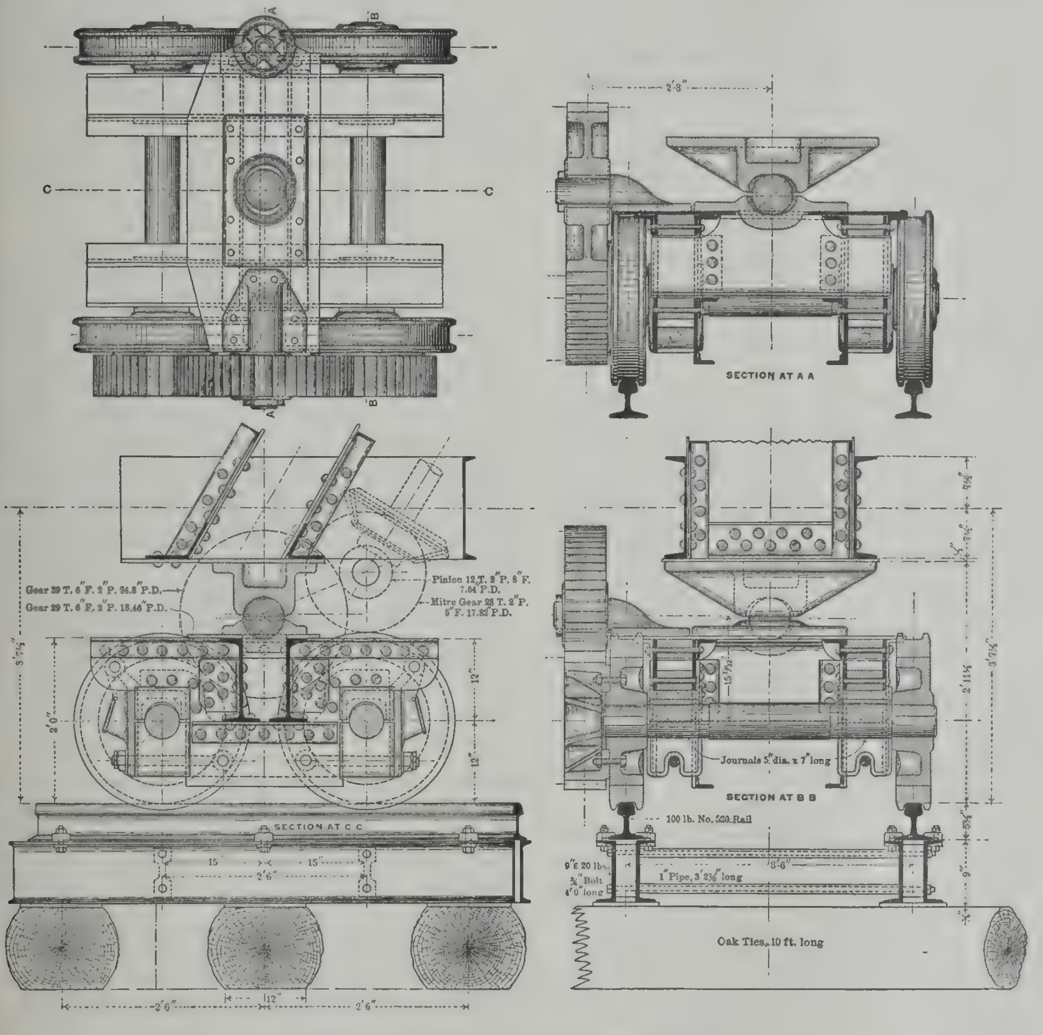
*Extract from an address by Mr. W. F. Goodhue, before the Purdue Society of Civil Engineering.



TRUCKS AND TRACK FOR GANTRY CRANE.

than was the engineer who repaired his wasteful management.

I see no reasòn why the engineer should not hold positions of equal responsibility and value with the lawyer. Lawyers hold these positions without becoming engineers, then why should not engineers attain them without becoming lawyers? If both are liberally and broadly educated their chances should be equal. I do not consider the question of natural ability at all. Bright men are not possessed exclusively by any one vocation of this busy world.

I have reasons of my own, born of a long acquaintance and daily contact with the individual, why the engineer has in so large a measure failed to hold his own in the business world, and I give them as follows: Because he is too often the slave to details. He is not always a student of human nature, and thereby fails to manage and understand men. He is too often deficient in business training, the keeping of accounts, etc., and disclaiming all egotism, he is withal a modest, diffident man, too much so for his own good. So many engineers in charge of work want to see and do everything themselves. They have a great horror of errors and mistakes, and are willing to trust nobody. Their heads are full of measurements, weights, elevations, designs, and all the ins and outs of the work in hand. They are a sort of monomaniacs on the rules of construction, and for the time being live and exist upon their work and have no thought or care for anything else. Timid themselves, they teach it to their assistants. The pent-up Utica of their daily life is the limited area of their workshop. They are seldom in the cabinet and always in the field. The lawyer is always in the cabinet and seldom in the field.

Now, a man should be commended for paying strict attention to business—it is almost the only rule of success—but should a man bury himself so deeply in its meshes that he is lost sight of? How would the battle go if the commanding general took a musket and lost himself in the ranks of his army? What would become of the ship if the admiral went below while engaged with the enemy? Victory in either case would be won by the subordinates in command. So it should be with the engineer in charge of work; let him divide the care of details with his subordinates; they will carry them out under the watchful, careful eye of the master, and he will thereby have more time to devote to the general management of the whole business. If the engineer is deeply absorbed in one set of details, he must of course neglect others, and that is what he sometimes does; he will hold firmly to all the details of construction and neglect the accounts belonging to it, which are, in the eyes of nearly all men, the essential elements of business. Some of our greatest engineers have been able business men. Captain James Eads was of this type, and so was the younger Roebling.

The engineer of to-day should be a practical business man, and it is well if he acquire his business training, partially at least, by actual contact with business methods. He should be as well versed in business as the lawyer, the contractor and the makers and dealers in materials, as he is brought daily in contact with one or more of these persons.

Municipal methods of voting and issuing improvement bonds of various kinds are well worth studying, because nearly all consulting engineers depend upon the issuance of bonds for employement, and it is not pleasant to be thrown out of remunerative work because of a faulty issue of the bonds which are necessary to provide the funds to carry it on. By giving attention to such matters the engineer soon becomes not only proficient in the details of issue and form of bond, but is a very competent judge of what constitutes a legal, solvent bond, and oftentimes can serve his own interests well by pointing out defects, which if allowed to pass unnoticed would defeat their legal issue, and a defective bond issue is quite a common occurrence among our smaller towns and cities. There is not a business or legislative body in the world that can equal the average common council for making serious blunders, and when they do blunder it is generally an expensive affair. Everybody connected therewith suffers more or less either in pocket, or in disappointment because of the resulting delay occasioned, excepting the members of the council, who have no responsibility in the matter at all and cannot be held accountable. They, perhaps, voted as best they knew, and there seems to be no legal form of indictment which can arraign such a condition of mind.

Nowadays wherever you find the common council there you will also find the city engineer, and I must say that I do not always find that sweet harmony which should prevail between them, and it is not to be expected. The rock upon which they most generally split is the difference between good and cheap work. The engineer has perhaps prepared his plans with great care, and when submitted to the council the first thing it wishes to do is to cheapen the cost, and if the engineer won't submit to the pruning process his plans are rejected. The aldermanic line of reasoning seems to be that if the work is not just as strong and durable after the cheapening process, then the plans are defective and the engineer is incompetent.

Upon one occasion I well remember sitting in a council chamber and witnessing a common council voting a form of sewer assessment of doubtful legality, directly against the advice of the city attorney and engineer, and had not the act been subsequently vetoed by the mayor, not one cent of the large assessment could have been collected by the city. Later one of the aldermen said to me: "We voted that assessment act simply to show the city attorney and engineer that they could not run this council." Yet the attorney and engineer both were advising in good faith, and without prejudice, but the minds of that council were not sufficiently elevated to appreciate a firm, disinterested opinion from those who had thoroughly investigated the matter and were well qualified to give their opinions.

This is a fair instance of the stubborn prejudice and ignorance combined which will confront the engineer in his life work. If he is a sensitive, timid man, he will bow before it; if he is brave and resolute, he will hold his own to the end, but will in the meantime receive many knock-downs of humiliation and discouragement. He will find that all bodies of men banded together to build and develop a great property are very much alike, whether it be a board of railway directors, the stockholders of a manufacturing concern, or the common council of a city. These men are not of his kind, they do not comprehend his work, his knowledge nor his methods of reasoning; they are impatient for results, paying results, and will not submit kindly to delays which affect such results, therefore the engineer must be patient with them; he should explain little and offer few apologies, but do all that he can to push the work along to completion; let his actions speak for himself, and these ebullitions of unreasonable impatience will soon pass away. To lose his temper and leave the work upon such occasions is to acknowledge defeat and would be a foolish act, for the next work he may engage would be perhaps quite similar and under the same sort of direction, thus he would be no better off than before.

The engineer must remember that the men, the capitalists who furnish the money and who are directors of many of the great works built and operated in this country are not technically educated men; they are mostly merchants who have acquired fortunes and are seeking investments for their surplus wealth. They are generally first-class business men themselves and it frets and annoys them when they learn that the engineer that they employ is not also a business man. It is a condition they cannot quite understand, because they are unused to such men. Therefore it is quite necessary that the young engineer should go to his life work fully prepared and equipped to meet these men on their own ground; by doing so he will avoid much that is disagreeable and he will also be more successful than have the engineers of this generation who are notoriously unbusinesslike.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Mining: The Right of Support.

Where the mineral estate in land is severed from the surface by a conveyance, the owner of the former is bound to leave enough of the mineral in place to support the surface, unless the owner of the latter has released his right of support. The release must be by express words or by necessary implication.—Robertson v. Youghiogheny River Coal Co. (Supr. Ct. of Penn.) 33 At. Rep., 706.

Right of Gas Company to Make Reasonable Charges.

When a corporation is chartered with the right to manufacture and sell gas, the right to charge a reasonable rate for all gas furnished is implied, and forms a part of its contract with the state, which cannot be impaired by legislation.—Cleveland Gaslight & Coke Co. v. City of Cleveland (U. S. Cir. Ct. of Ohio), 71 Fed. Rep., 1610.

Negligent Construction of Water-Works.

A water-works company is liable for the damages resulting from the fall of a water tower negligently constructed on its own premises; and where the tower fell and the water therefrom rushed upon a house, overturning a burning lamp, whereby a party was fatally burned, the damages sustained are not too remote in an action brought by the surviving wife and child.—Rigdon v. Temple Water-Works Co. (Ct. Civ. App. of Tex.) 32 S. W. Rep., 828.

Rights of Elevated Road in Streets of City.

An elevated railway company has such a property right in its structure lawfully erected in a street as cannot be damaged by a city without compensation. The construction of a viaduct along a street for the purpose of relieving the traffic along such street is not a mere change in the grade of a street, and an elevated railway company whose structure is interfered with by the viaduct is entitled to compensation.—Manhattan El. Ry. Co. v. City of New York, 35 N. Y. Sup. Rep., 505.

Change of Street Grade: Damages.

Where a city has by ordinance established a new grade of a street, but has done nothing towards raising the street surface to conform to it, a street railway company, which is granted the right to construct a track through the street, is liable to abutting property owners for damages resulting from laying the track at the latter grade, in the absence of an express provision authorizing the act. Stritesky v. Cedar Rapids (Supr. Ct. of Ia.) 67 N. W. Rep., 271.

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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

Since the publication of our issue of Dec. 3, in which some further reference was made to the work of the Baltimore topographical survey, we have received several letters continuing the controversy upon this subject, which space does not permit us to publish. We are also in receipt, however, of a letter from the Mayor of Baltimore, who is the head of the commission in charge of this work, in which he says:

> The so-called investigation was not authorized, nor have its findings been considered by the commission. The gentleman against whom the charges have been made is still in the position, and at present we have no disposition to remove him for alleged imperfect work.

It appears from the information now before us that the investigation (on which the comments in our issue of Nov. 12 were based) was conducted by a committee of the city councils, which has, as we now understand, no authority whatever over the work. This fact was unknown to us when we made our original study of and comments upon this investigation. Had we been aware of it, we should not have printed its conclusions or based our editorial opinions upon it. The only proper authority to investigate the Baltimore survey, it appears to us, is the commission in charge of the work or the authority which created that commission.

In view of these circumstances we desire to formally withdraw our comments on this survey made in our issue of Nov. 12, and to express our regrets that we were misled as to the non-authoritative nature of the investigation.

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A correspondent asks us to suggest topics for college theses in the field of bridge and structural engineering on which investigations would be interesting or useful to the profession. The request is rather a difficult one to fulfil. There are plenty of subjects in this field on which more knowledge is desirable; but in most cases investigations of the results of actual practice, extending over a long series of years, are needed rather than theoretical studies or investigations which can be made in the short time available for a thesis investigation.

Bridge structures of the standard types have been so exhaustively studied that a college student with the time and means at his disposal can hardly hope to add anything valuable to professional knowledge in that field. There is more opportunity, it appears to us, in investigating the applications of iron and steel in building construction. No one who has witnessed the enormous growth which the past few years has seen in the use of iron and steel in buildings can doubt that in the near future we are to see a very large proportion of our stores, mills, and even the better class of residences constructed with steel framework, and the solution of the problems in connection with this new use of steel shapes is likely to have practical value.

For example, there are already a great number of shops and factory buildings constructed with steel framework, and with no attempt at fireproofing. If the reader will turn to page 5 of our current volume, he will find that such a structure may collapse under even a very small fire. Instead of being a good construction to resist fire, as has been supposed, these structures are apparently even more easily injured by an interior fire than if they were built with wooden in place of iron columns.

The question is, what can be done to such structures to render them reasonably fireproof. The expense of ordinary fireproofing systems makes them out of the question; but may it not be possible to apply to the principal members of such structures something in the shape of a non-conductor or fire retardent which should effect the desired end? There are on the market a number of fireproofing paints, and fireproofing solutions. Descriptions of a great number of others can be found in the patent office records. Experiments with samples of these substances obtained from the makers or made up in the college laboratory might be exceedingly valuable in indicating the probabilities of success with constructions of this type.

Again, recent experiments have shown remarkable fire-resisting qualities in concrete. It would be a very useful task to investigate the effect of different cements, different aggregates, and different proportions upon the fire-resisting qualities of concrete. It may be that a thin coat of cement plaster, spread on a very cheap and light wire lathing could be made a fairly effective fireproofing for the frames of iron shop buildings.

We mention the above merely as suggestions; other topics in this field will doubtless occur to many of our readers. For subjects for investigation in bridge engineering, a fruitful topic might be found in some of the types of bascule bridge, and a comparison of the weight of their metal work and machinery with the weights of swing bridges of similar span.

◆

In a note in our "Construction News" supplement in our issue of Dec. 3, the fall of a bridge near Ensley City, Ala., was noted, and the name of Mr. P. S. Milner was given as County Surveyor, not with the idea that he was in any way responsible for the disaster, but merely in accordance with our usual rule to give the name of some official whom contractors and others in search of business may address. As a matter of fact we learn that Mr. Milner had nothing whatever to do with the structure which failed. It was under the charge of the County Superintendent of Public Improvement, an office entirely separate and distinct from that of County Surveyor.

In another item, which recently appeared in our "Construction News" columns, the defeat of bonds for sewer construction in a Massachusetts town was noted and the item concluded with the name of the chairman of the town committee on sewer construction, merely for the convenience of those who might desire to write for further particulars. The gentleman whose name was given, however, in a personal letter to us expressed the fear that the item might be construed as meaning that he was in some manner responsible for the defeat of the proposition. To guard against any mistakes of this sort by those who follow our "Construction News" items, we may say explicitly that the giving of names in connection with these items is done simply as a guide and for the convenience of those who use these items for business purposes; and no other significance whatever attaches to them.

SOME PLAIN WORDS ABOUT CITY GAS SUPPLIES.

In three great cities at the present time the question of gas supply is a subject of public discussion, and in each of them the fruits of a bad system of managing this important business are being made manifest. These three cities are Boston, Brooklyn and New York.

In each of these cities the policy has long been followed of giving franchises to a number of different gas companies in the expectation that competition between them would reduce the price of gas to a figure as low as it could be economically made and sold. Many times has the absurdity of this policy been shown. Many times has it been pointed out that it was bound to result in great injury to every city pursuing it, and that the only parties who would benefit from it would be promoters, stock speculators, and in some cases dishonest city officials. It has been shown time and again that the ultimate result of the chartering of a number of independent gas companies to operate in the same territory will be the consolidation of these companies into one organization; or if actual consolidation be prevented by court or statute, some practical form of co-operation will be devised by which the competition which was to work such benefits to the public will be stopped, and the same end will be attained.

Boston has made two separate and distinct attempts to inaugurate competition in the gas business, the history of which has recently been told in the Boston "Herald," as follows:

> When, years ago, Mr. J. Edward Addicks first made his appearance in the Boston field, and announced his intention of greatly benefiting the people of this city by the introduction of better and cheaper gas, we pointed out that the conclusion would be the union of the competing gas interests, with the subsequent exaction from the people of Boston of the money needed to pay interest upon needless, because duplicate, plants. It is doubtful if Mr. Addicks and his Bay State company would have been permitted to enter Boston if recourse had not been had to influences in securing official approval which were thoroughly reprehensible. But once in the field, and once in control of the old company, the promises made were not complied with. There was not that general reduction in the price of gas, neither was there any marked improvement in its quality. When, afterward, the Brookline Gas Co. came in as a competitor in Boston, again a demand was made calling for the spending of millions of dollars in unnecessary work, upon which expenditure the citizens would later on be called by consolidation to pay interest.
>
> In the case of the Brookline Gas Co. the competition that was permitted had the immediate effect of reducing the price of gas, a change which the Bay State company could much better have made before the Brookline company entered its field than after it was compelled to divide quite a part of its business with the newcomer.

As newspaper readers know, a consolidation has recently been effected of the Boston gas lighting companies and the capitalization has been increased to an enormous figure.

Brooklyn is another city which has tried competition in gas supply. Two years ago no less than five gas companies were doing business in that city. Since that time all these companies have been consolidated into one, and the attorney-general of New York has decided (doubtless correctly) that the state law against trusts is powerless to prevent such a consolidation.

In New York city four great corporations have for many years furnished a gas supply—the Equitable, the Standard, the Mutual and the Consolidated. No competition, at least as respects the price of gas, has existed between these companies for many years; apparently, there has been some private agreement between the several companies by which they have worked in harmony—such perfect harmony, indeed, that the price of gas was kept up by them to the enormously exorbitant figure of $1.75 per M. until it was reduced to $1.25 by an act of the legislature in 1885.

One would have supposed that the experience of the city with competing gas companies which did not compete would have taught the public something; but a half-dozen years ago a new concern came along, the East River Gas Co., and secured a franchise without difficulty, under which it has proceeded to tear up many miles of city streets, many of them newly paved, for the purpose of laying its mains. It has, we believe, sold gas at prices slightly below those charged by the other companies, and as a result a formal union of all the New York gas companies has recently been announced in the newspapers. The course of the stock market bore witness to the correctness of the announcement.

Here was another object lesson to the people of New York city and to those who are responsible for the public interests. Let us see how much effect it had. For several months past there has been before the Aldermen of New York an application for a franchise by a fuel-gas company. In the very week in which this consolidation was announced the Aldermen granted a franchise to this company by a vote of 26 to 4, and the committee which recommended the passage of the ordinance had the sublime assurance to present as a reason for the grant of the franchise that "If competition will force prices down, by all means let us have it."

The childish folly of such a remark in view of the actual circumstances is apparent enough. That the aldermen themselves are perhaps not so ignorant of the elements of municipal business principles as the above quotation would indicate is shown by the fact that at the same meeting a resolution was adopted authorizing an inquiry into the feasibility of the city owning its gas works, and in the preamble to this resolution the following occurs:

> Whereas, The recent combination between the old gas companies and the new best illustrates the futility of expecting reductions in the price of gas from the establishment of competing companies; and
>
> Whereas, This municipality has itself failed to secure cheap street lighting, because, in advertising for competitive bids for that purpose, it has been the invariable experience that there is not real competition, but that the different companies apportion among themselves the different districts of the city, and offer non-competitive bids for the respective districts.

Query: If the aldermen understand the "futility of expecting reductions in the price of gas from the establishment of competing companies," why did they proceed to grant a franchise to a fuel-gas company on terms which in several features run counter to well-settled principles that should govern the granting of all such franchises?

Fortunately, there has been during the past ten years an enormous advance in the public appreciation and understanding of the value of municipal franchises. In the case of the present proposition to give away another gas franchise in New York city, the press of the city is a unit in condemning it, the Mayor and the city's law officers are certain to use every effort to defeat it, and as it is only by a legal quibble that the aldermen can claim the right to grant such a franchise, anyway, there is a good prospect that the aldermen's action may be of no effect.

Since the above was in type the aldermen themselves have recalled the franchise above referred to from the Mayor and have referred it to the special committee on the establishment of a municipal gas supply, whose appointment was noted above. The aldermen, of course, deny that their action in granting the franchise was influenced by any motives but anxiety for the city's welfare; but they offer no explanation of the fact that a motion to make the franchise limited in duration instead of perpetual was voted down by the same vote by which the franchise was passed, and another motion to sell the franchise to the highest bidder (other companies having, in fact, already made better offers than the company to which the franchise was given) was defeated by the same vote.

Turning again to the general question, the three cities we have named have each pursued for many years the policy of competition in the gas business. What has been the result? Millions of dollars expended in laying duplicate lines of mains in the streets and building unnecessary and badly located gas works; millions of dollars expended in tearing up and relaying pavements for laying needless mains and making needless connections. Millions of dollars worth of damage done to street pavements for which the city taxpayers had to pay. Millions of dollars worth of gas lost by leakage from the badly laid mains of companies organized not to do an honest business, but to float shares on the stock market and make their promoters wealthy; and finally unnumbered millions of dollars paid by gas consumers in excessive gas rates above the price at which gas could be made and sold for under a single honest and efficient administration. Such is the net result of a half century of bad management of the gas industry in American cities.

What are the correct principles on which the gas supply of a city should be managed? Experience has developed one principle at least which can be stated without fear of contradiction, and that is that the gas supply of a city is of necessity a monopoly. Every attempt ever made to establish competition in it has resulted finally in failure, and because this plain fact has been so commonly and persistently ignored in American cities, the dwellers in them have to bear an enormous and wholly needless burden.

The cities of Great Britain and of the Continent have been far wiser in their administration of their gas supplies. There the essential monopoly of a municipal gas supply has long been recognized, and as a result the inhabitants of nearly all the principal European cities are furnished with gas at a cost of 50 to 75 cts. per M. ft., whereas, the average cost of gas to the consumer in American cities of similar size will average nearly or quite double this.

There are two general systems of controlling a city's gas supply when the monopoly principle is recognized, either of which can give admirable results. In the one, the city owns and operates its gas supply just as it does its water supply. In the other the city grants an exclusive franchise to a corporation for a limited term of years, and fixes in the franchise the quality of the gas, the prices at which it will be furnished to public and private users and the tax (preferably a percentage of its gross earnings) which shall be paid to the city. At the end of the term of the franchise the city has the option of taking the plant at an appraised valuation, and can either undertake the supply itself or make a contract with some company, either the old one or a new competitor for a new term of years.

Each of the plans above described has advantages; local circumstances may make sometimes one, sometimes the other preferable; but either is vastly better than the system which has been commonly pursued by American cities, and which is based on a false and obsolete political economy.

Unfortunately the problem before American cities at the present day is not the simple one of building anew on a correct basis. The mistakes and errors of two generations cannot be wiped out at once. The law does not annul the existing franchises because they were given away or sold for a song by an ignorant or dishonest board of aldermen a score of years ago. What each city should do, therefore, will depend on the circumstances in which it finds itself. In some cities faithful city attorneys or other public spirited officials have seen to it that no perpetual franchises were granted, and in these cities the introduction of a correct system will be a comparatively simple matter. In other cities grants have been thoughtlessly made by which companies have acquired perpetual rights to use city streets, often as a free gift. To undo this manifest wrong is a difficult task, but that it will be permitted to exist unremedied to the end of time seems too preposterous to be believed.

The experience of American cities has abundantly shown the folly of granting perpetual franchises. If the way is not yet open by which they may be annulled, we can at least prevent further folly of this sort. The organic law of every state should prohibit the grant of any public franchise for any longer period than a quarter-century. Such a provision would not interfere with any legitimate enterprise and it would save millions of dollars of "unearned increment" to the public purse.

LETTERS TO THE EDITOR.

Coal Consumption of a Gas Engine.

Sir: In your issue of Dec. 3 different opinions are expressed regarding the quantity of anthracite coal consumed per I. HP. per hour with a Dowson gas engine. In this connection I would mention the result of a test made by the City Engineer in Copenhagen, Mr. Ch. Ambh, on a Dowson gas engine manufactured by the Tuxen & Hammerick Co., Copenhagen.

The test lasted eight hours, with variable load, the engine developing from 38 to 47 I. HP.

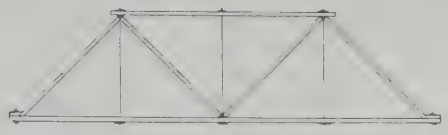
The average consumption of anthracite coal was 0.855 American lbs. per I. HP. per hour, measured in the generator.

Yours very truly,
K. Moller-Holst, C. E.

138 East 29th St., New York city, Dec. 9, 1896.

A Curiosity in Bridge Designs.

Sir: An item in your paper recently reminds me of a case where a large railway company a few years ago absorbed a small one on which "practical" men were employed rather than engineers. The resident engineer of the larger road reported that several of the bridges on the absorbed line wabbled excessively (in a vertical plane) under the passage of the trains of the large road, and a sketch of one of the bridges in question was sent to headquarters, with the report of the "engineer"—that it seemed as if the stringers had all the carrying capacity that there was in the bridge, and it was undoubtedly getting too weak to be in service. The sketch herewith shows that an engineer may be about as "practical" as the practical man.

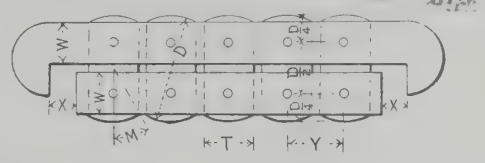


H. V. Hinckley, M. Am. Soc. C. E.

Topeka, Kan., Dec. 3, 1896.

The Design of Segmental Rollers for Expansion End of Bridge Spans.

Sir: In drawing segmental rollers for the expansion ends of bridges the dimensions indicated by W, X and Y on the accompanying sketch, must be made such that the bridge may expand or contract the required amount. I have worked out the following formulas which give values of W, X and Y, such that when the bridge expands or contracts A inches the rollers will bind in each of the three following ways:



$$Y = \frac{I}{\cos\theta}; \quad X = \frac{D}{2}\,\text{sine}\,\theta; \quad W = \frac{D}{2}\cos\theta;$$

$$\theta = \frac{A}{2}\cdot\frac{360}{D\pi}.$$

M must be equal to at least $\frac{A}{2}$ ins.

I have made tables for 6-in., 8-in., 10-in. and 12-in. rollers for necessary values of A.

Yours very truly,
F. P. McKibben.

Mass. Inst. of Tech., Boston, Dec. 9, 1896.

The Electrical Conductivity of Aluminum.

Sir: In your issue of Nov. 26 you make calculation upon the electrical conductivity of aluminum rods used by the Pittsburg Reduction Co. for transmitting the current from its generators in the power-house on the lower bank of the Niagara River to the pot-room on the upper bank of the Niagara River. These conductors are of ⅜-in. diameter, and in lengths of 350 ft. In your calculations as to the relative cost of aluminum to copper, you make the cost per pound of aluminum 1.8 times that of copper rods. This is somewhat in error, as you base your calculations upon the eleectrical conductivity of aluminum at 54.2% that of pure copper, while, as a matter of fact, we are furnishing aluminum in large quantities for electrical conductors with guaranteed electrical conductivity of 63% of copper. The actual test of the electrical conductors used by us at Niagara for our line shows this conductivity, and with our purest aluminum we have obtained results of 64% of pure copper; tests having been made by Mr. Chas. F. Scott at the electrical testing laboratory of the Westinghouse Electric Co., East Pittsburg. As a matter of fact, aluminum is as cheap as copper when at two times the cost of copper per pound.

The tensile strength of the rods used for our Niagara line was something over 21,000 lbs. per sq. in., with an elongation of 27% in 2 ins. and 16% in 8 ins. Similar rods of copper ordinarily would have a tensile strength of 40,000 lbs. per sq. in.

The relative longer distance which will be allowed between supports with the aluminum conductors as compared with copper conductors, makes the use of aluminum a special matter of advantage in many cases.

For further data regarding aluminum electrical conductors which we are using at our Lower Niagara Works, we have to inform you that the current is carried at 280 volts pressure, and that there are over 500 of these ⅜-in.

rods of 350 ft. length. The rods are painted with an insulating varnish and are strung in a wire tower which is attached to the penstock carrying the water to the turbine.

Very respectfully,
The Pittsburg Reduction Co.
Alfred E. Hunt, President.
Pittsburg, Pa., Nov. 30, 1896.

(On receipt of the above letter we wrote Mr. Hunt stating that the figure 54.2 for conductivity of aluminum was given on the authority of Mr. Lazare Weiler, who is considered good authority. Mr. Hunt's reply is given as follows:—Ed.)

Sir: Weiler's tables on the conductivity of aluminum are in error. The results were probably obtained with samples of impure metal. With all alloys, the conductivity is materially reduced. Any aluminum over 98% pure will have over 54% electrical conductivity, so far as our experience goes.

We have had a good many electrical conductivity tests made, and with our purest aluminum the results run over 64½%.

Very respectfully,
The Pittsburg Reduction Co.
Alfred E. Hunt, President.

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The New York Railroad Commission's Decision Concerning the Catskill, Cairo & Windham Electric Ry.

Sir: I would like to take exception to your note in your issue of Nov. 26 upon the recent refusal of the New York Railroad Commission to grant a permit for construction to the Catskill, Cairo & Windham Electric Street Ry. Co. In the first place, it is a street railway, and would be for the accommodation of the people living along the Catskill and Cairo turnpike, along which it is proposed to run, while the Catskill Mountain R. R., being a steam road, cannot, even if it attempted to do so, accommodate the people, except at stated stations along its route. The proposed road would not parallel the Catskill Mountain R. R. in the general meaning of the term for at least one-third of its length. They would both start from Catskill Point on the Hudson, but the steam road follows the Catskill Creek, while the electric road is intended to be a street railway, and would follow the main street of Catskill through that village and, continuing on through, would follow the turnpike, passing through three villages of considerable size and passing through Cairo at a distance of about eleven miles from its starting place would go on to Windham at the summit of the Catskills. The Catskill Mountain road passes through neither of the villages, and has no stations for them, with the exception of South Cairo and Cairo, where one branch ends, but the main line extends to Palmville, which is entirely off the line of the proposed road. The present road is not self-supporting, both because it is at arm's length from the villages and because it charges exorbitant freight rates and passenger fares; for the latter the charge is 10 cts. per mile, thus barring almost all but summer boarder travel. The local travel at present goes by stages, of which there are several all the year and in summer hundreds every day for the summer boarder traffic. The freight is now also carried by wagons. Without taking away any of the present traffic of the Catskill Mountain road an electric road would be a profitable investment. I write the above from a knowledge gained by living on the proposed route for a number of years, and knowing every foot of the ground of both the present steam road and the proposed electric road. I enclose a clipping showing the Catskill opinion.

I am, yours respectfully,
Lewis B. Sebring, C. E., Cy. Engr., Schenectady, N. Y.

(The clipping enclosed is from the Catskill "Examiner" of Nov. 21, and is as follows:—Ed.)

> The proposed road manifestly is not parallel to the C. M. Ry., which does not go to Jefferson, Leeds and South Cairo villages, has no stations at Leeds or Jefferson, and only at a distance from South Cairo. It does not and cannot, under the prohibitory rates for fare and freight, accommodate the public during the portion of the year it is in operation, and there is no doubt that the traffic thus tabooed would make an electric railroad a profitable venture. That it would be a great convenience and is practically a necessity nearly every business man in the village and residents along the proposed road attest. No evidence was before the commissioners to show that the road would not pay, except that given by persons either directly or indirectly interested in the Catskill Mountain Ry. That the commissioners should make such an outrageous decision in favor of monopoly is bringing anathemas from the general public upon them.

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The Ownership and Control of Water in the Irrigable West.

Sir: You are entitled to the thanks of Western irrigators for your timely discussion of our unsatisfactory conditions. The attention of the East is what is needed, and a proper appreciation of our situation is greatly to be desired. To this end I wish to call attention to one or two features of our water laws not generally understood, and not dealt with in your editorial of December 3.

(1) Transfers of lands to the arid states will not add to or take away from the control over streams already exercised by these states.

The act of Congress of July 26, 1866, recognized the validity of local laws and customs in the control of streams and in the appropriation of their waters, as is shown by the following extract (Sec. 2,329, Rev. Stat. U. S., 2d ed., 1878):

> Whenever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of the courts, the possessors and owners of such vested rights shall be maintained and protected in the same (Act of July 26th, 1866).

Under this sanction, rights have been acquired under state and territorial laws by virtue of which important streams have, for all practical purposes, passed from public to private control. The rights thus acquired have been upheld in both state and national courts of appeal, so that the right of Congress to reassume control of the water supply of these states is gravely questioned.

In Wyoming state ownership of streams is not a matter of implication. Congress conferred such ownership by specific grant and in the following manner:

The state constitution of Wyoming was framed, adopted by the people of the territory and submitted to Congress for the examination, and ratification or rejection, of that body. The approval of that instrument by Congress made Wyoming a state without Presidential proclamation or further action by the people of the territory. Whatever powers or authority that instrument asserted were thus absolutely ratified and confirmed by Congress. Sec. 1, of Art. 8, of the State Constitution reads as follows:

> The water of all natural streams, springs, lakes or other collections of still water within the boundaries of the state are hereby declared to be the property of the state.

Every legal authority whom I have heard discuss this question has agreed that by the ratification of this article by Congress the title of the state to the waters of its rivers became as complete as it is to the Capitol building at Cheyenne, and that Congress can now no more legislate about the management of one than it can of the other.

The state owns the streams, the nation owns the land; neither one is of value without the other, and without some concert in their management and disposal there can be no satisfactory development of our agricultural resources.

There is no such concert of action at present. Our land laws were framed for the humid East. They ignore the grazing lands; they make no provision for communal or concerted action in the reclamation or management of the irrigable land; they fail to protect capital in the construction of irrigation works, and by increasing the risk add to the cost thereof, and, in the end, to the burdens of water users. State laws for the management of water are impotent. State ownership of streams is of no consequence so long as the state has no land on which to apply them.

This situation is full of menace for the future. Having no land on which to apply the water there is a lack of local appreciation of its ultimate value, which makes it easier for individuals looking to the future to secure the passage of laws permitting the transfer of these streams to private ownership.

It is worth considering that the state which has most complete control of its streams is most carefully guarding its property. In no other of the arid states are the limitations on water rights as clearly drawn or public control as rigorously exercised as in Wyoming.

(2) Your statement that the act granting one million acres to each of the arid states requires that water rights should be inalienable therefrom, requires amendment. No such condition is contained in the national act. The Wyoming law accepting the donation makes land and water inseparable in this state.

(3) So long as separate ownership of land and water continues there can be no application of the principle of the Wright District Law to the reclamation of public land. The success of this act, or the liability to reclaim lands through any district or communal organization, depends on authority to pledge the land for the money required for its improvement, and in the right to subject all the lands in the district to the regulations which the district or community may find necessary. Present land laws permit neither of these things.

If human experience has any value it has certainly sufficed to show the evils and abuses of our present land system. The history of every irrigated country in Europe shows the necessity for uniting with land the right to the water which reclaims it. Under our system the control of these two joint agents of production is divorced at the outset. We have tried this system long enough to know that its results are in many cases pernicious, and in all insufferably inadequate.

The state of Wyoming has within its borders the headwaters of four of the great rivers of the arid region. It is situated in the path of the old emigrant trail and for 50 years home seekers have been exploring its valleys and fording its rivers, yet in all that time less than one million acres of agricultural land have passed into the hands of private individuals through the operation of our public land laws. During much of that time the laws providing for the requirement of title to land were much more liberal than they are at present. The best locations for reclaiming land have all been utilized. The streams which could be diverted at small cost are nearly all fully appropriated or over appropriated. If such inadequate results have characterized the favorable conditions of the last half century what can we expect under the same laws for the future?

I ascertained after the publication of the paper, from which you have quoted, that the table giving acreage of taxable lands is in one particular incorrect. I gave the area of patented land as the taxable area, but since its publication I have learned that railway land grants are taxed whether patented or not. At the time the paper was prepared I believed that these lands stood on exactly the same footing as land filings under other laws and were not taxable until patents has issued, but by legislation in 1886 this was changed. The taxable area in the land grant states is, therefore, as much greater than my table as the difference between the railroad lands which have been patented and the total grant. In several of the states it does not materially affect the percentages and does not at all affect the conclusion as to the adequacy of the land laws, but rather emphasizes it.

Respectfully, Elwood Mead.
Cheyenne, Wyo., Dec. 7, 1896.

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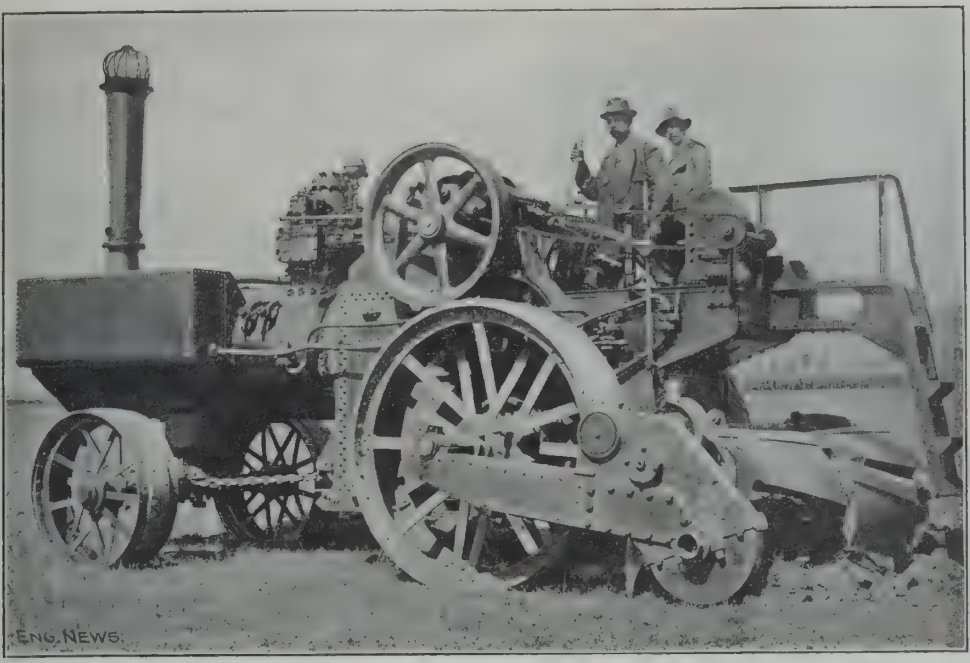
A CONVENIENT METRIC CONVERSION TABLE.

The following metric conversion table has been compiled by Mr. C. W. Hunt, M. Am. Soc. M. E., president of the C. W. Hunt Co., of New York city, and is the most labor-saving tool in the dealing with metric weights and measures which we have anywhere seen. We advise our readers to paste this convenient and compact table in their notebooks. For the benefit of those of our readers who preserve their copies for binding, we would add that Mr. Hunt has had copies of this convenient table printed on a slip with a gummed back, and will, we presume, mail one of these to any of our readers on request.

Millimeters × .03937 = inches.
Millimeters ÷ 25.4 = inches.
Centimeters × .3937 = inches.
Centimeters ÷ 2.54 = inches.
Meters × 39.37 = inches. (Act of Congress.)
Meters × 3.281 = feet.
Meters × 1.094 = yards.
Kilometers × .621 = miles.
Kilometers ÷ 1.6093 = miles.
Kilometers × 3280.7 = feet.
Square millimeters × .0155 = square inches.
Square millimeters ÷ 645.1 = square inches.
Square centimeters × .155 = square inches.
Square centimeters ÷ 6.451 = square inches.
Square meters × 10.764 = square feet.
Square kilometers × 247.1 = acres.
Hectares × 2.471 = acres.
Cubic centimeters ÷ 16.383 = cubic inches.
Cubic centimeters ÷ 3.69 = fluid drachms. (U. S. P.)
Cubic centimeters ÷ 29.57 = fluid ounce. (U. S. P.)
Cubic meters × 35.315 = cubic feet.
Cubic meters × 1.308 = cubic yards.
Cubic meters × 264.2 = gallons (231. cu. in.).
Liters × 61.022 = cubic inches. (Act Congress.)
Liters × 33.84 = fluid ounces. (U. S. Phar.)
Liters × .2642 = gallons (231 cubic inches).
Liters ÷ 3.78 = gallons (231 cubic inches).
Liters ÷ 28.316 = cubic feet.
Hectoliters × 3.531 = cubic feet.
Hectoliters × 2.84 = bushels (2150.42 cubic inches).
Hectoliters × .131 = cubic yards.
Hectoliters ÷ 26.42 = gallons (231 cubic inches).
Grammes × 15.432 = grains. (Act Congress.)
Grammes × 981 = dynes.
Grammes (water) ÷ 29.57 = fluid ounces.
Grammes ÷ 28.35 = ounces avoirdupois.
Grammes per cu. cent. ÷ 27.7 = lbs. per cu. in.
Joule × .7373 = foot pounds.
Kilograms × 2.2046 = pounds.
Kilograms × 35.3 = ounces avoirdupois.
Kilograms ÷ 1102.3 = tons (2,000 lbs.).
Kilograms per sq. cent. × 14.223 = lbs. per sq. in.
Kilogrammeters × 7.233 = foot pounds.
Kilograms per meter × .672 = pounds per square foot.
Kilograms per cubic meter × .026 = pounds per cu. ft.
Kilograms per cheval vapeur × 2.235 = lbs. per HP.
Kilo-watts × 1.34 = horse power.
Watts ÷ 746 = horse power.
Watts ÷ .7373 = foot pounds per second.
Calorie × 3.968 = B. T. U.
Cheval vapeur × .9863 = horse power.
(Centigrade × 1.8) + 32 = degrees Fahrenheit.
Francs × .193 = dollars.
Gravity, Paris = 980.94 centimeters per second.

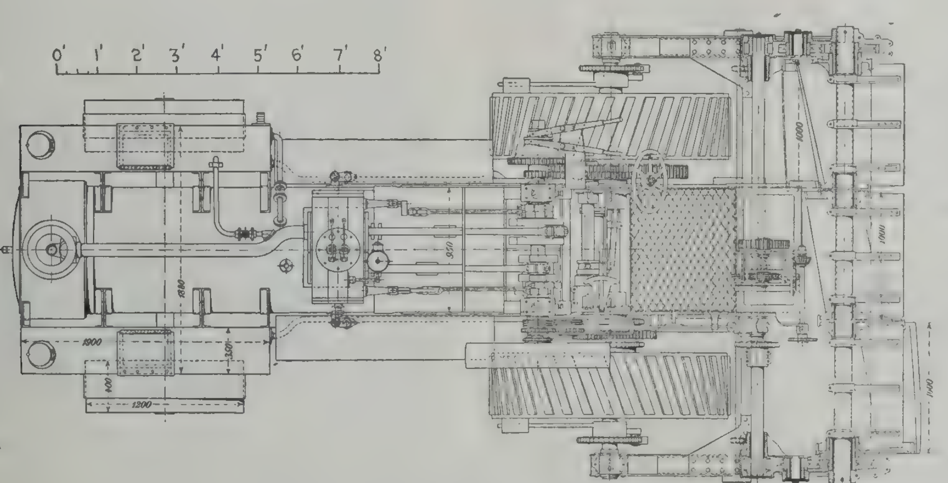
THE MECHWART ROTARY PLOWING MACHINES WITH STEAM AND PETROLEUM MOTORS.

The first steam plow was patented in England in 1846, and since that date machine plowing has been attempted, with more or less success, in every country where the importance of agricultural methods and the areas to be cultivated would warrant the necessary outlay. The first so-called steam plows were nothing more than a system of ordinary gang-plows hauled backward and forward across a field by ropes operated by stationary engines placed on each side of the field. Owing to the practical difficulties encountered this method has been very generally abandoned, and a traction engine was next used to haul after it a series of gang-plows. Many other plowing devices have been since patented, including so-called digging and spading devices, some of these being hauled by rope or by horses, and others being mounted directly in the rear of a traction engine and forming part of the engine. But mechanical defects, the softness and unevenness of the ground, the lack of uniformity in the depth of the cut made, and the usually high cost of these machines, coupled with unsatisfactory results, have prevented them from coming into general use.



MECHWART ROTARY PLOW.
Operated by 50 H. P. Steam Engine.

The requirements for a direct-acting rotary steam plow may be generally stated as follows: The machine must be strong, compact, easily repaired and not too expensive in first cost or daily operation; the plow must cut out a clean, compact mold, lift this out of the ground without disturbing the subsoil, and deposit this mold to the rear of the machine in a thoroughly loosened and inverted condition; the gage of the traction engine must be less than the width of the cut made so that the main wheels may always travel upon firm ground, and the depth of the cut made must be capable of adjustment, to suit the ground, and this depth must be automatically controlled by the ground surface itself.



PLAN OF 50 H. P. MECHWART ROTARY PLOW.

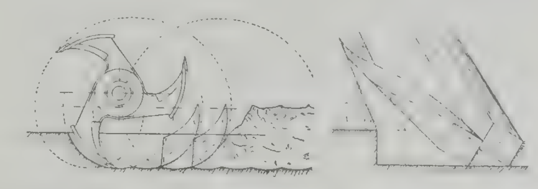
Rotary steam plows have been heretofore made; but these generally operated a series of narrow spades, upon a drum, which simply loosened the soil and scattered it about unevenly. To meet each and every one of the above requirements the rotary steam plow here illustrated has been invented and patented by Mr. Andreas Mechwart, the general manager of Ganz & Co., an important manufacturing concern of Budapest, Hungary. The practical needs of a machine of this character have been so carefully studied that this plow promises to revolutionize present practice in this connection.

As shown in the illustrations, the rotary plows are directly connected with the engine operating it and also supplying the motive power. The frame supporting the plows is pivoted to the main axle of the locomotive, and by special devices is made to automatically adjust the depth of cutting to the inequalities of the surface. To prevent one falling mold from interfering with the cutting of the next mold, by the following share, and to make the cutting without shock, the cutting edge of the share is given a shearing action by setting it at an angle to the axis of the drum, this angle approximating 30°, but varied to suit the soil. The peculiar form and angle given these shares enables them to lift the cut molds bodily and to deposit them rearward in an inverted position; and the claim is made that no other rotary plow accomplishes this important result. As the plows rotate in the same direction as the main running wheels, the pushing action of the plows in the ground practically assists the forward motion of the locomotive and to that extent decreases the tractive force required.

At the Budapest Exposition of 1896 the Mechwart plow was exhibited under running conditions. This plow, shown in the half-tone illustrations, was operated by a 50 HP. steam engine used to propel the plow and to rotate the cutting or plowing device. The plow, or cutter-drum, was 12 ft. long, with an outside diameter of 3 ft., and the cut made was from 6 to 14 ins. deep, according to the adjustment of the apparatus. Many previous tests made with this same machine, and in different soils, show that the action of the plows is similar in effect to the spading operation in garden work. Crops of wheat, barley, oats and corn, raised on soil thus treated, are claimed to have yielded from 5 to 15% heavier weight of product than similar crops raised from ground worked by the ordinary gang plow. This plowing machine has also been worked in combination with a harrow and cultivator hauled after it with no added expense.

The Mechwart plowing machine is made in three sizes of 30, 40 and 50 HP., plowing over a space 8, 10 and 12 ft. wide and having a working capacity, in 14 hours, of 14, 18 and 21½ acres. The weight of a 50 HP. machine is 10 tons, and the selling price of this class of machine is $4,000. An elaborate estimate puts the total cost of operating a 50 HP. plow at $16.80 per day; in this estimate the day is 14 hours long, coal costs $2.50 per ton, the engineer and fireman are paid $2.50 and $1.50 per day and the fuel consumed is 275 lbs. per hour. With an average of 21½ acres per day plowed 14 ins. deep the average cost of plowing per acre is 78 cts.

Cuts on the next page show a similar but smaller rotary steam plow operated by a 12 HP. petroleum motor, as exhibited at the Budapest Exposition. This motor was especially designed to work automatically and to be safe from explosion, smell or smoke. The petroleum vapor is carried automatically from a tank on the machine, without the use of a supply pump, and the ignition is brought about without the use of an electric spark or burning flame. An engineer is not needed, as any man or boy can soon be taught to operate the motor.



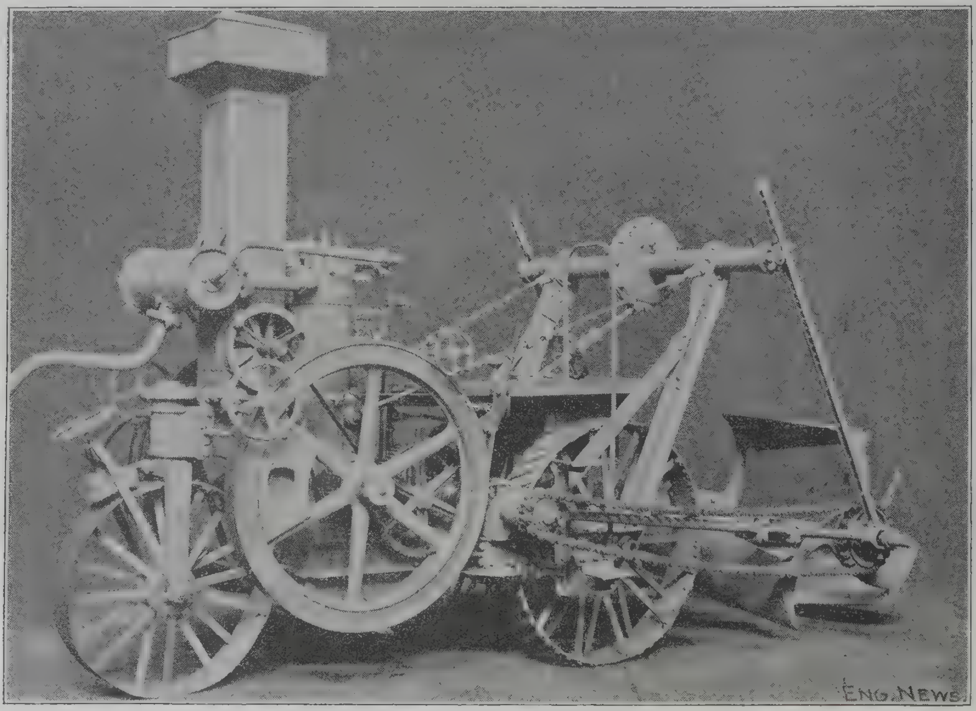
Sections Showing Principle of Cut Made by the Mechwart Rotary Plow.

In this petroleum plowing machine the circular cutter is 4 ft. wide and 3 ft. in diameter; but provision is made to insert a 5 or 6 ft. cutter when this is deemed necessary. The plow will cut from 6 to 12 ins. deep, as the soil may require, and it may be worked in a train with a harrow and cultivator. This machine has plowed an average of 8 acres, 12 ins. deep, in 14 hours. The machine is sold for $800, and the average daily cost of operation, including the investment, is put down at $3.78. In this estimate 1½ gallons of petroleum are used per hour and two farm laborers are included at $1 per day. On the above basis of 8 acres plowed 12 ins. deep in 14 hours, the average cost per acre is only 47 cts. Both machines are patented in the United States, and for further information the reader is referred to the American representative, M. Neumayer, M. E., C. E., 68 East 114th St., New York city.

THE NEW NORTHWEST WATER-WORKS TUNNEL for Chicago, Ill., is progressing quite satisfactorily, according to recent reports. Of the total 72,600 ft. of land tunnel, 5,600 ft. of the 10-ft. tunnel and 11,435 ft. of the 8-ft. tunnel have been completed. Of the lake tunnel, 10-ft. in diameter, about 800 ft. are completed.

STANDARD CEMENT SPECIFICATIONS OF THE SOUTH AUSTRALIAN GOVERMENT.

We are indebted to Alexander B. Moncrieff, M. Inst. C. E. and Engineer-in-Chief of the South Australian Government, for a copy of the standard specifications for Portland cement supplied to that government for use on its public works, under which he states satisfactory material has been received for some time past. These specifications are interesting in themselves, and show recent engineering practice in Australia in regard to cement.

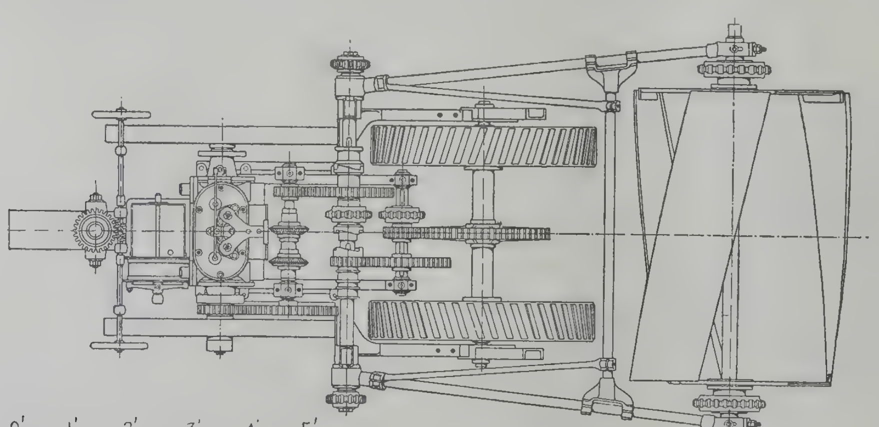


MECHWART ROTARY PLOW.
Operated by 12 H. P. Petroleum Motor.

The part of the specifications relating to weight, residue, sand, mixing and tests is as follows:

Weight—ascertained by filling a cylindrical, imperial bushel measure from a fixed hopper which will deliver the cement at a height of 2 ft. above the bottom of the measure. The measure, which is 13 ins. high, will be set upon a solid floor, and shall be filled in two minutes. No shaking or other means will be allowed to cause the cement to settle. The weight of the "striked" bushel shall be not less than 100 lbs.; and the specific gravity of the cement not less than 3.10. The tests for weight and specific gravity shall be made not earlier than 28 days after the cement has left the contractor's works.

Residue—ascertained by sifting 10 lbs. through a sieve of 5,806 meshes per sq. in., made of wire No. 45 I. S. W. G., shall not be more than 1 lb., and all this residue shall pass through a sieve of 2,500 meshes per sq. in., made of wire No. 39, I. S. W. G.



PLAN OF 12 H. P. MECHWART ROTARY PLOW.

Sand—used for the tests shall be River Torrens sand, thoroughly washed and dried, all passed through a sieve of 400 meshes per sq. in. and caught on a sieve of 900 meshes per sq. in.

Mixing—will be effected in a Faija's mixer, the proportions of cement, sand and water being determined by weight and all the water being added at once.

Test blocks—or briquettes will be made by filling the material, mixed as above, into metal molds of the form shown in the margin,* and resting on non-absorbent beds, and pressing it uniformly so as to exclude the air and make the briquette compact.

The pressure shall be applied by hand to each briquette for not more than 2 minutes for neat cement, and 3 minutes for cement and sand, and the pressure shall not exceed 56 lbs. upon a tool similar to that shown below.

The blocks shall be kept in the molds exposed to the air for 24 hours, and then in water for the balance of the specified periods, when they shall be taken out and immediately tested.

Testing of the blocks will be done in a testing machine approved by the Engineer-in-Chief. The strain on each block commencing from 0 lbs. and increasing at the uniform rate of 400 lbs. per minute until the block is broken.

Tensile strength per sq. in. of neat cement, 7 days after mixing, shall not be less than 400 lbs.

Tensile strength of neat cement, 28 days after mixing, shall not be less than 550 lbs. per sq. in.

Tensile strength per sq. in. of a mixture of 1 part of cement to 3 parts of sand, 28 days after mixing, shall not be less than 200 lbs.

Setting and Cracking Test.—Pats of neat cement, about 3 ins. in diameter and ½-in. thick, with thin edges, will be mixed on glass with sufficient water to form a stiff paste, and the times of setting hard enough to support ¼-lb. on a wire 1-12-in. diameter, and 1 lb. on a wire 1-24-in. diameter shall not be less than 1 hour and 3 hours, nor more than 4 hours and 12 hours respectively. One-half of the pats, when set, will be kept in water for a period of 7 days and the other half will be exposed to the air, and if distortion or cracking of edges develops in them, the cement from which they were taken will be rejected.

In addition to the above tests the Engineer-in-Chief may order such chemical tests and analyses as he may think necessary to demonstrate whether or not the article supplied contains the requisite constituents of Portland cement.

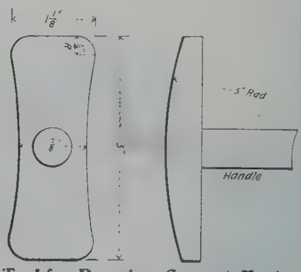
Four samples at least for each test shall be obtained from every 400 bushels for the purpose of testing.

In the event of a sample failing to stand any of the required tests, the Engineer-in-Chief shall have the option of ordering fresh tests at the expense of the contractor, or of rejecting the whole of the parcel from which such sample was obtained.

All costs of testing shall be borne by the contractor. The charge for testing the samples representing each 400 bushels shall be one guinea.

Should the contractor request in writing any further tests, the charge for making each such additional test shall also be one guinea.

It is not intended that there shall be any departure from the established departmental mode of testing, but if any test be objected to by the contractor on the alleged ground of insufficient pressure being used in filling the mold, and he request that a further test be made the pressure shall in such further test be applied by a machine rolling a tool, similar to that shown herewith, over the surface of the mixture, under a direct dead-weight of 56 lbs. The time occupied in filling each mold in such case shall not exceed 3 minutes for neat cement and 4 minutes for cement and sand.



Tool for Pressing Cement Mortar into Briquette Molds.

In further clauses it is specified that while the tests shall be made at such place and in such manner as the Engineer-in-Chief may direct, the contractor has the option of being represented at the testing. No cement will be received that has not been properly cooled and aerated before delivery; and the contractor must stack the cement in separate lots of 400 bushels each, estimating about 4 bushels of cement to each barrel or 2 bushels to each sack. From each lot so stacked at least four samples will be taken by boring with an auger into several packages, or by other approved means. No delivery will be considered complete without the certificate of the Engineer-in-Chief that the cement is of the required standard; nor will any payment be made on account of cement delivered without the production of this certificate. Tenderers must give the schedule price per imperial "striked" bushel of Portland cement as measured upon completion of 28 days' test. This price must include all patent rights and royalties, packages, carriage, testing, and "any claims whatsoever arising from the making, conveyance, stacking and delivery of the cement, in accordance with the terms of this specification."

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THE CYCLE INDUSTRY IN THE UNITED States, says an interesting and lengthly article on this subject in the London "Times," has grown from 6 factories, in 1885, with a total output of 11,000 machines, to 500 factories in 1895, counting only those which turn out not less than 1,000 machines annually, and having a total production of 600,000 cycles of various grades. The capital invested in these 500 factories is placed at $90,000,000, and the lowest estimate of the output of completed machines for 1896 is one million valued at $60,000,000. If the manufacture of tubing, bells, lamps, and other bicycle paraphernalia is included it is estimated that the total capital invested would amount to $125,000,000. The export of American bicycles practically commenced in 1895, and for the last half of that year the value of those exported only amounted to $243,721, according to the reports of the Treasury Department. But for the first six months of 1893 the same report puts the value of exported machines at $1,654,291. Nearly one-half of this export goes to England, incompleted machines or parts of machines, and Germany and France are the next best customers. The success of the American machine, says the "Times," is the attention paid to the development of strength with lightness and the finish and high quality of the product. Bicycles are made weighing only 26 lbs., which will safely carry 300 lbs. over any road. The price of the best bicycles has been reduced from $140 in 1893, to $100 in 1896, for the same quality of machine or even better. The "Times" estimates the number of bicycles in use in the United States at not less than 3,000,000. Mr. George F. Parker, American Consul at Birmingham, says that in 1895 about 750,000 bicycles were made in England, valued at about $58,392,000. The export value of English bicycles for the first 9 months of 1896 amounted to $6,452,691; but the trade in cycle material with the United States has declined to $62,787, and Mr. Parker says it will practically cease by the end of the season of 1897.

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*This is practically the Am. Soc. C. E. section.—Ed.

AUTOMATIC BUCKET FOR COAL HOISTING; SOUTHERN PACIFIC RY. DOCKS, OAKLAND, CAL.

In a paper in a recent number of the "Journal of the Association of Engineering Societies," Mr. John D. Isaacs, of the Technical Society of the Pacific Coast, described certain apparatus designed by him for handling coal for the Southern Pacific Ry. Co. at Port Costa and Oakland Wharf. The bucket used is particularly interesting, and it was devised to meet peculiar conditions existing at that point. These conditions required that most of the coal should be landed from ships into receiving bunkers and then transported by rail to the place of consumption. The high cost of coal, the high rate of wages paid to stevedores, and the importance of quickly unloading the vessels made it very desirable that waste and breaking should be diminished as far as possible, that manual labor be minimized in handling the coal and that the ship be discharged quickly.

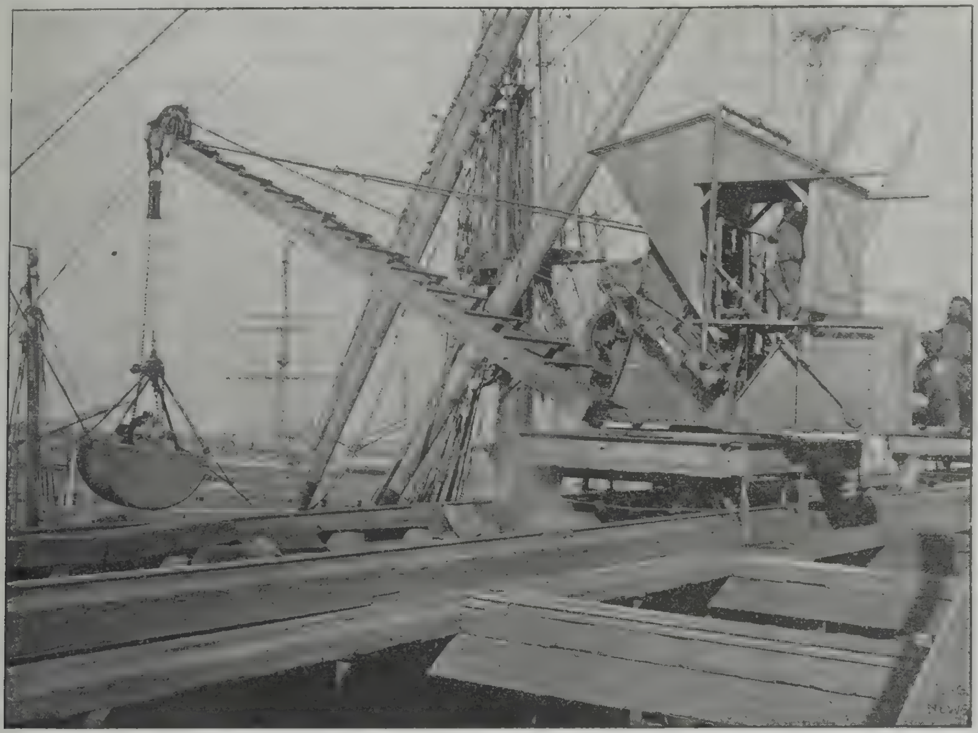

FIG. 1. -COAL UNLOADING PLANT AT SOUTHERN PACIFIC RY. DOCKS; OAKLAND, CAL.
Designed by John D. Isaacs, M. Am. Soc. C. E.

The mechanical digging conveyor, supplemented by a fore-and-aft conveyor in the ship bringing coal to the main buckets, is the ideal method of landing coal from vessels and in some form is in common use in the Eastern and Middle States for unloading barges. But on the Pacific Coast there are complications which make this system practically impossible. The coal ranges in size from dust to pieces measuring several cubic feet in volume; it is sometimes very wet and at other times very dry; the range of tide, the variation in the draft of ships and in the size and position of the hatches, and the interference of rigging and special bulkheads would all interfere with the proper working of the conveyor system. The only practical method of general application is the hoist of a bucket by means of a derrick of some form; and it was to the improvement of this latter method that Mr. Isaacs directed his attention.

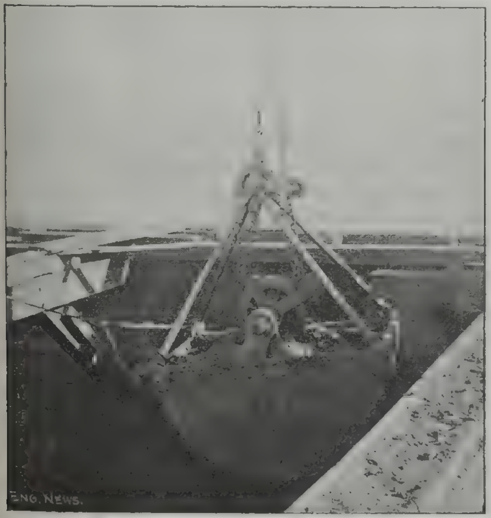

Fig. 2.—View of Automatic Coal Bucket, Closed.

The ordinary "tipper" bucket involves much manual labor and a high dump for the coal; consequently many varieties of clam-shell dredger, or "grab-buckets" as they are there called, have been devised. These buckets should be simple, with few parts and these easily replaced; they should be moderate in cost, with a low repair account; they should be geared to bite lumps of coal in two when these are caught between the lips; they should bury themselves in the coal and come up full; have a low dump and be handled entirely by the derrick engineer. The buckets which conformed most nearly to the conditions of low dump, automatic action and applicability to various states of the coal, says Mr. Isaacs, were very complicated in their gears, springs, pawls, etc., and caused constant delay and expense in repairs.

The grab-bucket designed by him and here illustrated, is only limited in size by the dimensions of the hatches and the capacity of the derrick. Three sizes have been made, of 3,000, 3,800 and 5,000 lbs. capacity, level full; but the medium size meets the conditions and is now the only size in use. It weighs 3,775 lbs., with a ratio of dead weight to useful load, of about 1 to 1, and has a capacity of 64.4 cu. ft. The maximum speed of lift is about 400 ft. per minute, and the average fall of coal is 8 ft., as compared with 21 ft. from the tipped bucket. In operating it, only one stevedore is required at the hatch, instead of six as with the tipper. Five of these grab-buckets have been in almost constant use at the Oakland Wharf since November, 1894; and to this time there has been absolutely no delay by disarrangement and there have been no charges against them for repairs.

This bucket is operated as follows: It is lowered into the hold, both lines being paid out together. When the bucket has nearly reached the coal, the running line is let go, and the weight of the lower sheaves, hinges, etc., throws the bucket wide open by the time it rests upon the coal. The hanging line is now slacked and the running line hauled in, and the bucket buries itself in the coal, up to the lower sheave-shaft, and closes. Both lines are now hauled in together, but the lift is kept entirely on the runner. As soon as the bucket clears the hatch it begins to swing and hoisting is stopped as it clears the top of the bunker and it then passes to the point of discharge. At this latter point the hanging line is held and the runner released, opening the bucket and dumping the coal; and with this latter operation a reverse motion towards the ship begins.

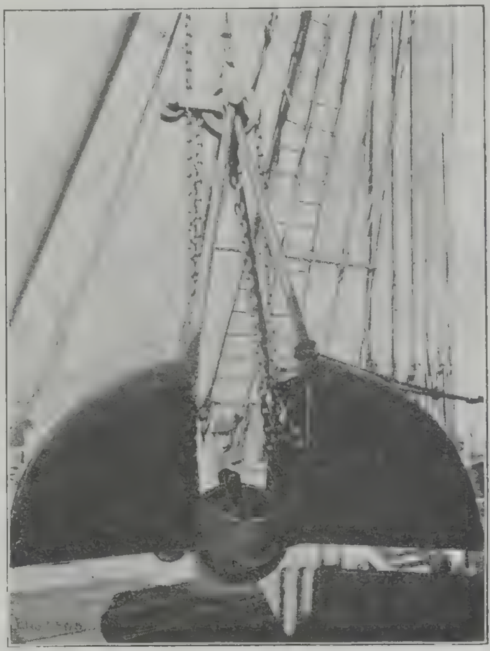

Fig. 3.—View of Automatic Coal Bucket, Open.

The derricks employed in handling these buckets are of the ordinary type, with double independent drums, friction brakes and the usual appliances. The reach of the boom is 32 ft. The derrick car runs on a track of 8 ft. gage, and is hooked down to the track stringers when in use. All lowering is done by the brakes. In the same paper Mr. Isaacs describes and illustrates the receiving and distributing bunkers built at Oakland and at other points. These bunkers have each a capacity of 10 tons per foot run, level full. They contain an average of 1,266 ft. B. M. of timber per foot run and cost by contract about $36.60 per foot. The trestle approach contains 266 ft. B. M. and it cost $6.60 per lineal foot. The track on the top of the bunker is 46 ft. above the coaling track, which is outside of the bunkers, as giving the greatest capacity for a given height and width.

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COMPARATIVE VALUES OF GAS AND ELECTRICITY FOR HEAT, LIGHT AND POWER IN GERMANY.

At the last meeting of the German Union of Gas Manufacturers, says "Le Genie Civil," Mr. W. G. Oechehauser gave some comparative figures relating to the cost of gas and electricity for lighting, heating and power purposes. These figures, which are based solely upon German practice, are as follows:

In gas lighting, under ordinary pressure one cubic meter of gas ordinarily furnishes 560 Hefner units. In using the incandescent electric light, with lights of 16 candle-power, it is usual to rate one kilo-watt hour as giving about 280 Hefner units. On this basis one cubic meter of gas is equivalent to two kilo-watt hours. With the arc light compared with gas, one cubic meter of gas, under a pressure of one meter, furnishes 1,000 Hefner units; and one kilo-watt also gives 1,000 Hefner units. In this case one cubic meter of gas is about equivalent to one kilo-watt hour. For lighting purposes one cubic meter of gas, in Germany, costs from 3½ to 5 cts., while the cost of a kilo-watt hour is from 15 to 20 cts.

For power purposes, one effective horse-power hour, according to the power of the motor, requires an expenditure of gas varying from 600 to 800 litres; one cubic meter of gas can thus be rated as furnishing from 1.25 to 1.66 horse-power hours.

In electric power, one effective horse-power hour is equal to 736 watts; and in the actual electric motor the mean useful effect varies from 80 to 90%, according to their power. They absorb then from 820 to 920 watts per horse-power hour produced,and one kilo-watt produces from 1.08 to 1.22 horse-power hours. In this case again, one cubic meter of gas is approximately equivalent to a kilo-watt.

For heating purposes, the experiments of Messrs. M. J. Hasse and F. Goly show that the combustion of one cubic meter of gas furnishing 2,400 to 2,600 effective calories in gas-cooking appliances; 3,840 calories in heating water for baths, and from 3,628 to 4,080 calories in general gas heating apparatus. For heating by electricity, Messrs. F. H. Haasse and A. Herzberg figure that we can utilize from 80 to 95% of the product. On this basis one kilo-watt will only produce from 700 to 800 effective calories.

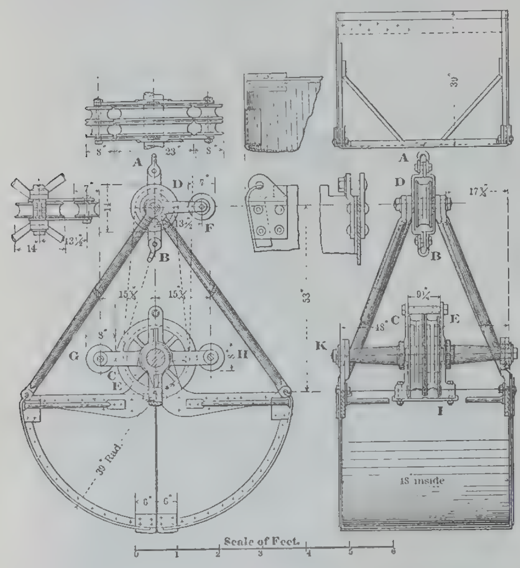

Fig. 4.—Details of Automatic Coal Bucket.

The ordinary German price for gas supplied for heating and power purposes varies from 2 to 3 cts. per cubic meter; under similar conditions the cost of a kilo-watt varies from 5 to 7½ cts.

THE MANAOS TELEGRAPHIC CABLE, laid in the Amazon River, to connect Para and Manaos, cost $1,000,000 and failed to work within 31 days after being laid. It was guaranteed for only 30 days by the contractor. No messages have been transmitted over it since last February; but it is being inspected for breaks and it is hoped that it may be in operation again before long. This cable was supposed to supplant the overland telegraph line to the center of the rubber trade; a line continually interrupted by the rapid growth of tropical vegetations and the antics of Brazilian monkeys.

A FRENCH-SOUDAN RAILWAY, or, rather, the completion of a railway commenced in 1881, is being considered by the Colonial Minister of France. Up to 1896 $2,600,000 had been expended on a line extending from Kayes to Bafoulabe, with a proposed extension to the Niger, with the practical result that about 56 miles of rails have been laid down on ties spaced about 16 ft. apart, with the rails held by single bolts. Surveys have now been completed to the Niger, and a project for finishing the road has been favorably reported upon by the Minister. The two towns mentioned are on the Senegal River, emptying on the West Coast of Africa at St. Louis, and between Bafoulabe and the Niger, emptying into the Gulf of Guinea, lies high and difficult ground. The opinion is advanced that the proposed line is a simple waste of human energy and the hard-earned money of too sanguine investors.

DOUBLE DECK HIGHWAY AND RAILWAY BRIDGE ROCK ISLAND, ILL.

(With inset.)

The Rock Island Bridge, whose principal structural features are illustrated in the accompanying engravings and on our inset sheet this week, is one of the most important bridge structures constructed in the United States during the past year. Briefly described it is a combination railway and highway bridge 1,850 ft. long over all, with seven fixed spans and one swing span; the highway being carried on the main floor at the bottom chord line and the two-track railway line upon a second floor 12½ ft. in the clear above the highway. The bridge crosses the Mississippi River, between Rock Island, Ill., and Davenport, Ia., and has been built at the joint expense of the United States Government and the Chicago, Rock Island & Pacific Ry., the railway company paying 60% of the cost. Accurately speaking, the bridge has been constructed by the United States Government and 60% of its cost, by agreement, charged to the railway company. A. R. Buffington, Colonel of Ordnance, U. S. A., Commanding Officer, Rock Island Arsenal, was the Government representative having the work in charge, and he appointed Mr. Ralph Modjeski, Assoc. M. Am. Soc. C. E., Chicago, Ill., as Chief Engineer, to design and construct the bridge.

History.—Historically, the Rock Island bridge is unusually interesting, it being the lineal descendant of the first bridge constructed across the Mississippi River. According to the records the first Rock Island bridge was built under a charter granted Jan. 17, 1853, by the Legislature of the State of Illinois. The purpose of its construction was to connect by spanning the Mississippi River the Chicago & Rock Island R. R. terminating at Rock Island, Ill., with the Mississippi & Missouri R. R. in Iowa. It was the first bridge to be built over the Father of Waters and the opposition by the so-called "river interests" to its construction and maintenance was most bitter and prolonged. However, the bridge was finally built—a single track, wooden, Howe truss structure—and served its purpose until on May 6, 1856, when the first span, east of the swing span, 250 ft. long, was destroyed by fire, communicated by the steamboat "Effie Afton," which collided with and burned at one of the piers. In the litigation which followed, and which was brought by the owners of the burned boat, it is of interest to note that Abraham Lincoln, of Springfield, Ill., was one of the counsel for the railway company.

This did not end the troubles of the bridge, however, for in 1860, a suit was brought by James Ward, a citizen of St. Louis, Mo., which resulted in Judge Love, of the District Court of the United States for the District of Iowa, declaring the bridge a "nuisance" and ordering "all the piers within the state of Iowa, together with the superstructure thereon, removed on or before the 1st day of October next." As denoting the opinion of those days regarding the comparative importance of the railway and the navigation interests, it is interesting to note, among other things in Judge Love's decree, the statement that, "if the bridge were to remain, we would probably in no great period of time have railway bridges upon the Mississippi River at every 40 or 50 miles of its course;" also, "that the loss involved in the removal of this bridge would be but trifling compared with the great mischief which must inevitably flow (to the commerce of the river) from the precedent of maintaining it." In one respect the prediction of Judge Love has been in a great measure realized, for at this time there are at least 35 railway and highway bridges over the Mississippi River between Minneapolis, Minn., and St. Louis, Mo., a distance of 800 miles. However, to return to the subject, the Supreme Court of the United States reversed the decision of Judge Love, principally on the ground that the jurisdiction of the District Court extended only to the middle channel of the river, and the removal of the three piers in the State of Iowa would not remedy the obstruction, while it would destroy the bridge.

This decision seems to have settled the trouble from litigation, and in 1866 and 1867 two acts were passed by Congress authorizing the construction of a new bridge to replace the old one. Before work was begun, however, the bridge had suffered serious accidents. In March, 1868, the first pier on the Iowa shore was pushed bodily some 20 ft. or 30 ft. downstream by the ice, and in April of the same year, during a severe wind storm, the swing span was lifted from its masonry and blown over on its side upstream, so that it hung supported by the pier with both ends free in midair. In June, 1869, the contract for the masonry for the new bridge was let, and the structure was completed in October, 1872. Mr. C. Shaler Smith, M. Am. Soc. C. E., was Chief Engineer, and the Phoenix Bridge Co., of Phoenixville, Pa., the contractors for the superstructure. Nineteen years after the completion of the new bridge it was found necessary to strengthen the upper or railway floor, and in 1891 the wooden system then in use was replaced by iron construction. Despite these repairs, however, the bridge was inadequate to the traffic, particularly to the railway traffic, there being but one line of track and no great surplus of strength for the heavier and more frequent trains. In 1894-95, therefore, Congress authorized an entirely new superstructure and partly new substructure, and appropriated the sum of $490,000 for the work. It is this last structure with which this article is immediately concerned, and to which the remaining description will apply.

General Description.—The general plan and elevation of the new bridge are shown by Fig. 1, and, as will be seen, it consists of seven fixed spans and one swing span of the following dimensions and weights:

	Length, ft.	Length, ins.	Weight, lbs.
One swing span, A............	365	7	2,466,271
Two fixed spens, B............	258	0	3,298,955
Three fixed spans, C..........	216	6¾	3,690,815
One fixed span, D............	193	3	789,142
One fixed span, E............	98	9	337,779

Spans A, B, C and D are 29 ft. wide, c. to c., of trusses, and span A is 62 ft. high at the centre and 50 ft. high at the ends. Spans B and C are 50 ft. high at the centres; span D, 30 ft. high, and span E, 25 ft. 4½ ins. high, but only 28 ft. wide, c. to c., of trusses. All spans carry a roadway at the lower chord line 226 ft. wide, with two 6 ft. sidewalks, and a two-track railway line on an upper deck. The styles of truss and lateral bracing, with one exception, which will be noted further on, are shown by the drawings as is also the location of the piers and other general features.

Substructure.—It having been determined to utilize the old piers for the new bridge, and this structure being considerably wider than the old one, it became necessary to remodel the masonry to suit new conditions. This was done in the manner shown by Fig. 2, that is the coping and top part of the old pier was removed down to a point where by interrupting the batter of the old cutwater and extending it upward vertically the increased width obtained would be sufficient for the new conditions. For the old piers Joliet limestone had been used, but the new masonry was composed of Kettle River sandstone for the facing and coping and of Anamosa stone backing, laid in Alsen's Portland cement mortar, of two parts sand and one part cement, for the facing, and three parts sand and one part cement for the backing. The specifications for the masonry required tests of the stone and were rigidly drawn to secure the best workmanship, but need not be given in detail here. As general contractors for the bridge the Phoenix Bridge Co. sublet the masonry work to Sooysmith & Co., of New York.

Truss and Floor Construction.—To understand the metal work details, drawings of the swing span only need be considered, since they are typical of the whole work. These are shown in Figs. 3 and 4, and as far as the general composition of the various truss members and connections, portal and lateral bracing, characteristic strains, etc., are concerned, they are self-explanatory. Some of the minor requirements in the metal work construction will be noted in the abstracts of the specifications given further on. In the roadway floor construction no unusual design is found, it being a simple floor beam and girder construction, with the necessary flooring and paving for wagon traffic, and with two lines of street railway track. The railway deck floor and track construction, however, demand further notice. Transverse girder floor beams carry four lines of grider stringers, one stringer under each rail, and these stringers carry a solid floor of trough sections of the form shown in detail in Fig. 5. The Phoenix Iron Co., of Phoenixville, Pa., made special rolls for this trough section. A detail of the connections of the floor troughs, stringers and floor beams at each floor beam is shown by Fig. 6. The floor troughs are, of course, riveted to the stringers in the manner indicated by Fig. 5. On top of the floor troughs and under each rail is a 20 × ⅜-in.

plate continuous the whole length of the bridge and, of course, riveted to the floor troughs. The object of the continuity of these plates was that in connection with the floor troughs they might form a lateral bracing against wind pressure. The troughs take the shear and the continuous plates act as chords to take the bending moment. On the top of these plates at each trough top there is an 8½ × 8 × ⅜-in. steel blocking plate to support the rail, and to their inner edges, that is between rails, a guard angle is riveted as shown by Fig. 3. Altogether this floor weighs 940 lbs. per lin. ft. It is also water-tight to protect the roadway floor below.

In calculating the various members the following loads were used: Dead load, span A, 7,380 lbs. per lin. ft. of bridge; span B, 7,220 lbs.; span C, 6,700 lbs.; span D, 4,000 lbs.; span E, 3,400 lbs. Live load for trusses, 80 lbs. per sq. ft. or 3,050 lbs. per lin. ft. for roadway and 4,000 lbs. per lin. ft. per track for railway deck; live load for roadway floor, Cooper's road roller and electric car, each 12 tons in 7½ ft., or 100 lbs. per sq. ft., and for railway floor the locomotive and car load shown by Fig. 7. The wind load was placed at 650 lbs. per lin. ft. at the railway deck, 300 lbs. at bottom chord, and 200 lbs. at top chord.

DOUBLE DECK RAILWAY AND HIGHWAY BRIDGE, ROCK ISLAND, ILL.
Ralph Modjeski, Assoc. M. Am. Soc. C. E., Chief Engineer.

Turntable.—The general dimensions and construction of the turntable and drum are shown by Figs. 3 and 4. The track-bed plates are of tough gray cast iron, and are planed top and bottom to a uniform thickness. The tread segments are of forged steel, and planed to uniform thickness and bevel. The wheels are of cast steel.

Material.—Generally all structural plate and shape work is of medium open hearth steel and all rivets are of soft open hearth steel, except the trough floor, which was made of soft steel. Cast steel is used for end bearings, turntable wheels and other parts of the machinery; cast iron for bed plates and certain portions of the machinery, and wrought iron for the spider rods of the turntable and minor parts. The specifications were in abstract as follows:

Steel shall be made by the open hearth process. The amount of phosphorus shall never exceed 0.08% in acid steel and 0.04% in basic steel. The variation in cross section or weight of rolled material shall never be more than 2½% from the specified dimensions and weights. Steel pins over 4 ins. in diameter shall be hammered. In tests the following requirements shall be met:

	Med. steel, lbs.	Pin. steel, lbs.	Soft steel, lbs.
Minimum ultimate strength	63,000	63,000	54,000
Maximum ultimate strength	71,000	71,000	62,000
Minimum elastic limit	38,000	38,000	32,000
P. C. elongation in 8 ins.........	22	18	28
P. C. reduction of area...........	44	36	52

(A somewhat higher elastic limit, it will be observed, was adopted.—Ed.)

All material must be perfectly straightened—mill straightening will not be considered as sufficient—and the templets shall not be applied to any material unless it is perfectly straight. They must lay flat without distortion while the marking is being made. The diameter of the punch shall be at least 3-16-in. smaller than the finished hole in all material ¾-in. or less. It shall be ¼-in. smaller than the diameter of the finished hole in material ¾-in. to 1 in. in thickness. No punching will be allowed in material thicker than 1 in. The diameter of the die shall, in no case, be more than 1-32-in. in excess of the diameter of the punch. After the pieces have been punched or drilled, they shall be assembled and the holes reamed or drilled to the required size. The punching must be sufficiently accurate to permit 1-16-in. of metal to be taken out all around the hole by reaming. Otherwise a smaller punch shall be used. No drifting shall be allowed which would cause initial strains in any of the assembled pieces. The reaming shall be done in a neat manner, taking out 1-16-in. of metal all around the hole. While the reaming is being done the different pieces shall be held firmly together by bolts and clamps. After the pieces are reamed, every hole shall be gone over with a counter-sinking tool, cutting off the sharp edge of the hole, and making a fillet of about 1-16-in. under each rivet head. The members shall then be taken apart and cleaned, the surfaces in contact painted, and the members carefully reassembled and riveted up before the paint is dry. The diameter of the rivets will be such as to require, when heated, a slight pressure to force it into the hole. The size of the rivets shall be adjusted to fill this condition. Whenever possible the riveting shall be done by power. The manufacturer shall procure special riveting machines to meet special positions. All rivets shall have hemispherical heads of neat and workmanlike appearance concentric with the axis of the rivet hole. They shall be well up against the metal. The rivets shall fill the holes and be absolutely tight. No calking or recupping will be allowed. Counter-sunk rivets shall be so driven as to fill the counter-sunk holes completely, and in such a manner as to dispense with chipping when possible. All chipping, whether of rivets or other parts, shall be done in a neat and workmanlike manner without breaking out of metal. Each chipped surface shall be finished off with a file. Where metal is chipped or planed out of a plate or shape, all sharp or concave corners shall be rounded off to at least a 2-in. radius. (This requirement is unusually novel. To understand its application reference may be made to Fig. 4, where the plate X has its corner chipped and rounded according to this clause.—Ed.) No chipping shall be done with a sledge hammer.

Forged Work.—All steel heated for the purpose of forging, bending, or up-setting, shall be subsequently annealed by heating to a dark red heat and allowing to cool slowly. The heads of eye-bars and screw-ends shall be up-set by a process acceptable to the commanding officer. No welds will be allowed except in wrought iron. The design of the heads of eye-bars may be determined by the contractor, provided this design is uniform throughout for each width of bar, and provided the head is strong enough to break the body of the bar. The head will never be more than 1-16-in. thicker than the body of the bar.

Machine Work.—All sheared edges or ends of plates or shapes shall be planed or faced so as to take off at least ⅛-in. of metal. No sheared or punched surface shall be left in the work. Curved edges may be chipped and filed unless specified to the contrary. The ends of riveted chords shall be faced after they are riveted up complete, excepting the projecting splice plates. The lengths shall be measured with iron standards. The chords shall be provided with suitable spacing blocks and clamps, especially near each end, to hold the plates and angles firmly in their proper relative positions while the ends are being faced. The chord sections shall be fitted together at the shops in lengths of at least 120 ft. When so fitted together there shall be no perceptible wind in this length. The reaming of the splices, as well as all other field connections, shall be done with the different parts assembled. When this is impracticable, the connections shall be reamed through iron templets at least 1½ ins. thick. The parts which have been reamed together shall be stamped with stencils, and marked with white paint in such a manner as to be easily put together in the field in the same relative position. Diagrams for marking shall be furnished by the commanding officer or by the inspector. The angles for cross frames, portals and laterals may be reamed from iron templets, provided that one cross frame of each kind, one portal of each kind, and one panel of lateral angles of each kind is fitted up in the shop complete. When so fitted the rivet holes must come truly opposite each other; otherwise the different pieces must be assembled for reaming. All pin holes shall be bored with a sharp tool. A finishing cut shall always be taken. The finished pin hole shall be perfectly smooth and polished. Roughness in a pin hole shall be sufficient reason for rejecting a whole member. The distance between pin holes shall be measured with an iron standard of the same temperature as the member. The plans show the distance between the centers of pin holes; shop measurements shall be made between the bearing surfaces of tension of compression members, with a proper allowance for the diameter of the pin. Pin holes shall be bored exactly square with the member and absolutely parallel with each other. The play of the pins in the pin holes shall never exceed 1-50-in. This applies to all pin holes in the structure, and must be strictly adhered to. Machine fitted bolts must fill the holes with a driving fit. All pins shall be accurately turned to a gage and shall be full size throughout. Pins above 5 ins. in diameter shall be bored through center as shown on plans. The ends of stringers and floor beams shall be squared in the facer. The end angles must be so fitted that facing does not reduce the thickness of the angles by more than ⅛ of their original thickness. The cut will extend over the whole surface of the angles. The stringers shall be measured with an iron standard and must be absolutely true. All bearing surfaces shall be truly faced. All machine-finished surfaces shall be covered with a thick coat of white lead and tallow before leaving the shop. All machine work shall be performed in the best possible manner and according to plans, whether specified here or not.

Eye-bars.—Eye-bars, after being annealed, shall be bored with a sharp tool at exact distances. The pin holes shall be perfectly square with the face, and exactly on the axis of the body of the bar. Roughness in the pin hole shall be sufficient reason for rejecting a bar. The distance between pin holes of each bar shall be tried with an iron standard of the same temperature as the bar. There shall be no perceptible difference in the length of the bars in the same billed length. The play of the pins in the pin holes shall never exceed 1-50-in.

Full-sized Tests.—There shall be 12 full-size eye-bars tested to destruction. The sizes of test bars shall be determined by the engineer in charge. The 12 tests shall be divided into four groups of three tests each. When a full set of eye-bars of the same dimensions as one of the test bars has been manufactured and annealed, the inspector shall select a test bar from that set. When three test bars have been selected in this manner, they shall be tested without delay. The three tests will then constitute a group. No bars known to be defective in any way shall be taken for test bars. Such defective bars shall be rejected. If tested by the manufacturer the results shall in no way influence the acceptance or rejection of other bars. The tests of full-size bars shall be made at such place as the commanding officer of Rock Island Arsenal may direct. They shall meet the following requirements:

Minimum ultimate strength..................	60,000 lbs.
Minimum elastic limit.............	33,000 "
Minimum elongation for each bar............	10%
Average elongation for a group of three tests..	12%

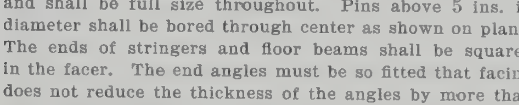

Fig. 7.—Locomotive Diagram for Live Load, Rock Island Bridge.

The elongation shall be measured in 20 ft., including the fracture. The bars will be required to break in the body. When a bar breaks in the head, but develops 10% elongation, another bar of the same size and lot shall be tested, the two tests being counted as one. If the average elongation of these two tests attains 12%, the test will be considered as satisfactory; provided, however, that no more than one bar of each group of three tests breaks in the head. In case of an unsuccessful group of tests, the engineer in charge, under direction of the commanding officer, shall examine the cause of the failure and determine which bars shall be rejected. If the bars fail in the ultimate strength, elastic limit, or elongation, the engineer in charge may reject all bars of the same melt as the defective test bar, whether already manufactured or not, or he may reject the whole bill of eye-bars. The commanding officer of the Rock Island Arsenal may, however, order additional tests. If, in a group of three tests, more than one bar breaks in the head, all bars presented by this group of tests shall be rejected. If a test bar is too long for the machine, it shall be cut in two and both halves reheaded, annealed and tested; the two tests, however, to count as one. If the cross-section of a test bar is too great for the capacity of the machine, it shall be planed down on a length of 10 ft. to a section equal to the capacity of the machine in pounds divided by 75,000, and then tested to destruction, care being taken to have all corners and angles at the places of change of section carefully rounded off. The elongation shall then be measured in 8 ft. One clevis and one sleeve nut of each size shall be tested coupled to corresponding bars. They will be required to break the bar. The bars used for these tests shall be of steel accepted for this work.

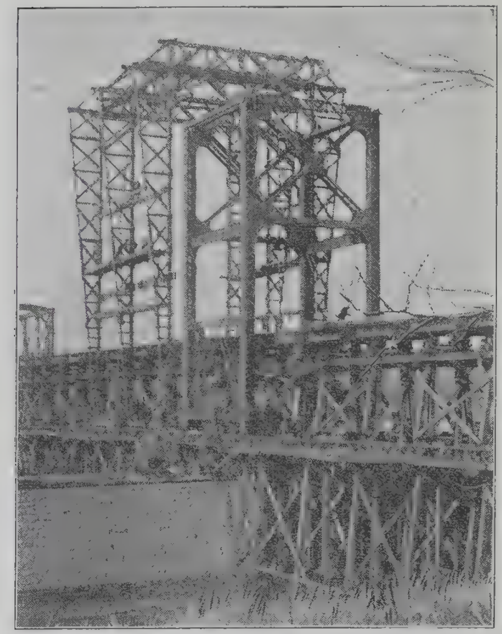

Fig. 8.—View of Falsework and Traveler Used in Erection.

The specifications have been quoted thus fully because they indicate more clearly than could be easily done in any other way the quality of workmanship and material, which are among the notable features of the bridge. In their rigidness and regard to detail they are worthy of careful study, and are characteristic of the best character of government work.

Operating Machinery.—It is not possible at the present time to give detail drawings of the operating machinery, which is in many respects novel, but the following general description in connection with the details shown by Figs. 3 and 4 will give a very fair understanding of its salient features. The contractors for this machinery were the well known firm of Geo. P. Nichols & Bro., Chicago, Ill. For the present purpose the operating machinery may be considered under five different headings, as follows:

(1) The Swinging Machinery Proper.—The rack attached to the tread on the center pier is made of cast steel, and instead of having teeth of the usual form, is made wih sprockets. On each side of the drum are two vertical shafts, supported by brackets, on the lower end of which shafts are cast steel sprocket wheels corresponding in pitch with that of the rack, which is 12 ins. These sprocket wheels carry an endless chain, with links of 12 ins. pitch, which engage the sprockets on the rack. On the upper end of these vertical shafts are sprocket wheels, which are connected by a chain to a vertical driving shaft midway between them, which rises to the floor of the machinery room. This is duplicated on the opposite side of the bridge. An interesting feature of this part is that all these vertical shafts are run on ball step bearings. On the upper end of these main vertical shafts above the machinery floor are bevel gears, one looking up and the other looking down, the two being connected through bevel pinions to a horizontal cross shaft, divided in the center where an equalizing gear is attached. By means of a train of gears a 50 HP. electric motor is connected with the shaft, thereby transmitting the power to the rack below. All the machinery in the room is mounted on one common bedplate.

(2) Rail Locks.—On each of the four ends of the tracks on the bridge are a system of rail locks consisting of heavy steel slides fitted to the outside of the rails and held in position by guides, so that they may be slid into position or withdrawn, thereby connecting the ends of the rails on the bridge with those on the fixed span, so that the wheels of the train will pass over the intervening gap on these slides without any jar, a continuous line being presented on which the wheels pass. These slides are operated by means of a pneumatic cylinder located in the center of the bridge at each end, through a system of connecting rods so arranged that all four slides at each end move simultaneously.

(3) The End Jacks.—The jacks are of the semi-toggle type, consisting of two parallel pairs of bars attached to the end beams directly under the chords by pins so as to turn freely, while on the lower end are rollers which rest on bearing plates on the shore abutment. By means of a pneumatic cylinder, a center crank and struts connected to the roller pins, these jacks are forced to a vertical position when the bridge is closed, and drawn in to release the bridge when it is to be opened.

(4) The Interlocking and Controlling System.—A Hall signal is placed on each of the fixed spans within a few feet of the ends of the draw, standing normally at danger. Connected to each of the jacks and rail locks are electric switch boxes, from which wires run through insulated pipes to an indicator in the machinery room. When any one or all of the jacks or rail locks are in a closed position, a red lamp is lighted in the indicator, one lamp for each jack or pair of rails, and when they are released for the bridge to swing, a corresponding white lamp is lighted, replacing the red. By a combination of electric connections, the man in charge of the bridge can set the signal to safety only when the end jacks and rail locks are set. Should for any reason the bridge not be properly locked, the engineer cannot receive his signal to enter upon the draw.

At the front end of the machinery room, in a bay window from which the operator can have a clear view of the tracks and river, is placed an interlocking controlling stand, having four levers, the first one to the right operating a hand brake. The second lever controls the rail locks through an air valve, and can be moved at will; this being thrown forward, the end jack lever which previously has been locked is released, the movement unlocking the motor controller lever, which now can be moved for operating the bridge. This system makes it impossible for the operator to swing the bridge until first the rail locks and then the end jacks have been released, the indicator above referred to announcing to the operator that these various devices have properly responded to the movement of his levers.

In the machinery house is also an air compressor, driven by an electric motor, and in the attic above the machinery room are two steel reservoirs of a combined capacity of 200 cu. ft., from which air is drawn to operate the various cylinders. A uniform pressure of 120 lbs. is maintained by an automatic device whereby the pump is started automatically when the pressure falls below 110 lbs. and stops when it reaches 120 lbs.

Electric current for swinging the bridge is furnished from the power station of the Tri City Ry. Co., whose wires pass directly over a support on the bridge; also from the Peoples' Power Co. of Moline, Ill., whose wires are brought up to the same support on the bridge. By means of a system of rings and brushes, current is taken from these wires are brought to the switch board in the machinery room, where a double throw-switch is placed so that the motor may be connected either with the railway wires or those of the People's Power Co. at will.

(5) Emergency Hand Devices.—To guard against any possibility of the bridge being made inoperative through any cause, a supplementary hand connection has been made for each separate device. To swing the bridge a capstan is placed underneath the roadway deck at each end and attached to the floor beams. Eye bolts are fastened in the masonry at the abutment, and at the ends of the stone protection. A heavy hawser stored on a platform near the capstan is attached to these eye bolts in case of emergency and the rope reeved around the capstan. By means of a lever this capstan can be operated by hand and the bridge opened and closed. Connected with the center crank which operates the end jacks at each end is a worm gear, to which the same lever which is used to work the capstan can be attached and the jacks may thus be raised and lowered in case of necessity. On the railway deck the rail lock system is also provided with levers so as to work independently of the air, should occasion arise.

Erection.—The principal difficulty arising in connection with the erection of the bridge was that the old structure had to be kept open to the railway traffic until the new bridge was ready for use. The method adopted to accomplish this was as follows: Underneath the roadway floor of the old bridge was built a falsework, and on top of this falsework were placed trestle bents inside the trusses and carrying the upper or railway deck. This allowed every part of the old structure except the railway floor to be removed. Since the new bridge was double tracked and the old bridge single tracked, the new trusses came outside of the old trusses. Outside of the new trusses came the traveler tracks. Obviously the falsework was made much wider than the old bridge. The photograph, Fig. 9, indicates the construction just described. The method of procedure was to remove span by span the old structure, except the railway floor, and to replace it by the new structure, the railway floor of the new structure being the last part to go into place.

End View of Swing Span, Rock Island Bridge.

Engineers and Contractors.—The Rock Island bridge was built after the designs and under the supervision of Mr. Ralph Modjeski, Assoc. M. Am. Soc. C. E., of Chicago, Ill., as Chief Engineer. Col. A. R. Buffington, Ordnance Corps, U. S. A., was the representative of the United States Government. Mr. E. H. Connor was Resident Engineer, and Byron B. Carter, Mechanical Engineer. The general contractors for the bridge were the Phoenix Bridge Co., of Phoenixville, Pa., John Sterling Deans, M. Am. Soc. C. E., Chief Engineer. The subcontractors for the substructure were Sooysmith & Co., of New York. The contractors for the operating machinery for the swing span were Geo. P. Nicholas & Bro., Chicago, Ill.

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THE WORCESTER-MILLBURY SEWAGE POLLUTION suit has resulted in a decision by the court that a nuisance exists in the Blackstone River, in Millbury; that the city must take steps to remove objectionable matter from the sewage before discharging it into the River; that the city report within three months what steps it has taken to abate the nuisance; and that the city pay the costs of the litigation. We understand that the city some months ago began exhaustive investigations looking towards important changes in its sewerage system, especially the separation of the storm water and sewage proper.

BIDS FOR GARBAGE DISPOSAL, and for a garbage disposal plant, at Milwaukee, will be received until Jan. 15, as stated in detail in our advertising columns. The garbage of the city is treated by the Merz process, described in detail in our issue of Nov. 1, 1894.

THE PROHIBITION OF WOOD PAVEMENTS in Milwaukee and the requiring of concrete foundations for all pavements, is effected by an ordinance signed by the Mayor a few days ago. The general features of the ordinance are in accordance with recommendations by Mr. Geo. H. Benzenberg, M. Am. Soc. C. E., City Engineer.

COBBLESTONE PAVEMENTS IN BALTIMORE are prohibited for the future by an ordinance just introduced in the city council. The ordinance provides that where the cost of paving is met by abutting property owners, they may choose from sheet or block asphalt, vitrified brick, Belgian blocks, mosaic blocks, or such other improved material as may be approved by the mayor and city commissioner. In case property owners do not make a selection within the specified time, it will be made by the commissioner, subject to the approval of the mayor.

SUBMERGED GAS AND WATER MAINS have been laid beneath the Quinnipiac River at New Haven, Conn. The gas main is 16 ins. and the water main 24 ins. in diameter, both being about 700 ft. long. Pile foundations were used where the bottom is soft, and Falcon flexible joints were placed about 50 ft. apart. The greatest depth of water was 25 ft., at mean high tide. The mains were tested to 150 lbs. pressure from time to time during the work, and at 80 lbs. on completion. The final test showed the gas main to be absolutely tight, while the water main leaked very slightly. The work was carried out for the water and gas companies by Mr. Jos. G. Falcon, of Evanston, Ill., as contractor, and with Mr. A. B. Hill, M. Am. Soc. C. E., of New Haven, as consulting engineer. Mr. Chas. A. Ferry was in direct charge of the work as Mr. Hill's assistant.

THE ELEVATION OF TRACKS at Allegheny, Pa., is to be carried into effect, and it is said that work will be commenced in the spring. The Pennsylvania R. R. will pay the cost of the work, but the city will pay for any damages resulting to property-owners. Mr. F. J. Torrence is chairman of the council committee on grade crossings.

THE PARK AVE. VIADUCT and its four-track drawbridge over the Harlem River, will be put in use for train service by the New York Central R. R. in January. The present low-level tracks under the viaduct will be abandoned, and the open cut filled in to the street level. The viaduct and drawbridge have been very fully described and illustrated in our columns.

THE BOSTON TERMINAL CO., of Boston, Mass., has been authorized by the Railroad Commissioners to issue additional bonds to the extent of $2,000,000. The $6,000,000 of bonds authorized last July have all been taken, and, with necessities arising to $4,115,000 in excess of that amount, the terminal company is again asking for more. It is, however, buying land for the city of Boston for streets, as well as for its great station, and out of the $10,000,000 required for expenditure the terminal company expects from the city about $1,000,000. This gives the maximum cost of the new station and approaches, roughly estimated, at between $9,000,000 and $10,000,000.

ELECTRIC AND STEAM TRACTION over the same railway tracks is briefly discussed in the report of the Railroad Commissioners of Connecticut. It is said that the New York, New Haven & Hartford R. R., with its ownership of the Meriden electric and the Stamford street roads, is admirably situated to introduce this system of operation, and that when the power-house at Berlin is finished and the electric cars are running over the New Britain branch, and over the New England R. R., between Hartford and New Britain, further developments may be expected in this direction, and, should there be sufficient travel to warrant it, the street cars of Meriden may be run into Hartford and New Haven with like connections elsewhere.

AN UNDERGROUND CABLE RAILWAY, called the Glasgow District Subway, has recently been put in operation at Glasgow, Scotland. It is a continuous belt line, 6½ miles long, partly in two single-track brick tunnels 11 ft. wide and 9 ft 6 ins. high above rail level; and partly in two circular iron-lined tunnels 11 ft. diameter. The 15 stations are in brick archwork, 28 ft. span, with an island platform at each station. In each tunnel is a 1½-in. steel cable, running at 15 miles per hour and driven by a simple non-condensing engine with one cylinder 42 × 72 ins. Messrs. Alexander Simpson, W. S. Wilson and Robert Simpson were the engineers.

THE HARDIE COMPRESSED AIR LOCOMOTIVE for trial on the New York elevated railways has been completed at the works of the New York Locomotive Co., Rome, N. Y. According to report it resembles the present steam locomotives, except that it has no smokestack, and a two-wheel instead of a four-wheel truck. The four driving wheels are under the reservoir which takes the place of the boiler, and the cylinders are under the cab. A compressor plant is being established at Greenwich St.

FOUR-CENT STREET CAR FARES IN CHICAGO are made compulsory by a bill passed by the common council by a vote of 63 to 3. The bill must still be approved by the mayor. It provides that six tickets must be sold for 25 cts., 12 for 50 cts., and 25 for $1.

THE UNDERGROUND TROLLEY SYSTEM, which is employed in the street railways in Lenox and upper Lexington Avenues in New York city, was stopped by the heavy snow storm on Dec. 16. The cause of the stoppage and the plan proposed for preventing it in future, was thus explained by Mr. F. S. Pierson, Chief Engineer of the Metropolitan Traction Co.:

> A sudden drop in the temperature caused a thin coating of ice to form on the underground rails that carry the electric current. The shoes that slide along these rails and carry the current through the motor slid over the ice until the cars stopped. The ice acting as an insulator shut off the current from the car entirely. It took us some time to find out what the trouble was, and then we spent several hours equipping a car with knife-like scrapers that would take this ice off. By the time we got this car in working order the slots had filled up with snow and slush to such an extent that the tracks were so covered with snow that it took many hours to get the roads open. The loss of electricity through the slush and snow was comparatively small. Pure snow is not a conductor, but an insulator. It is the slush that runs into the slots from the street that causes the "grounding" of the current, as we call it. Now that we know that ice may form on the underground rails, we will be prepared with plows to scrape it off.
>
> During the time that the Lexington and Lenox Avenue lines have been running they have never been blocked until yesterday. It is because of the success of these lines that the traction company has decided to put the underground electric system on the Sixth and Fourth Avenue lines. The system will work better on the downtown lines, because the cars will be run so often that they will keep the conduit cleaner. With plants to supply plenty of extra power when it is wanted, and cars equipped to scrape away the ice and snow from the electric rails, the electric system is just as reliable as the cable.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a glancing collision on the Erie R. R., near Rutherford, N. J., Dec. 22. As an eastbound freight train was approaching a westbound passenger train one of the freight cars jumped the track and fouled the other track so that it was struck by the passenger train. The engine was upset and the engineman and fireman were killed, but none of the passengers were hurt. As far as the officers of the road have been able to ascertain, the freight car was thrown from the track in front of the passenger train on account of a brakebeam falling upon the track.——A derailment at Danville Junction, Me., on the Grand Trunk Ry., was caused Dec. 21 by a broken rail. The engine and three passenger cars went down a 30-ft bank and 12 persons were injured, but none very seriously.

THE POWERHOUSE of the Lookout Mountain & Lula Lake incline railway, at Chattanooga, Tenn., was destroyed by fire Dec. 12. The car at the top was released by the burning in two of the cable, and ran down the incline until it left the track at a curve.

A WIRE SUSPENSION BRIDGE over Fish Creek, Wheeling, W. Va., gave way under a crowd Dec. 21, throwing about 40 persons into the creek. Two persons were killed.——The White Rock Creek bridge, near Boulder, Colo., gave way under a traction engine and reaping machine Dec. 14.

A BOILER EXPLOSION at a mine near Mingo Church, Pa., Dec. 14, resulted in the death of the engineman. The boiler was being started up to pump out the mine.——One of the boilers of the Kent Woolen Co.'s mill at Centreville, R. I., exploded Dec. 19, killing four persons. The boiler is said to have been of the Allen return tubular type, and to have been inspected only a few weeks before the accident.

A BROKEN HOISTING CABLE at the Virginius mine, Ouray, Colo., caused the cage to drop 1,400 ft. The five men in the cage were killed.

A GRADE-CROSSING COLLISION between an electric car and a locomotive occurred Dec. 16 at Dighton, Mass., on the New York, New Haven & Hartford R. R. The car ran away on the hill aproaching the crossing and knocked the locomotive off the track. Nobody was hurt.

THE BURNING OF THE SCHENLEY PARK CASINO in Pittsburg on Dec. 16, which caused the total destruction of the building and a loss of $400,000, was due to a most unusual cause. The building contained an ammonia refrigerating plant. The cylinder of one of the ammonia pumps burst, and the ammonia gas escaping came in contact with the fire in the boilers, and at once set the building on fire.

LAND-SLIDES CAUSED BY IRRIGATION have occurred on the line of the Canadian Pacific Ry. in British Columbia, and Col. Robert B. Stanton, M. Am. Soc. C. E., and Mr. James D. Schuyler, M. Am. Soc. C. E., were lately appointed a board of experts to examine into the matter for the railway company The San Diego "Union" speaks as follows of their experience:

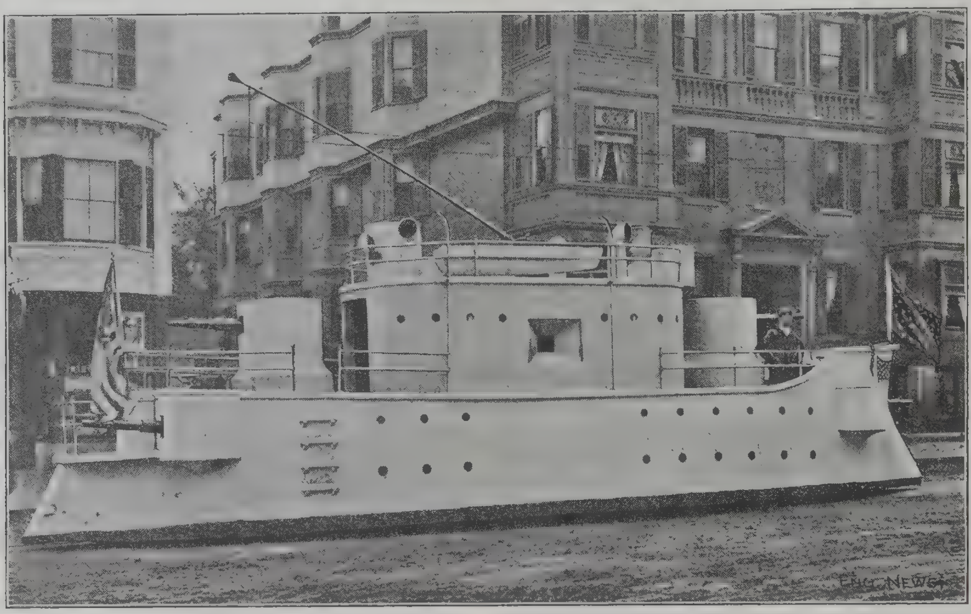
> An action has been brought by the Canadian Pacific Ry. Co. to secure an injunction against the farmers on Thompson River to prevent them from further irrigating lands contiguous to the railways, this irrigation having already caused land-slides which have swept down upon the tracks of the company. Along this river the land rises in benches extending from 50 to 500 ft. above the river. The soil is gravelly, with a clay sub-soil. The farmers irrigate their lands by water from creeks back in the mountains, and the land is sliding downward apparently on the slippery clay sub-soil. In one place 66 acres have slid down in a mass, and the experts estimate the volume of one of these slides at 32,000,000 tons. At times the railway track has been shoved 5 ft. out of line in one night, causing great outlay in reconstruction. The jury has found in favor of the railway company, ascribing the slides to the irrigation.

THE CORROSION OF STEEL BOILERS by surface feed waters is being studied by the Steam Users' Association, and a circular has been issued to the members by Mr. Geo. Atkinson, Secy., 87 Milk St., Boston, asking for information concerning such corrosion and for samples of the feed water. An investigation of this corrosive action is about to be made by the Department of Water Analysis of the Massachusetts Institute of Technology, in charge of Mrs. Ellen H. Richards, to whom will be furnished samples of the water collected by the Steam Users' Association.

A SUBMARINE BOAT FOR WRECKING AND EXploring purposes is about to be built by the Columbian Iron Works, of Baltimore, after the plans of Mr. Simon Lake, a Baltimore inventor. The practicability of the design, it is stated, has been proved by experience upon a small boat. The boat will be capable of rising to the surface and submerging at will, and it may be propelled in any desired direction when on the bottom. A door may be opened, through which the occupants, by donning a diving suit, may pass from the interior to the outside and back again. The boat will be used principally for searching the bed of the ocean adjacent to coast lines and in locating and recovering sunken vessels and their cargoes. It will be about 54 tons displacement and will carry a crew of six men. It will be propelled while on the surface by an engine and screw of the ordinary type, and while under water the screw will be driven by an electric motor, taking current from storage batteries. A searchlight will light up the pathway of the vessel as she moves along the bottom.

A WARSHIP ON A STREET RAILWAY.

The novel sight of a make-believe warship moving through the streets was a feature of many parades in Fitchburg, Mass., and neighboring towns during the recent election campaign. This singular craft is shown in the accompanying view, taken from a photograph sent us by Mr. W. W. Sargent, Superintendent of the Fitchburg & Leominster Street Ry. Co. The vessel was 37 ft. long, and was built on a construction car 26 ft. long, with a wheel base of 6 ft. 6 ins., equipped with two 30-HP. Westinghouse motors. It was constructed of sheathing and timber, the whole being covered with canvas painted and varnished. The hull, turrets and boats were painted white; superstructure, yellow; iron work, bronze; guns, anchor and anchor chain, black. It was lighted with 25 incandescent lamps, and red fire was burned in the smokestack. It made all its trips without a breakdown or accident of any kind. At one time it carried 104 men, this being the entire crew of officers and men. The car was designed to run slowly through the street during a procession, with its crew marching in front, on both sides and in the rear, while many of the officers would ride; then during a long trip from town to town officers and men would ride together. It has now been dismantled and will be erected on a raft at the pleasure park of the railway company in the early spring. The boat was designed by Mr. W. W. Lapointe, naval architect, and was constructed at the car house of the railway company under the direct supervision of Mr. Sargent.



A WARSHIP ON THE FITCHBURG & LEOMINSTER ELECTRIC RAILWAY.

MATHEMATICAL THEORY OF THE LIPPINCOTT PLANIMETER.

By Townsend Wolcott.

The accompanying engravings represent a new form of planimeter, which has been designed to obviate the defects which exist in other instruments of this class.

The wheel has a knife-edge, and is free to move on its shaft, so that there can be no slipping on the surface upon which it travels, giving the same results upon the roughest table as when used upon the finest paper.

In other instruments, in tracing some lines of the diagram, the wheel travels at right angles to its shaft, so that it can roll freely; at other points, the direction of its motion is changed until it is compelled to move in a line with its axis, so that the edge simply scrapes over the paper. For this reason the accuracy of these instruments is largely dependent on the texture of the surface upon which the wheel moves. This feature also causes a variable resistance, which makes it difficult to closely follow the lines. With the Lippincott planimeter the sliding is done entirely upon the shaft, and not on the paper, and as this shaft is made of glass, it is practically frictionless.

Inside of this glass shaft is placed the scale, which is printed upon specially prepared paper, so that the greatest contrast and legibility may be ensured. The ends of the shaft are then hermetically sealed under a partial vacuum, so that the scale can never become discolored, or affected by the atmosphere.

Three of these tubes are provided with the instrument, each containing two scales, so that the mean effective pressure can be read directly for the following springs: 8, 10, 12, 16, 20, 24, 30, 32, 40, 50, 60 and 80, or other graduations can be substituted. The legibility of these scales can be seen by referring to Fig. 2, which shows the scale and tube full size.

By pressing the small knob found on the top of the instrument, as in Fig. 3, a steel point, P, is protruded through the pivot screw, thus providing a convenient method of setting the instrument to the length of the diagram to be measured.

With this construction, no bending of the tracer point can affect the reading, which is not the case where separate points are provided on the top for setting to the card length. This improvement is of vital importance where absolute correctness is demanded.

To use the instrument, select a tube containing the scale corresponding to spring used in taking the card, and insert the same in the clamp, as in Fig. 1, after which the clamp screw C is to be tightened sufficiently to prevent the tube from being easily moved.

Loosen the set screw and adjust the points P and T to the exact length of card, holding the instrument as in Fig. 3. The set screw is then firmly tightened.

Having fastened the card upon the table by thumb tacks, place the instrument as shown in Fig. 1, but with the tracer-point T at the upper left hand corner of the diagram. The wheel may be readily set to zero by moving the point R to the right or left before finally pressing it into the surface.

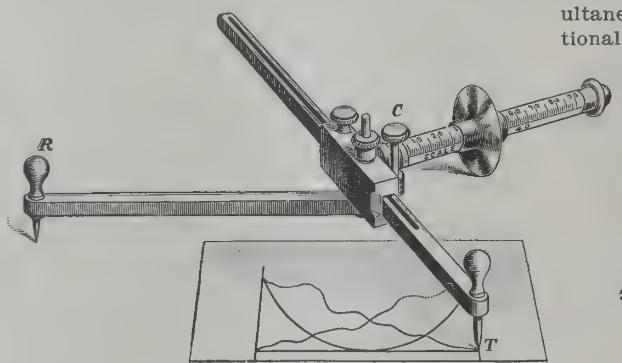


Fig. 1.

In tracing the right-hand diagram of Fig. 1, the starting point should be made somewhere in the steam line, so that the wheel will not strike the clamp before it moves to the right.

If the diagram is very short, the points may be set twice the card length. By tracing the diagram twice, the reading will be the M. E. P.

If a reading is desired in square inches, use a 40 scale, and set the points 4 ins. apart, without regard to length of figure. The points may also be set 5 ins. apart, and a 50 scale used, or 6 ins., and a 60 scale. The latter is preferable, when the figure is large.

As the operation of this planimeter is so different from that of other instruments of its class, it is thought that an explanation of its theory may interest the readers of Engineering News.

The essential peculiarity of the Lippincott planimeter is, that the quantity directly measured is not the rotation of a wheel, as in most other planimeters, but the axial motion of the wheel upon its shaft. As the rotation of the wheel is not measured, its amount is immaterial; and consequently the wheel may have any convenient diameter, and if the diameter becomes reduced by wear, no harm is done. In order that the wheel may register accurately, it is only necessary that it should be able to revolve upon its own axis, and upon a vertical axis through its point of contact with the surface on which it rolls, without skidding or slipping sidewise.

Like other planimeters it measures areas, but by selecting the proper scale and properly adjusting the tracing arm, the reading of the scale will give the area in the required units multiplied or divided by any required constant. The instrument is intended chiefly for measuring indicator cards where the required quantity is not the area but the mean effective pressure, which is obtained by dividing the area by the length. This is the quantity that the instrument gives when the scale used in the instrument is the scale of the spring with which the card was taken, and the length of the tracing arm is the same as the length of the card.

In the diagram, Fig. 4, we will first suppose the polar arm P stationary. As the tracing arm T revolves about the center O, the short arm t describes an equal angle in the same time, and the axis of the scale tube does the same. The axis of the scale tube therefore remains at all times tangent to the circle c. As the point of tangency is advanced through an elementary distance $t\,d\,\theta$, (θ being the angular motion of the tracing point in circular measure), it is evident that the rest of the scale tube must be pulled through the same linear distance, and that it also swings through the same angle $d\,\theta$. The angular motion is allowed for by the rotation of the integrating wheel, and the linear motion by the scale tube sliding through the hub of the wheel. The scale therefore registers the elementary arc $t\,d\,\theta$, and t being constant, the integral $\int t\,d\,\theta = t\,\theta$. The point of contact of the integrating wheel therefore moves in an involute to the circle c.

The sliding of the wheel upon the scale, due to the angular motion of T, is not affected by a simultaneous motion of P, for it is simply proportional to the angular motion of T in all positions of P. In carrying the tracing point around a closed figure, and back to the starting point it is evident that the arm T makes equal excursions in both directions. Therefore whatever the shape of the figure, for every positive element $t\,d\,\theta$, there is at some other part of the perimeter a corresponding negative element, $-\,t\,d\,\theta$,

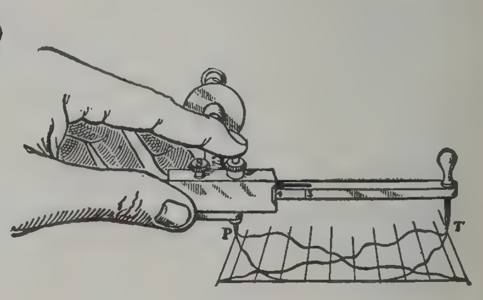


Fig. 3.

and t being a constant these two elements cancel and the integral $\int t\, d\, \theta$ taken clear around any closed path equals zero. As in practical use, the tracing point is always moved clear around a closed path, this motion of T or t does not in any way affect the final scale reading.

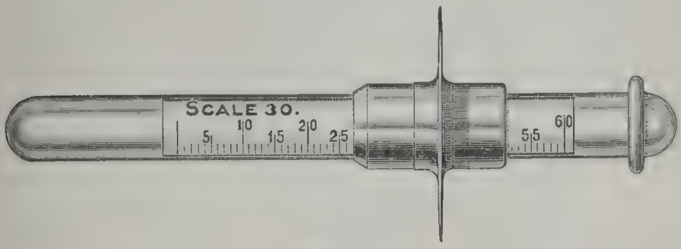


Fig. 2.

The only other motion in the instrument is the angular motion of the polar arm P. Suppose for the moment that these arms t and P are fixed at the angle ψ. The scale tube axis produced, is tangent to the circle e, and by a chain of reasoning similar to that before employed, it may be shown that the angular motion $d\, \varphi$ of the arm P causes an axial motion of the integrating wheel through a distance equal to the corresponding arc of the circle e. This is true also for the instantaneous motion $d\, \varphi$ when ψ is variable. In any given figure, ψ is a function of φ. The triangles O f h and R g h, are similar, and right-angled; therefore $\frac{t}{\cos \psi} = \overline{O\, h}$, and $\overline{O\, h} : \overline{h\, R} :: t : \overline{g\, R}$. That is $\frac{t}{\cos \psi} : P - \frac{t}{\cos \psi} :: t : g\, R$, or $P \cos \psi - t = \overline{g\, R}$, and the axial motion of the integrating wheel is $\int (P \cos \psi - t)\, d\, \varphi$. The integral $-\int t\, d\, \varphi$ disappears for a closed path, just as does the integral $\int t\, d\, \theta$, so that all that remains is the integral $\int P \cos \psi\, d\, \varphi$.

This does not in general disappear for a closed path, for ψ being variable the corresponding elements $P \cos \psi\, d\, \varphi$ and $- P \cos \psi\, d\, \varphi$ are not necessarily numerically equal, and do not necessarily cancel.

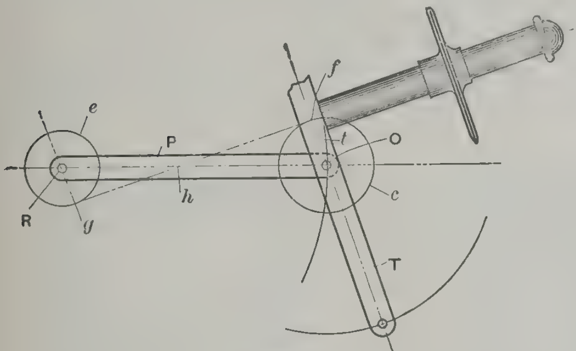


Fig. 4.

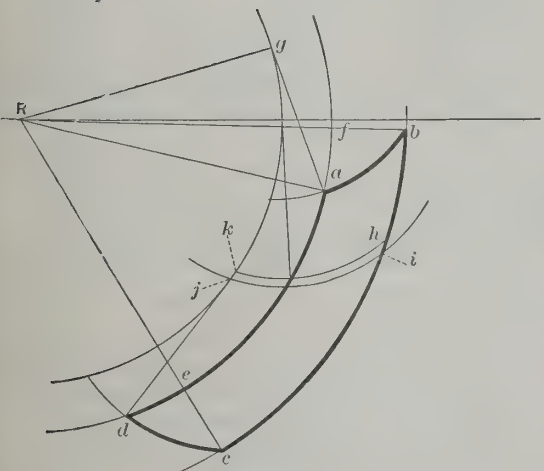


Fig. 5.

To show that the integral $\int P \cos \psi\, d\, \varphi$, is proportional to the area actually described by the tracing point, we will first take the area a, b, c, d, e, in Fig. 5. In this figure $\overline{R\, g} = P$, $\overline{g\, a} = T$, and g is a right angle. That is $\psi = \frac{\pi}{2}$ and $\cos \psi = 0$, and therefore $\int P \cos \psi\, d\, \varphi = 0$, from d to a. From a to b, φ is constant, and also from c to d, leaving only the arc from b to c, where the integral is finite. Now for this portion of the path ψ being constant $\int P \cos \psi\, d\, \varphi = P \cos \psi .\, \varphi$. As the figure c, d, e equals the figure b, a, f, the figure a, b, c, d, e equals the figure b, c, e, a, f. The area of this by the rule for circular sectors, is

$$\frac{\overline{R,\, b}^2 - \overline{R,\, a}^2}{2}\, \varphi.$$

The radius $\overline{R,\, b}$ is the third and longest side of a triangle, the other (given) sides being P and T, and the included angle the supplement of ψ. In Fig. 6, erect the perpendicular $\overline{p,\, q}$; this is evidently equal to $T \sin \psi$, and $O,\, p = T \cos \psi$. Then $\overline{R,\, b}^2 = (P + T \cos \psi)^2 + (T \sin \psi)^2 = P^2 + 2\, P\, T \cos \psi + T^2 (\cos \psi)^2 + T^2 (\sin \psi)^2 = P^2 + T^2 + 2\, P\, T \cos \psi$. The square of the radius $\overline{R,\, a}^2 = P^2 + T^2$, therefore,

$$\frac{\overline{R,\, b}^2 - \overline{R,\, a}^2}{2}\, \varphi = P\, T \cos \psi .\, \varphi.$$

which differs from the scale reading only by the constant coefficient T.

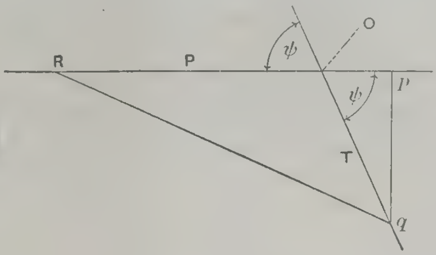


Fig. 6.

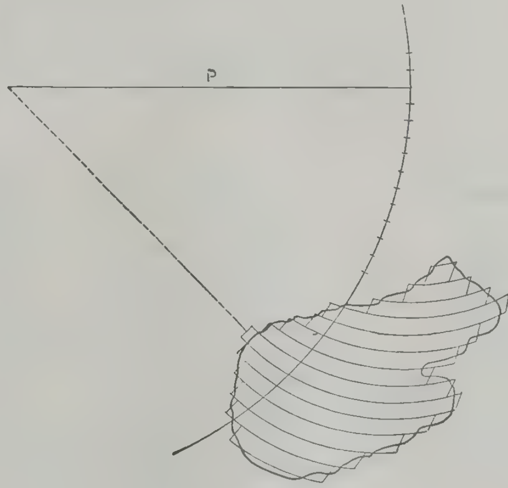


Fig. 7.

For any radius smaller than $\overline{R\, .\, a} = \sqrt{P^2 + T^2}$, ψ is obtuse and therefore $\cos \psi$ is negative. But if the tracing motion be reversed φ becomes negative, and $\cos \psi .\, \varphi$ positive. This is what it should be, for if the tracing point move from b to c to register positively, giving the correct area (or known fraction thereof) it must move in the opposite direction to add an area lying within the zero circle d, e, a, f, otherwise the combined area could not be evaluated by a single continuous motion of the tracing point around the figure.

Having shown that the planimeter correctly evaluates a figure of the form of Fig. 6, it remains to show that it will do the same for any other figure. In the elementary area h, i, j, k, Fig. 5, the ends $\overline{h\, .\, i}$ and $\overline{j\, .\, k}$ are the only parts that contribute anything to the scale movement, $P \cos \psi\, d\, \varphi$., Therefore, if any number of these elements be placed side by side, their combined perimeter will be less than the sums of their separate perimeters by twice the length of the coalescing sides, yet as these coalescing sides take nothing from the scale reading the combined area is correctly evaluated. By taking these elementary areas of different lengths a finite area of any form may be built up, as in Fig. 7, and its area will evidently be correctly evaluated by following its perimeter with the tracing point.

In an indicator card, the area of the diagram divided by its length gives the mean ordinate. Therefore, if in this planimeter the length of the arm T be made equal to the length of the diagram, the scale reading will give the mean ordinate, for the scale reading is $\int P \cos \psi\, d\, \varphi$, and the area $\int T\, P \cos \psi\, d\, \varphi$. If this movement is measured with the scale of the spring with which the card was taken, the scale reading is the mean effective pressure.

The Lippincott planimeter is sold by the Hine & Robertson Co., 68 Cortlandt St., New York city. Its price is $15.

WATER DEVELOPMENT BY TUNNELING AT ONTARIO CAL.

By Jas. T. Taylor, M. Am. Soc. C. E.

The Ontario Tunnel, commonly known as the Bodenhammer Tunnel, is located on Mountain Ave., about one mile west of the famous Euclid Ave. of the Ontario Colony lands, San Bernardino Co., Cal., and about 5½ miles northwesterly from the growing and prosperous city of Ontario.

The mouth of the tunnel is very near the San Bernardino base line, at an elevation of some 1,700 ft. above sea level, and commanding a large area of land which has been demonstrated to be first class for the successful growth of citrus fruits.

Mountain Ave. runs north and south and at right angles to the general slope of the upper portion of the valley, or mesa, and has an average fall of about 200 ft. per mile.

The object of the tunnel was to intercept the underflow from the mountain range known as the Sierra Madre, and divert the waters so developed by gravity into the present system for an increased supply of the Ontario lands, and possibly other lands in the immediate vicinity.

Prior to the commencement of the tunnel proper several shafts were sunk to a considerable depth and tests of the water supply made by pumping. These tests, as reported, seemed to indicate a considerable volume of water available, and to support in a measure the theory advanced by the promoters, and concurred in by the "water witch enthusiasts," that a stream af water exceeding 1,000 ins. was running to waste, and only required tapping to secure and control the precious fluid.

The glowing accounts and reports of the hidden treasures, coupled with the growing necessity for a more ample supply of water for the Ontario lands, led to the making of the contract by the San Antonio Water Co., on the part of the property owners, with Mr. Bodenhammer, et al., the promoters, for the development and delivery of a water supply, on a basis of $500 per in., measured at the mouth of the tunnel, the company to furnish the capital for the development under the management of the promoters.

The tunnel is timbered throughout with 6 × 6-in. redwood, and 2 × 6-in. redwood for lugging. The bottom width is 4 ft. in the clear, the top width 3½ ft., and the height is 6 ft. The bottom of the tunnel and the sides to a height of 1 ft. are lined with concrete. The total length of tunnel is about a mile, and there is about one-fourth mile more of shafts along the line of the tunnel.

Nothing of particular interest occurred in the cutting of the tunnel until the water stratum was entered at the face of the tunnel, causing a cave. After abandoning further development in the main tunnel, considerable water flowed into the tunnel for a time, until, about Jan. 1, 1896, it reached its normal flow, discharging at the mouth of the tunnel 4 miners' ins.

At this time the promoters of the enterprise decided to connect the tunnel with a shaft about 210 ft. deep, at a point about 20 ft. back from the face, and run side drifts or tunnels into the water-bearing stratum above the main tunnel, first by pipes and afterwards by shaft. Some four wells were driven before a connection was made to be of any benefit in increasing the supply of water in the tunnel below. The first well was started with pipe 14 ins. in diameter, and reducing to 12, 10, 8 and 6 ins. The second well was bored to a depth of 165 ft., where some tools were lost and this well abandoned. Well No. 3 met with the same fate at about 175 ft., and well No. 4 was finally driven to the tunnel and a connection made. On cutting the pipe at the water stratum, some considerable water was obtained for a time, diminishing, however, until the normal flow was reached, which resulted in about 30 miners' ins. The pipe also filled with debris, and it was found necessary to excavate the shaft the full depth to allow the water to enter the tunnel.

The sinking of the shaft was a very tedious and expensive operation, as the several pipes had to be cut out in pieces as the work progressed.

The expense of the work, including tunnel, shafts and accessories, has exceeded $75,000, and the additional tunnel must be necessarily expensive.

In consequence of the existing conditions, and the enormous outlay and resultant limited supply of water, sealed proposals were called for, to be received on Monday, Sept. 13, at Ontario, Cal., by the San Antonio Water Co., for the construction of certain proposed extensions of the tunnel, resulting in the awarding of a small contract to a local contractor. Work is still progressing on the tunnel, with some success in increasing the water supply.

This tunnel is one of the sources of water supply of the Model Colony, of Ontario. The total supply for the present season is now approximately as follows:

	Miners' ins.
San Antonio Creek	165
San Antonio Tunnel	81
Frankish & Staur Tunnel	18
Bodenhammer Tunnel	25
Total	289

The direct effect of the light rainfall for the winter of 1895 is shown by the unusually small surface flow of the San Antonio Creek.

THE STRUCTURAL FRAMEWORK OF THE ASTOR HOTEL, NEW YORK CITY.

(With inset.)

We illustrate this week the principal details of the structural work of the new Astor Hotel, now being erected at Fifth Ave. and 34th St., New York city, for Mr. John Jacob Astor. Mr. H. J. Hardenbergh is the architect, and the steel structural skeleton has been designed by and built under the supervision of Messrs. Purdy & Henderson, of New York city. Mr. John Downey is the general contractor, and the steel work has been built and erected by J. B. & J. M. Cornell, of New York. We are indebted to Messrs. Purdy & Henderson and to Mr. Hardenbergh, for the material used in the preparation of this article.

The Astor Hotel adjoins the famous Waldorf Hotel, on the northwest corner of Fifth Ave. and 33d St. The architectural design of the new building has been made to harmonize with that of the older one. The main dining-room in the new building will connect directly with that of the Waldorf, making practically one room extending across the entire length of the Fifth Ave. front of the ground floor of the two buildings. This room, 50 × 200 ft., will be practically unobstructed by columns, having only a row of columns along each side, about 6 ft. from the wall. The great ballroom, 85 × 96 ft., on the first floor, will also be free from columns, so that special truss designs have had to be introduced to carry the columns of the upper floors. On the 34th St. side of the first floor there will also be a banquet room, 40 × 72 ft., occupying the space between two rows of columns, 40 ft. apart, this space being spanned by heavy plate girders. The site occupied by the building is 98 ft. 9 ins. × 335 ft., with the shorter side fronting on Fifth Ave., and the rear will be broken by four light courts. The 34th St. front will be opened so that at the main entrance carriages can be driven across the sidewalk directly into the building. The steel columns on the front of the building are covered with cement grouting, brickwork, and a sandstone finish. The exterior of the building is of red brick, with red sandstone trimmings.

The foundations are all on solid rock, 35 ft. below the street level, or deeper where required. The rock surface was found about 3 ft. below the level of the street, at the Fifth Ave. end, and then at increasing depths to a maximum of 65 ft. under the western end of the building. Foundations extending below the 35 ft. level were opened for the required area, and built up with concrete. The carrying load was 29,000 lbs. per sq. ft. at the top of the concrete piers thus formed. Upon the rock or the concrete piers (as the case may be) are brick piers, with granite caps for the column shoes.

Fig. 1 is a diagram plan showing the arrangement of the columns, but its more important purpose is to show the position of the several trusses, to which reference will be made later. The three trusses, D, E, F, on the east side of the building are to support the columns above the first floor, leaving the ground floor clear for the great dining-room, which occupies the space between columns 1, 16, 17 and 21. The trusses at the west end of the building are to carry the columns above the fourth floor, leaving that part of the fourth floor clear of columns for the great ballroom, which will be 85 × 96 ft., occupying the space between columns 162, 167, 219 and 226.

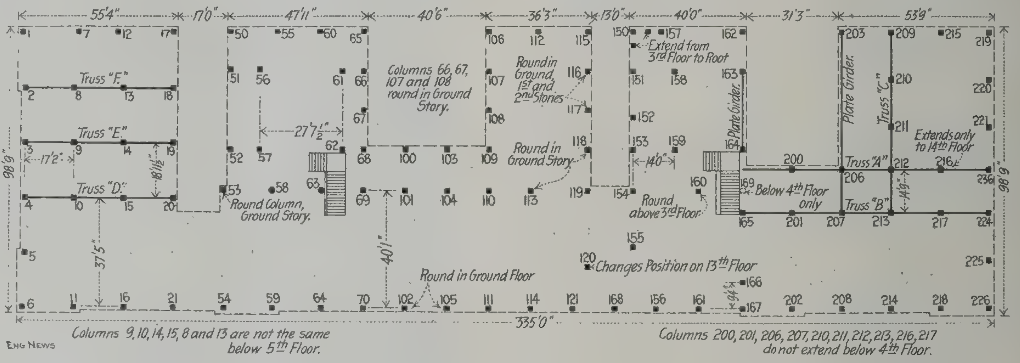

55'4"
17'0"
47'11"
40'6"
36'3"
13'0"
40'0"
31'3"
53'9"
98'9"
Truss "F."
Truss "E."
Truss "D."
17'2"
18'11½"
37'5"
27'7½"
40'1"
14'0"
14'9"
Columns 66, 67, 107 and 108 round in Ground Story.
Round in Ground, 1st and 2nd Stories
Round in Ground Story
Round Column, Ground Story.
Extend from 3rd Floor to Roof
Plate Girder.
Plate Girder.
Truss "C."
Truss "A"
Truss "B"
Extends only to 14th Floor
Below 4th Floor only
Round above 3rd Floor
Changes Position on 13th Floor
Round in Ground Floor
335'0"
Columns 9, 10, 14, 15, 8 and 13 are not the same below 5th Floor.
Columns 200, 201, 206, 207, 210, 211, 212, 213, 216, 217 do not extend below 4th Floor.
Eng News

FIG. 1.—PLAN SHOWING COLUMNS AND TRUSSES IN THE ASTOR HOTEL, NEW YORK CITY.

Fig. 2 shows a part of the floor framing of the eighth floor, and is a typical example of the framing system adopted, which is composed of I-beams and plate girders, there being some 1,600 tons of the latter in the building.

Fig. 3 is a portion of one of the architect's plans of the interior arrangement, and represents the general arrangement of rooms, etc., on the eighth floor. This is shown merely as an example of the design, since the arrangement varies, of course, on nearly every floor, and it is this irregularity in floor plan which, as already noted, has caused so much unusual study in the design of the structural arrangement, this structural design having been subordinated to the architectural design regardless of expense.

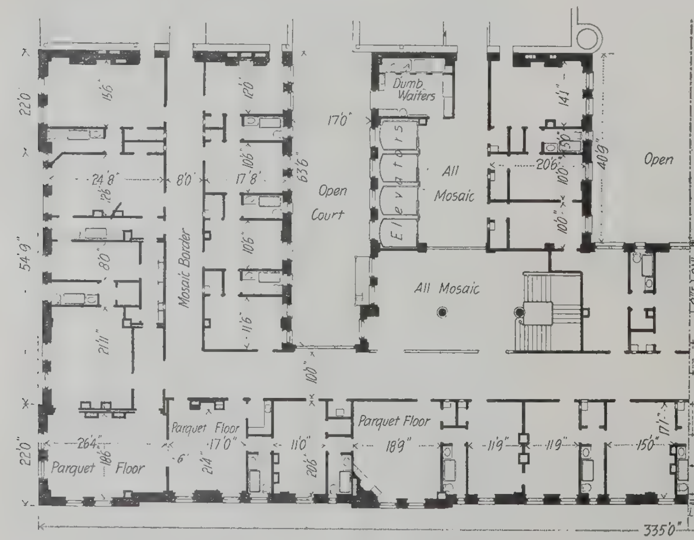


FIG. 3.—PART PLAN OF INTERIOR ARRANGEMENT (EIGHTH FLOOR).

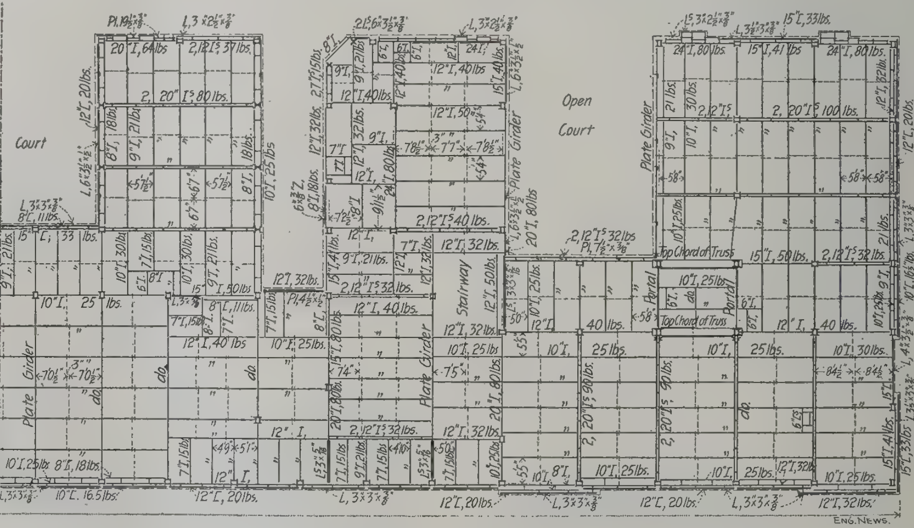


FIG. 2.—PART PLAN OF FLOOR FRAMING (EIGHTH FLOOR).

This eighth floor is one of the floors devoted entirely to living rooms, and it will be noted that the suites of rooms on the Fifth Ave. front have a private hallway inside of the main public corridor. All the rooms have either gas-log hearths or open fireplaces, and the number of flues required by the latter proved to be one of the disturbing elements in the structural design, it being necessary to arrange the framing and connections so as to leave room for the flues and the necessary clothing to protect the metal work.

An interesting detail to which attention may be called is the arrangement of the small spaces for "shoe boxes," one to each room. In every large hotel, the management is constantly troubled by the loss or theft of boots and shoes left to be cleaned, and as this not only causes much annoyance but also considerable expense in providing new shoes to replace those which have been stolen, steps have been taken to put a check upon this in the Astor Hotel. In the corridor partition of each room is an aperture just above the floor, and on the inside of the room is a shoe box, having a glass door flush with the partition and another door opening into the room. The occupant of the room puts his shoes in the box at night and latches the door. The porter making

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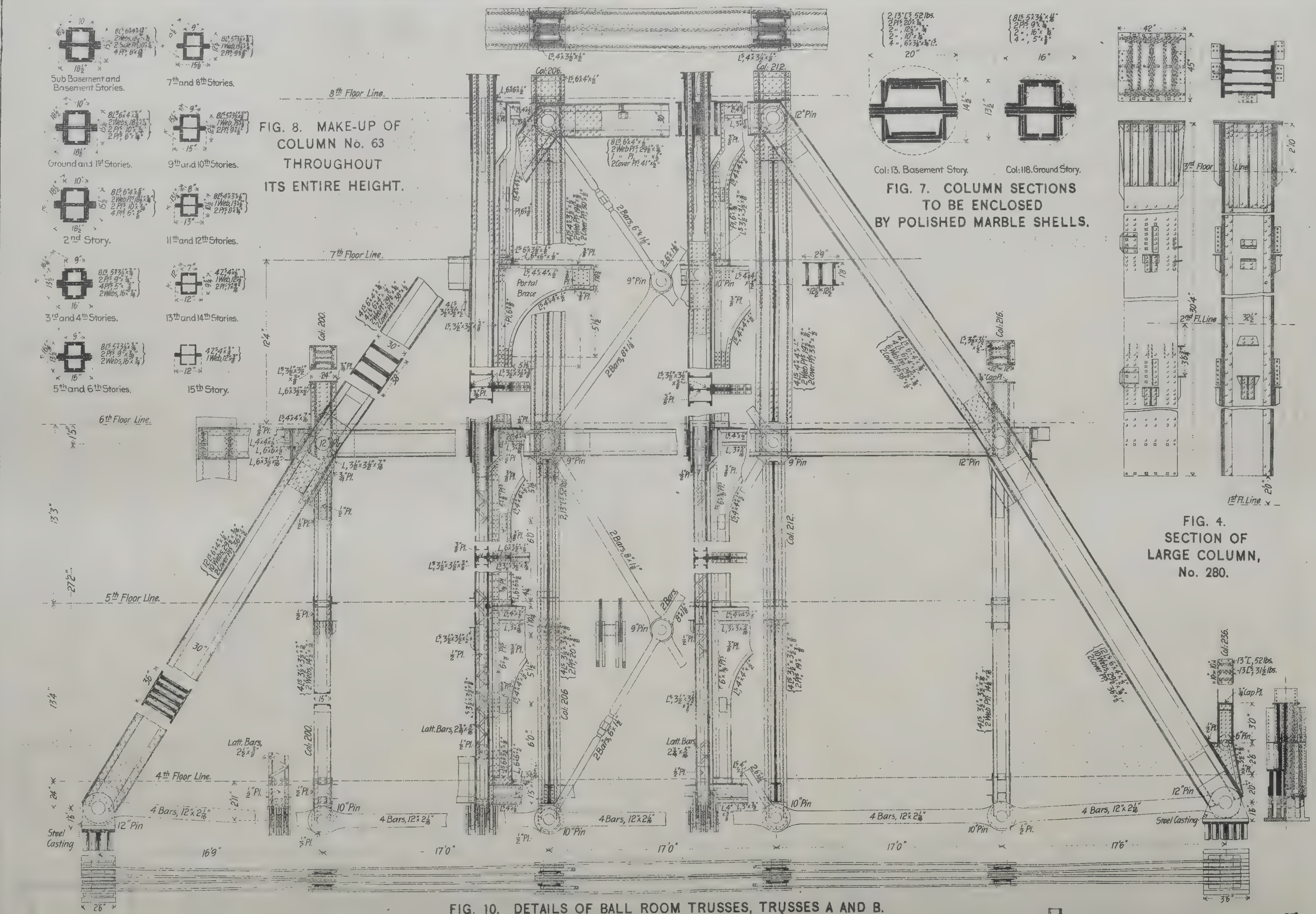
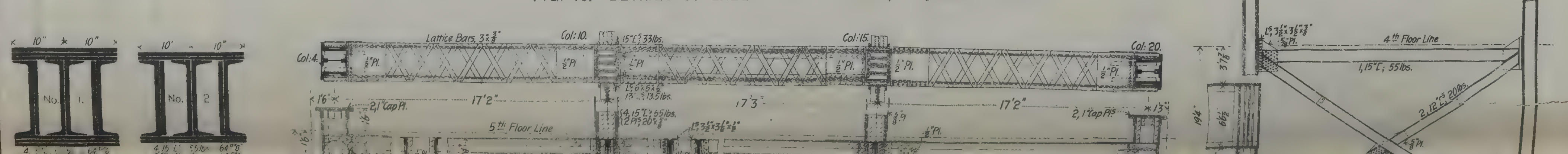


FIG. 8. MAKE-UP OF COLUMN No. 63 THROUGHOUT ITS ENTIRE HEIGHT.

FIG. 7. COLUMN SECTIONS TO BE ENCLOSED BY POLISHED MARBLE SHELLS.

FIG. 4. SECTION OF LARGE COLUMN, No. 280.

FIG. 10. DETAILS OF BALL ROOM TRUSSES, TRUSSES A AND B.



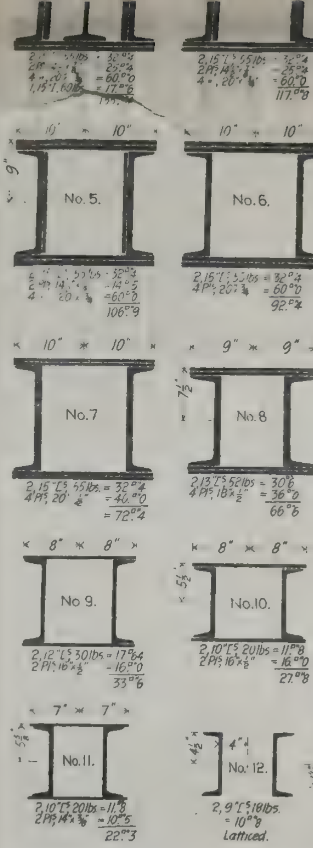


FIG. 6.
TYPES OF
STANDARD
COLUMN SECTIONS

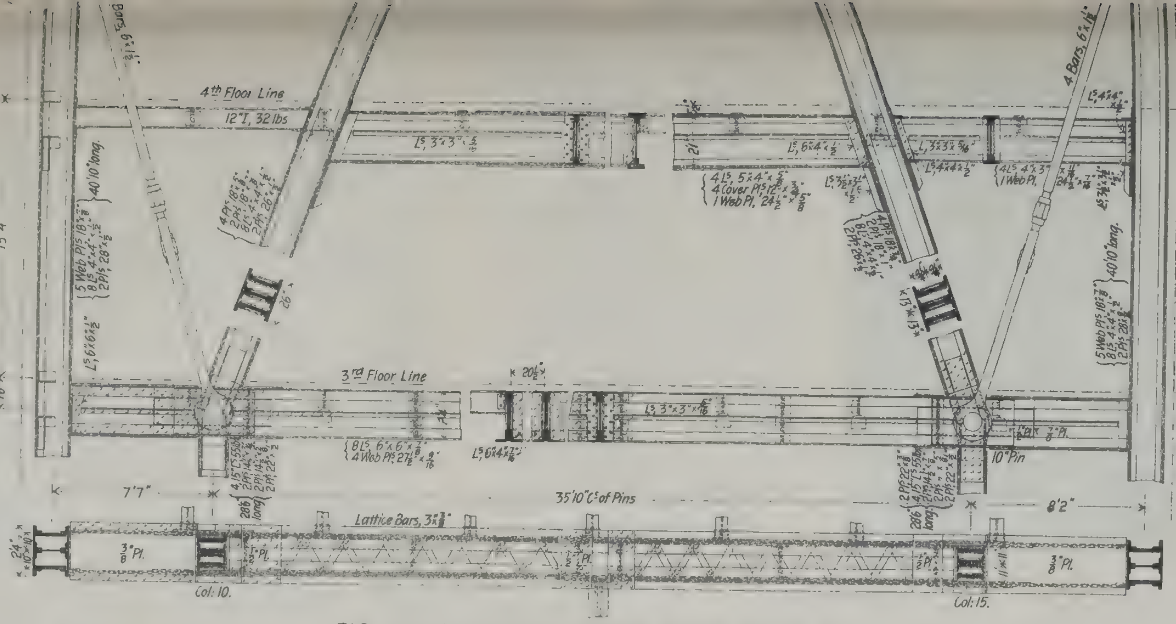


FIG. 16. DETAILS OF DINING ROOM TRUSS D.

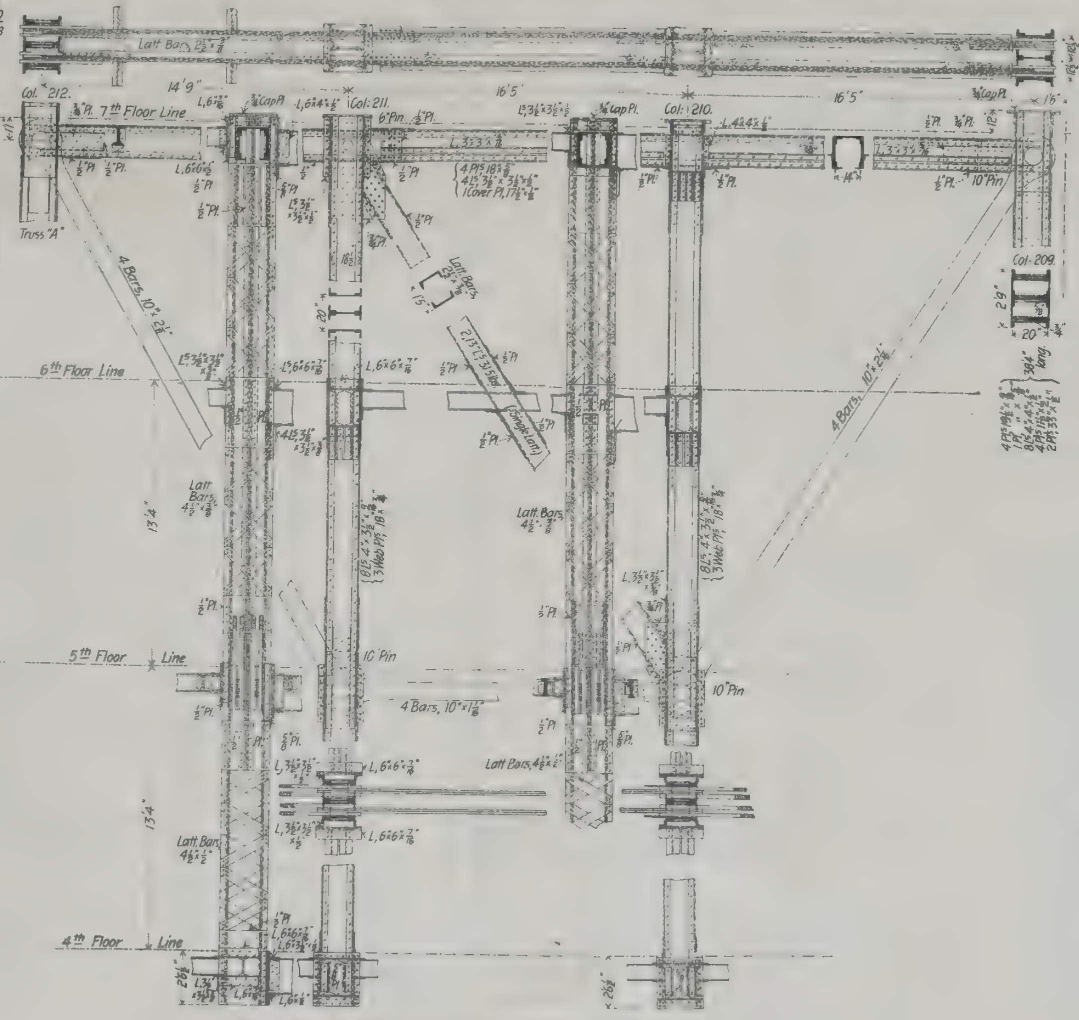


FIG. 15. DETAILS OF BALL ROOM TRUSS C.

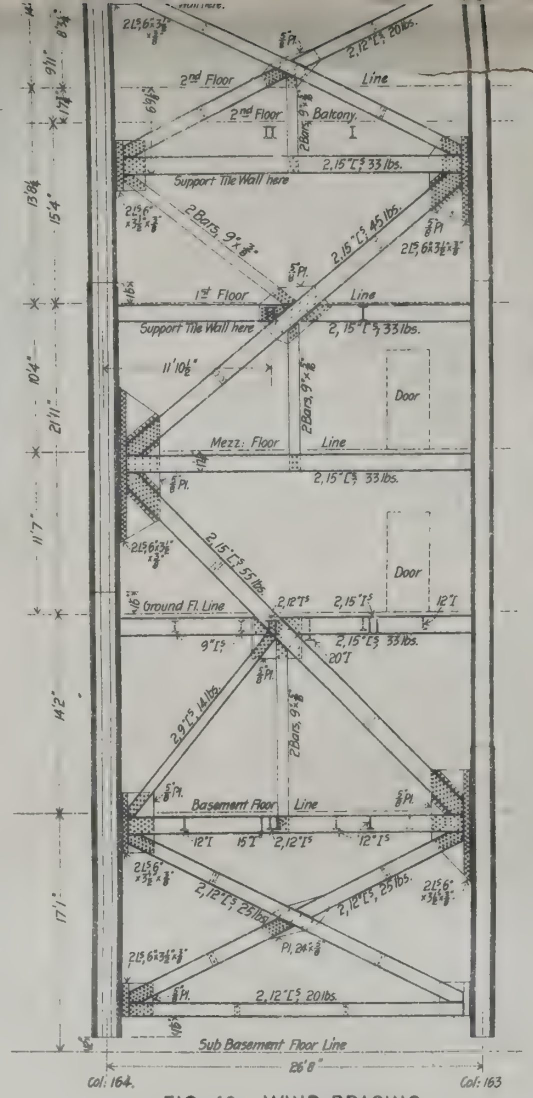


FIG. 19. WIND BRACING.

STRUCTURAL IRON WORK
OF THE NEW ASTOR HOTEL,
NEW YORK CITY.

H. J. Hardenbergh, Architect.

Purdy & Henderson, Consulting Engineers.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

his rounds can see through the glass door whether there are any shoes; if so, he unlocks this door and takes the shoes out. When they have been cleaned they are put back and the door again locked.

Fig. 4 shows the lower section of column 280 (supporting the trusses), which is the heaviest column of the entire building, and carries the greatest load, namely, 5,400,000 lbs. This enormous column has 10 web plates, 4 cover plates and 12 angle irons. Its length is 30 ft. 4 ins. and its weight is 46,980 lbs. A view of the column is given in Fig. 5. Some of the standard column sections are shown in Fig. 6, and these need little explanation. In some cases a column of small size but with a great mass of metal became desirable, the dimensions being limited by reason of the enclosing of the column in a circular shell of polished stone, and for this particular purpose the column sections shown in Fig. 7 were devised by the engineers, the form comprising a heavy concentration of metal in a section well adapted to receive a circular clothing, as shown. Fig. 8 also shows a column of this type, with the variations in its construction for the several floors which it carries.

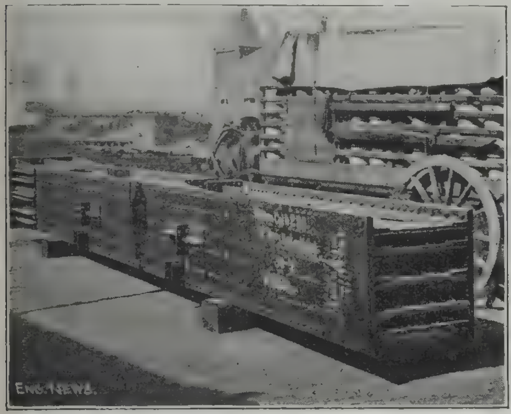


Fig. 5.—View of Large Column, No. 280.

The construction as thus far described does not present any exceptional features of design, except in matters of dimensions and details, but we come now to the consideration of the solution of a difficult problem. The great ballroom is on the first floor, with its ceiling at the level of the fourth floor, and it was required that this room should be kept free from obstructing columns. Had this been an upper floor, the design of a truss roof would have been easy enough, but it must be remembered that there are 16 floors, and that the ballroom trusses must carry the supporting columns of the floors above. It must also be remembered that the trusses had to be designed so as not to interfere materially with the arrangement of the rooms above the fourth floor or to diminish the value of the space for hotel purposes. These considerations greatly complicated the actual design of the trusses.

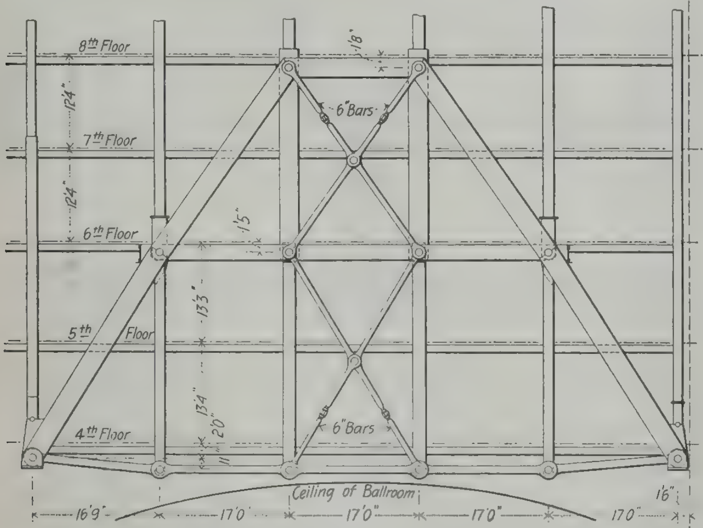


FIG. 9.—GENERAL DESIGN OF BALLROOM TRUSSES.

Fig. 9 shows the solution of this problem, which was eventually adopted. Each of the two trusses is triangular in form, 51 ft. 3 ins. deep, its lower chord being built into the fourth floor and its upper chord built into the eighth floor. The top chord is 17 ft. and the bottom chord 84 ft. 9 ins. long, c. to c. of pins. The lower chord is of unusually large eyebars, 12 ins. deep, with 12-in. pins. The truss is of the double-deck type, having a horizontal member at mid-height (sixth floor) while the two intermediate floors (fifth and seventh floors) are carried mainly by brackets on the truss posts and columns. The middle panels have diagonal bracing, as shown. It was at first planned to have the two upper diagonal pieces of the upper panel and the two lower diagonal pieces of the lower panel formed by square rods 3 × 3 ins. with welded loop ends. In the manufacture of these rods, however, it was found to be difficult to obtain satisfactory and reliable welded joints in bars of this size, and eyebars 6 × 1½ ins. were therefore substituted, these bars having upset threaded ends and turnbuckle connections, as shown, and as originally planned for the square bars.

The use of trusses under such conditions is, of course, not new. They were employed as long ago as 1887, by Wilson Bros. & Co., of Philadelphia, in the Drexel Building, where two trusses were used, as shown in our issue of March 19, 1896. These had clear spans of 48 ft. 10½ ins. and 58 ft. 3½ ins., and each extended through four floors, one being from the fourth to the eighth floor, and the other from the fifth to the ninth floor. One of these carried eight and the other seven floors, including that of the bottom chord.

Again, in the construction of the extension of the Waldorf Hotel in New York city, it was required to leave a ballroom on one floor unobstructed by columns, and for this purpose a truss arrangement was designed by Mr. Purdy, the consulting engineer for the ironwork. This truss, which was fully described and illustrated in our issue of March 5, 1896, is 82 ft. 6 ins. long and 28 ft. 4 ins. deep, its bottom chord being at the second floor level and its top chord at the fourth floor level, while the first floor is carried by columns which extend below the truss and act now as suspenders. When the new Astor Hotel is completed the ballroom in the Waldorf extension will be given up, and columns will then be put in between the ground and first floors, as was described in our former article.

The detailed construction of one of the two great ballroom trusses in the Astor Hotel is shown in Fig. 10. The lower chord is composed of four parallel sets of eyebars 12 × 2 1-16 ins., with 10-in. pins except at the endpost shoes, where 12-in. pins are used. These shoes are steel castings with ribbed top surfaces to fit the webs of the posts. In the lower half of the truss the end posts have an immense amount of metal, there being no less than 10 web plates (in five pairs), ¾ × 29½ ins., two cover plates ½ × 36 ins., and 12 angle irons ½ × 4 × 6 ins. The cross-section of the member, on Fig. 10, gives an idea of the great amount of metal used. At the base of the end post is a column connecting with the column seated on a 6-in. pin, as shown on the right of Fig. 10, and also in Fig. 11. In the upper half of the truss each end post consists of 6 web plates ¾ × 29½ ins.; 2 cover plates, ½ × 38 ins.; 4 angle irons, ¾ × 4 × 6 ins., and 4 angle irons, ½ × 4 × 6 ins. The top chord is composed as follows:

1 Web plate	½ × 29½ ins.
2 Web plates	¾ × 29½ ins.
2 Cover plates	½ × 41 ins.
8 Angle irons	½ × 4 × 6 ins.

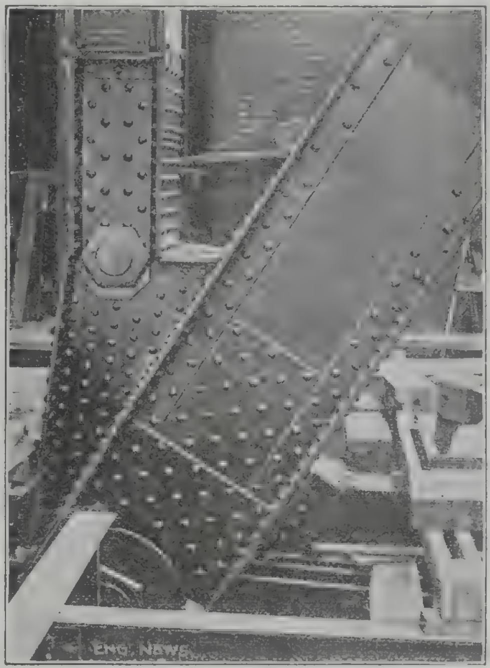


Fig. 11.—View of Base of End Post of Ballroom Truss.

The middle chord, at the sixth floor level has two channel-shaped sides, each composed of a web plate 7-16 × 23½ ins., and two angle irons ½ × 3½ × 4 ins., these sides being connected by horizontal lattice bars ⅜ × 4½ ins. The chord connects with each end post by a 12-in. pin, which also forms the seat for a column rising above it.

The two trusses, A and B, are practically alike. They are spaced 14 ft. 9 ins. apart, c. to c., and the middle posts are connected on each floor by arched portal bracing, as shown in Figs. 10 and 12. Two general views of these trusses are shown in Figs. 13 and 14. These trusses were built by the Keystone Bridge Co., of Pittsburg.

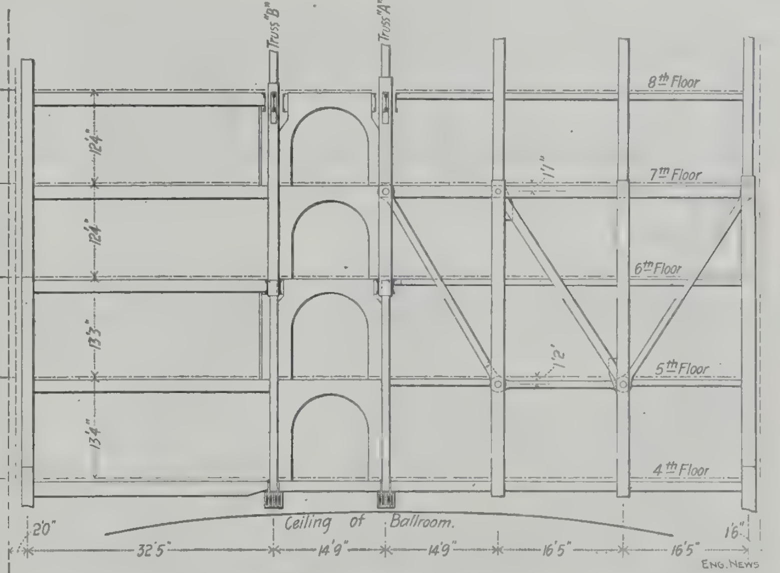


FIG. 12.—ELEVATION SHOWING POSITION OF TRUSS C.

It will be seen on reference to Fig. 1 that truss A carries one end of another truss which is at right angles to A and B, this being marked truss C. This carries the weight of the floors over the end of the ballroom. One end of the truss is carried by a 10-in. pin in the post of truss A, while the other is carried by a 10-in. pin in the wall or abutment column No. 209. The truss connection makes a somewhat complicated arrangement necessary, since it causes a double reversal of the strains in the post, the bearing on the 10 in. pin of truss C being at right angles to the top and bottom pins of truss A. The details of this truss are shown in Fig. 15.

Similar conditions exist at the dining-room on the ground floor of the Fifth Ave. front. Here it was stipulated that the position of the side columns should conform to that of the columns in the dining-room of the Waldorf Hotel, so that when the party wall is opened there will be one large room practically unobstructed by columns, as already noted. In order to meet these requirements and to carry the columns of the 14 floors above the dining-room it was necessary to devise a truss arrangement, and this is shown in Fig. 16, which is truss D, one of the three which span the dining-room. The posts of this truss are practically inclined columns connecting the vertical columns above and below, the truss being two stories in depth. In consequence of the arrangement of the corridors and rooms, no diagonals could be placed in the center panel of the truss, and the somewhat singular arrangement of counters in the end panels had therefore to be introduced. It was at first proposed to make these counters or diagonals of 3-in. square rods with welded loop ends, but for reasons already stated eyebars 1½ × 6 ins. were substituted, having the ends upset and threaded for the turnbuckle connections. The posts are of box section, having 6 web plates, 2 cover plates, and 8 angle irons. The chords are each composed of 2 plate girders 28 ins. deep, 20½ ins. apart, having the flanges connected by lattice bars. The truss is 26 ft. 8 ins. deep, c. to c. of pins, and its length is 51 ft. 7 ins. At the bottom, the center panel is 35 ft. 10 ins., while one side panel is 7 ft. 7 ins., and the other 8 ft. 2 ins. At the top, the center panel is 17 ft. 3 ins., and the two side panels are 17 ft. 2 ins., all c. to c. of pins. Brackets on the columns and truss posts carry the beams of the fourth floor, which crosses the truss at its mid-height.

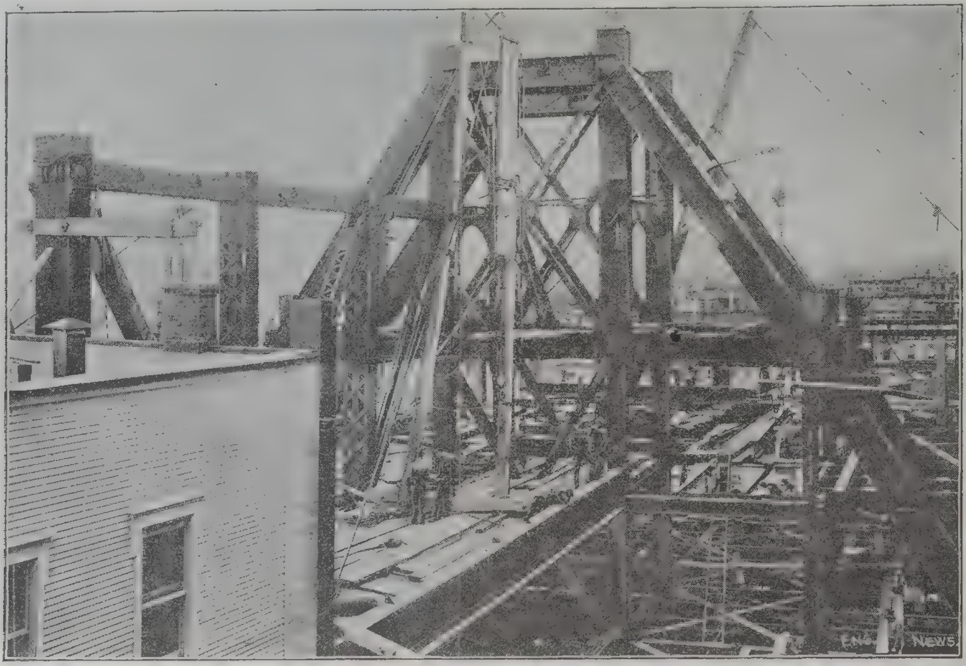


FIG. 13.—VIEW OF STRUCTURAL WORK, SHOWING THE BALLROOM TRUSSES, A, B AND C.

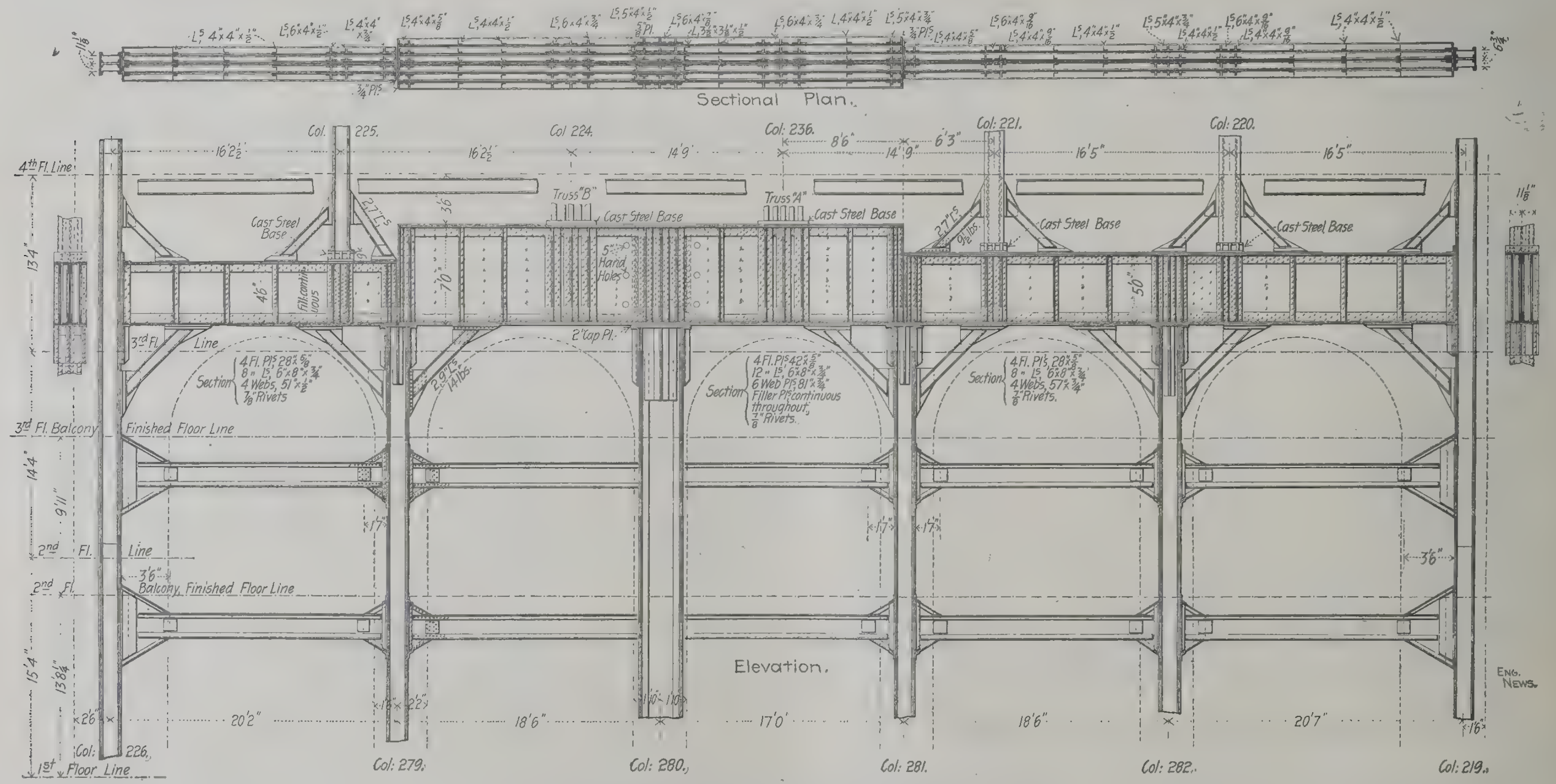


FIG. 17. GIRDER SUPPORTS FOR THE BALLROOM TRUSSES.

Another interesting feature in the structural design is the method of supporting the great ballroom trusses A and B, for, as will be seen on reference to Fig. 1, they are not seated upon columns. The spacing of the columns in the western end of the building is entirely changed at the fourth floor level, and to provide for this a line of heavy plate-girders was introduced, and the trusses rest on one of these girders instead of directly upon the columns. It should be explained that this complicated arrangement was necessitated by requirements of the owner of the building in order to facilitate the use of the lower stories, and to satisfy architectural ends.

This peculiar arrangement is shown in Fig. 17, the lower part of which shows in dotted lines the finished outline of the architectural work in the spaces between the columns, and shows also the knee-braces or stiffeners connecting the columns and girders. The trusses and columns above are not in line with the columns below, but eccentrically on either side of column 280, which is the heaviest column in the building, as already described. The continuous plate girder resting on columns 279, 280 and 281, is of very massive construction; the total length is only 35 ft. 6 ins., but the depth is 7 ft., and the makeup is as follows:

6 Web plates	¾ × 81 ins.
4 Flange plates	⅝ × 42 ins.
12 Angle irons	¾ × 6 × 8 ins.
Filler plates continuous throughout.	

As the steel skeleton up to the second floor forms practically the foundation for the trusses and the superstructure which they carry, it is essential that this lower part of the work should be absolutely stiff and rigid, for which purpose a very complete system of knee-bracing and gusset-plate connection has been introduced, as shown diagrammatically in Fig. 18, which represents the portion immediately below that shown in Fig. 17. The steel foundation work is also tied together rigidly by horizontal diagonal bracing of flat bars riveted to the top of the floor beams for the floor which forms the ballroom ceiling, and in some of the upper floors.

The wind bracing is of a very substantial character, consisting of heavy diagonal bracing of channel irons, with vertical bars from the intersection of the diagonals to the floor beams below. An example of this is given in Fig. 19, showing the bracing between columns No. 163 and No. 164, extending from the sub-basement level (or the feet of the columns) to the fourth floor.

All the main structural work is of mild steel, and members are given one coat of paint at the shops and two coats after erection. A graphite paint is used, supplied by the Detroit Graphite Mfg. Co., containing 33% of graphite and 20% of iron oxide. The columns are enclosed with brick masonry in cement, laid close in contact with the metal work.

The building will contain about 10,000 tons of structural steel work, the cost of which represents about one-tenth of the total cost of the building. This proportion is said to be unusually low, particularly when the great spans between the columns (and the consequent heavy construction) are taken into consideration.

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THE REPORTED FAILURE OF THE STEEL PLATES intended for use in the hulls of the battle ships now under construction at Newport News is causing a good deal of newspaper comment, but the whole facts in the case will not be known until the report of the investigating board is made public. The "American Manufacturer" of Dec. 18 has an editorial on the subject, probably based on statements it has received from the manufacturers of the plates. It says:

> Sufficient is known to show that the fault did not lie with the makers of the plate. It seems that there was an error, and that error was such as could easily be made by any one not thoroughly posted on the manufacture of steel. Among engineers nowadays it is the rule to require great tensile strength in steel material. Years ago 50,000 lbs. tensile strain was considered a very satisfactory test, and steel of that composition could be bent and twisted in any way. But now specifications will call for a tensile strength of 70,000 lbs., forgetful of the fact that to get this, more carbon must be added, and that tensile strength is secured at the expense of ductility. This was exactly the case in the plates about which so much has been published. Each and every one of those plates were made according to specifications, and all stood the government test.

This statement does not harmonize with statements made in a press despatch from Norfolk published in the New York "Herald" of Dec. 20, which says:

> In the bending test more than 64% of the specimens failed to come up to the letter of the contract, and in the quenching test the failures amounted to exactly 50%. In the pulling test 10.7% fell below the contract requirements for tensile strength, and 18% showed deficient elongation.

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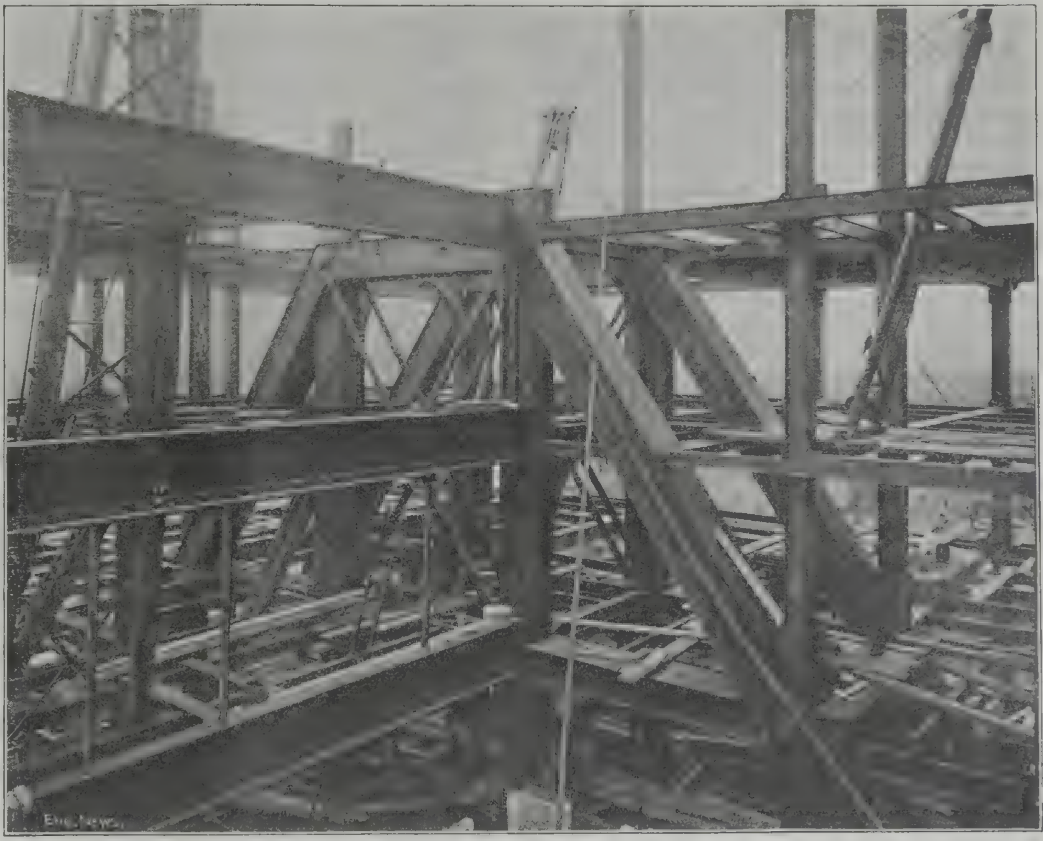
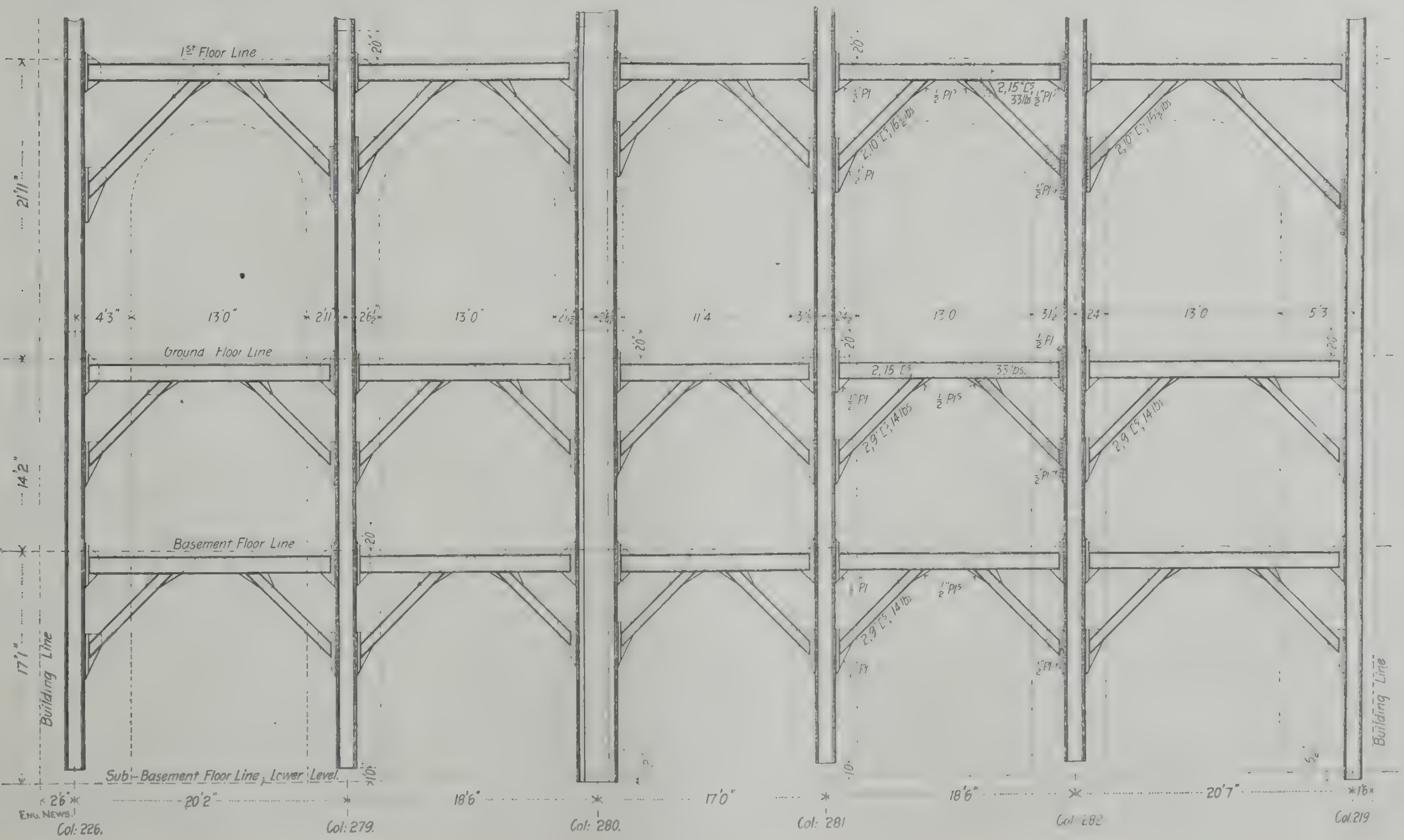


FIG. 14.—VIEW OF BALLROOM TRUSSES.

THE INTERSTATE COMMERCE COMMISSION has presented its tenth annual report to Congress. From advance abstracts issued to the press, it appears that a large part of the report is devoted to a discussion of the effect upon the work of the commission of recent decisions of the United States Courts. The amendments to the law which are recommended by the commission are as follows:

1. To confine the procedure of the courts for enforcement of orders of the commission to the record made before the commission, and to provide that the order of the commission shall be enforced unless the court shall find in the proceeding some material error which furnishes sufficient reason for refusing to enforce it.
2. To so amend section 15 as to make it expressly provide that the commission may, after due procedure and investigation, issue an order requiring the rates, facilities or practices complained of to be changed, modified or corrected as in the order specified.
3. To make railroad corporations liable to indictment for offenses against the statute, as well as their officers, agents and employees.
4. To require the carriers to adopt a uniform freight classification.
5. To make the rate sheets, reports and contracts of carriers on file with the commission, by express provision in the statute, competent testimony and prima facie evidence of what they purport to be in all proceedings before the commission or in the courts.
6. To permit the commission to appoint special agents with the authority to inquire into the business management of carriers.
7. To provide for the interchange of traffic between connecting roads and the continuous carriage of freights from point of shipment to place of destination, as contemplated by sections 3 and 7 of the act.
8. To require carriers to file reports with the commission for each year ending June 30, on or before Sept. 15 next following, and to enforce obedience to this requirement by a cumulative money penalty for non-compliance; to make the provisions authorizing the commission to prescribe a uniform system of railway accounts more specific, and failure to conform to such a uniform system prescribed by the commission a misdemeanor; to require the carriers to file monthly reports with the commission covering earnings and expenses.
9. To require that joint tariffs shall specify the names of the carriers parties thereto, and that each of said carriers, other than the one filing the tariff, shall file with the commission such evidence of concurrence or acceptance as may be required by the commission; to authorize the commission to prescribe and from time to time change the form, contents, and arrangement of the schedules and joint tariffs required to be published and filed.



IG. 18.—KNEE BRACING AND GUSSET PLATE CONNECTIONS.

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AND
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With the reassembling of Congress, the possibility or probability of legislation respecting the Nicaragua Canal is again a theme of public discussion. Most of the journals which are really friendly to the enterprise recognize the fact that the only sensible course for the government to pursue, if it takes any action at all, is to provide for the making of a thorough survey of the route, as was recommended by the commission of engineers last year. A few newspapers, however, still adhere to the absurd idea that the government should guarantee the bonds of the enterprise in its present position. One of these journals, the New York "Mail and Express," in advocating this view, bestows the following gratuitous insult upon the able commission of engineers who reported on the enterprise last year:

> The commission appointed by the President to investigate as to the practicability of the project made a predetermined adverse report, but it was subsequently proved that they did not visit the canal territory, and that their so-called tour of inspection was a mere junketing trip at the expense of the government. All of the objections urged against the canal by this ex-parte commission were shown to be groundless and worthless.

It is needless to inform our readers that the statements made in the above quotation are absolutely without foundation. It has not only never been "proved" that the commission of engineers did not visit the canal territory, but we are not aware that any such claim has ever been made. The "Mail and Express" may condemn the report of these engineers, if it chooses, and may claim that their professional judgment was mistaken; but it goes beyond the limits of fair debate when it charges that the character of these engineers' report was determined in advance of their investigation, and further, that they did not visit the canal territory at all, and their report was, in consequence, necessarily a pure fabrication. The statement made by the "Mail and Express" is a gratuitous insult, not only to the able engineers whom it so wantonly condemns, but to the engineering profession of which they are honored members.

As our readers know, Mr. Alfred Noble, the civilian member of that commission, is a member of the American Society of Civil Engineers, and is Vice-President of the Western Society of Engineers. Major Ludlow and Mr. Endicott are connected with government engineering departments, in which the sense of professional honor and esprit de corps is quite as high as it is among civilian engineers. The average newspaper reader, who believes what he reads, will naturally form the conclusion that engineers, even of the highest rank, know no such thing as professional integrity, when he reads such an item as that which we have quoted above. It is for this reason that we have deemed it worth while to call attention to the matter.

We sincerely hope that the "Mail and Express" may see fit to make such amends as in its power for its unwarranted insult, by publishing a retraction of its wholly unfounded statement.

The advisability of securing for a large electric lighting or power station a location on a water front, where an abundant supply of water may be had for condensing purposes and where coal may be received and ashes shipped away on boats, has once more been brought to notice by the announcement of an extensive project by the Edison Electric Illuminating Co., of Brooklyn. It has recently purchased a shore front property at 66th St., Brooklyn, measuring 260 ft. on the water front and 1,150 ft. in depth, of which 550 ft. is under water. It is the intention of the company to construct there an electric central station, which will be one of the largest and most economically operated plants of its kind in the world. On the land under water two piers, 60 × 550 ft. each, will be built for handling and storing coal. From the bulkhead line back, a one-story brick building will be erected, which will contain boiler and engine rooms. The engine room will also contain the dynamos and other electric apparatus. The new station will be put in connection with the other stations of the Edison company, and, in addition, will run connections into each sub-district of the city and to surrounding suburban towns as far as Babylon, Roslyn, Garden City and Hempstead. Underground conduits will be used for transmission.

The economies resulting from the location of a large central plant on tide water, as compared with a number of small plants scattered throughout the city and away from the water, are manifold. Probably the largest saving is that due to the use of condensing, instead of non-condensing, engines, by means of which a saving of from one-fourth to one-third the fuel may be made. Receiving coal by water instead of by rail usually results in considerable advantage to the purchaser, giving him a choice of coal companies to purchase from, and a chance of low transportation charges. The comparison is still stronger if we compare water transportation with the haulage of coal and ashes by horses and carts through the streets to and from the power station, which is common in Brooklyn and other large cities. In the boiler plant also a large plant offers more chances for saving than a small one, in the use of machinery for conveying and firing coal, and for removing ashes. The cost for installation, interest, depreciation, repairs, insurance, superintendence and labor, per unit of power developed, may also, by proper management, be made considerably smaller in a large plant than in a small one.

The very high temperatures in the fire and engine rooms and dynamo compartments of our new warships stands out prominently in the report of the Surgeon-General of the United States Navy, just presented. On the "Cincinnati," for example, there is a record of 204° Fahr., in the forward fire-room, and the average for the year in this room is 145.8°. The subject of better ventilation on board these ships is forcing itself upon the designers on shore, and the engineering staff at sea; but much evidently remains to be done to remedy matters. The chief trouble lies in the fact that a modern warship is cut up into a series of small compartments by tight bulkheads demanded for purposes of strength and security. This arrangement in itself interferes with the circulation of natural air-currents and renders the work of artificial ventilation very difficult and intricate. But when to these unfavorable structural conditions are added the heat from enormous boilers and from auxiliary engines in close compartments and the steam-pipes which run almost everywhere, the sufferings of the men who have to live and work in these places become well-nigh unbearable.

On the "Detroit" the two passageways on either side of the ship have iron floors directly over the boilers, covering a superficial area of 492 sq. ft. in all. When the ship is under steam the temperature of the floor plates is 135°, and this great radiating surface raises the temperatures of the passageways to 125°. The only escape for this extreme heat is through the end-doors and seven deck ventilators. So far all attempts made to improve upon this condition of affairs have only succeeded in reducing the average temperature to 110°, under the most favorable circumstances.

Of course, much has been done in the way of forced ventilation, nearly all the ships are now provided with Sturtevant blowers, fitted for either exhaust or supply and having a capacity of 10,000 cu. ft. of air per minute. The main ducts from these blowers are sometimes as large as 27 × 15 ins., tapering to 4 to 6-in. terminals, and in addition to these appliances there are in use electrical fans, 12-in. and 14-in. deck and lateral ports, wind-sails, etc. The U. S. S. "Maine" has in each engine room a steam driven blower of 10,000 cu. ft. capacity, with other blowers of varying capacity in the ammunition room, dynamo rooms and steam-steering room; but each of the two fire-rooms depend for ventilation upon three 20-in. cowled pipes leading from above the ship's superstructure and expanded below into large flares.

Aside from questions of personal discomfort, or the dictates of common humanity, the abnormal conditions now surrounding some of the most important working men aboard ship have a serious bearing upon the general efficiency of the ship as a fighting machine. The surgeons, in reporting upon the physical condition of the engineer's force, say that the exhaustion apparent is not due to the work but to the excessive temperature endured while at work; to the motionless impure air in the coal-bunkers, and to the constant clogging of the sweat-glands by the coal dust. The surgeon of the U. S. S. "Detroit" says that in one trip it was only possible to keep the firemen and coal-passers at work by giving to each of these men two ounces of whiskey at the end of each four-hours' watch, and even then the men were almost collapsed, streaming with perspiration, accompanied with stertorous breathing, rapid pulse and trembling limbs. It is a fact worth noting in this connection that in the summary of deaths in the U. S. Navy, in 1895, pneumonia and heart disease rank as the most common causes of death. The deaths are not reported according to occupations of the crew; but it is fair to presume that they are most common among the men engaged in the engine and fire-rooms.

What further remedies can be added to those already in practice, in the way of non-conducting covering for boilers and pipes, non-conducting floors over boilers and more extensive systems of artificial ventilation, it is for naval engineers and architects to decide. But it is evident to all that if the efficiency of the engineer's force, especially, is to be maintained, some scheme must be devised for overcoming this excessive temperature in the vitals of the ship. The difficulties presented are the natural sequence of the transition from wooden sailing ships, with roomy open decks pierced with portholes of liberal dimensions, to the floating iron-clad fortress of the present day. But have not our naval architects paid too much attention to the development of an engine of destruction, and too little to the prevailing conditions in which the men must live who work and man this modern warship? Modern conditions of naval warfare are bad enough under the most favorable conditions for fighting, without adding to these the misery and physical wreck of men engaged in peaceful cruising. The general good health of the men in the engine-room and before the boilers is essential at all times; but in an emergency their powers of endurance may decide a battle, and it is not expedient to overstrain these powers.

The recent successful experiments with compressed air, as a substitute for steam or hydraulic power in operating the auxiliary engines of the coast-defense monitor "Terror," may yet have an important bearing upon this question of better ventilation. Compressed air is one of the best agents for this purpose, and as it has proved its advantages over steam and hydraulic power in turning the turrets, loading and elevating the guns and steering the ship, its further use as a ventilator of the ship would seem a natural sequence.

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The strain upon the physical powers of the workers aboard ship, here referred to, may be better appreciated by noting the number of deaths and prostrations that in any large city follow a heated term of only 100° temperature. Contrast this record, and the conditions of open space and quiet labor with the actual suffering of men who are engaged at the hardest of manual labor in a confined engine or fire-room, with an average temperature of say 150° and a maximum reaching 200°. The only wonder is that they can endure it at all and live to tell the tale; and, in this connection, it may be said that a surgeon's report has nothing to say of the men who part company with the ship after one cruise, physical wrecks, and leave no official record behind them of their later illnesses or deaths.

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An extraordinary state of affairs exists in the iron and steel trade. The steel billet pool, which was organized in April last, and raised the price of billets $3 to $5 per ton, remains intact as to its organization, but a single concern (the Bellaire Steel Co.) has withdrawn, and the market is an open one, with cutting of prices the rule. The nail trust collapsed a few weeks ago, and the selling price of nails has dropped 50% as the result. Thus far everything is in the consumer's favor, and to encourage him still further to believe that the era of low prices was at hand, a rumor has been going the rounds of the press to the effect that Mr. Rockefeller, the Standard Oil magnate, who owns some of the largest ore mines in the Lake Superior region, and also the new fleet of steel steam vessels for carrying ore on the lakes, was about to build a great iron and steel works near Chicago, which would compete with the Carnegie works. This report has proved false, and, instead, it is now announced that an arrangement has been concluded between the Carnegie Steel Co. and Mr. Rockefeller by which the steel company acquires control of several properties on the Mesaba range, the ore from which will be carried to Conneaut, on Lake Erie, by the Rockefeller steamers, and thence by Mr. Carnegie's new railway line, the Pittsburg, Bessemer & Lake Erie, to the furnaces and steel works of the Carnegie company at Bessemer, Duquesne and Homestead. The Carnegie Steel Co. some years ago acquired the control of the Frick Coke Co., whose plant was by far the largest in the Connellsville region. Hence it now has in its own control all the raw materials necessary for producing steel, and also all the transportation lines required for assembling them at its works. It has also by far the largest iron and steel manufacturing plant in the world, when its works at different places are taken together, and is reported to be building 16 additional basic open-hearth steel furnaces, which will give it a total of 36 basic furnaces, in which it can utilize the product of mines below the Bessemer grade. The great reduction in the cost of transportation which will follow from the use of steam vessels of great tonnage on the lakes and from the new railway with roadbed and rolling stock especially adapted for carrying ore, together with its unequaled facilities for manufacturing, puts the Carnegie Steel Co. in a position where it will probably be able to produce steel in any shape, from billets to structural material, far cheaper than any other concern in the country, and either to undersell its competitors or to dictate terms to them concerning prices and "allotments." Whether it will use its power to put up or to put down prices is a matter which no one outside of the company may predict.

◆

We congratulate the English engineering journals on the vigor on which they are attacking the schemes of those unscrupulous speculators who are taking advantage of the public interest in motor carriages to sell stock at ridiculous prices in "Horseless Carriage companies." The wholesale manner in which the class of men who a few years ago engineered the boom in worthless South African mining shares a now booming motor carriage companies leads the London "Electrician" to suggest that the most appropriate name for the new vehicle is "Promoter car."

◆

THE DEVELOPMENT OF STRUCTURAL IRONWORK DESIGN.

The construction of the exceptionally high buildings with steel framework, which now form such a notable feature of the larger American cities, has led not only to the development of a new and large market for structural steel and iron work, but also to new problems in structural design. The introduction of this type of construction dates back only a few years. Previous to that time ironwork design had been limited mainly to bridges, roofs and the framework of factory or mill buildings, none of which cases called for the solution of the problem of superimposed masses of material to form a high, narrow and rigid structure.

We have from time to time published drawings of buildings of this class, with drawings also of the members and the details of construction, and any of our readers who have had occasion to study these critically must have been struck by the many peculiarities in design and the many new governing conditions under which the general and detail designs have had to be prepared. In bridge design the engineer is, as a rule, limited only by the required span and loads to be provided for, and has a free hand to design the structure and arrange the material according to his ideas of what will be most satisfactory. In structural design for tall buildings, however, the engineer is limited by the general plan arbitrarily set for him by the architect. He must so plan his columns and braces as not to interfere with the arrangement of rooms, corridors, etc. This may involve a very unsymmetrical structure, and necessitate the use of heavy beams, girders or even trusses for the floor systems. In a building intended for ordinary office purposes, as are the majority of these tall structures, this general column plan, when once laid out, is carried up through the whole height of the structure, the architectural, or room plan, being practically identical on all the floors. If the structure is intended for other purposes, however, it may be that variations in the room plans will necessitate breaking the continuity of the columns, and this, of course, will very considerably complicate the problem of the structural design of the building. A notable example of this is afforded by the new Astor Hotel, in New York City, which is illustrated on our inset sheet this week. This building will have 15 floors, and on some of the lower floors are a dining room, a ball room and a banqueting room, in which great areas are required to be kept free from columns. The problem was, therefore, to devise some means for carrying the several tiers of floors above these open spaces, and for supporting the columns of these floors, and, at the same time, to provide the necessary rigidity of the structure. In the first two cases this has been done by the construction of great trusses, as described in detail elsewhere, while for the banquet room, where a clear space of 40 ft. between columns was demanded, heavy box girders span this space and support the intermediate columns of the floors above.

Another difficulty which is encountered is in so arranging the floor systems, connections, etc., as to avoid interference with the multiplicity of passages required for flues, plumbing, electric wires, water pipes, etc., and in a large building this is no small matter. Then, again, it is necessary to provide a means of support and attachment for the masonry of the exterior walls, the weight of this masonry being usually carried by a string course of beams or girders at each floor, or at certain intervals. The wind bracing is another special feature in the design, and in many cases diagonal bracing cannot be introduced for this purpose, on account of its interference with corridors, doorways, etc. In such cases a very successful solution of this particular problem has been effected by the use of arched portal bracing, which is, in fact, a modified and improved form of knee bracing, which latter is also sometimes used. In order to ensure absolute rigidity, and freedom from vibration of the floors, horizontal diagonal bracings of flat bars, riveted to the floor beams, is also sometimes employed.

The requirements for wide spacing of the columns may result in very exceptional loads upon certain columns. A column load of 3,000,000 lbs. will be reached in the 30-story Park Row Building illustrated in our issue of October 8, and a load of 5,000,000 lbs. is carried by one column in the Astor Hotel. It will be obvious that very massive construction is necessary to carry such enormous loads; in the latter case we have a mammoth column built up with no less than 10 web plates, 4 cover plates and 12 angles. The weight of this column is 46,980 lbs. in a length of 30 ft. 4 ins.

Another difficulty met with in this hotel building was that the arrangement of trusses and columns could not be harmonized. In one case the truss posts are practically inclined columns, connecting the wider-spaced columns below with the closer-spaced columns above. In another case the outer ends of two great trusses could not be supported by the wall or abutment columns; or by the intermediate columns and it was necessary to provide a line of immense plate girders which spanned the intermediate columns and supported the trusses. While speaking of columns, reference may be made to one special feature calling for special design. Some of the columns in the Astor Hotel, which carry heavy loads, occurred in places where they would not be built into the walls or partitions, but would be isolated, and would be enclosed in shells, or cases, of polished stone. In order to avoid clumsiness in the appearance of the column as thus clothed, it became important to keep the actual metal column as small as possible, and this was effected by the use of column sections specially designed for such locations.

An examination of the drawings of such structural work as we are here considering will show an immense number of cases were specialization in members, details and connections has been required, all of which, of course, add greatly to the trouble of estimating, and the cost of construction, to say nothing of the brain work involved in the solution of the innumerable problems, small and great, but all having an important bearing upon the technical success of the design and the expenditure involved in the building as a whole. These difficulties are probably appreciated not at all by the owner, and only to a limited extent by the architect (unless he is himself an engineer experienced in structural work), and the designing engineer can expect but little credit for the successful results of his labors, since the work is all built in and enclosed as soon as erected, so that the casual observer never gives it a thought, and even if anyone were interested in it, it is hidden from examination.

Few of those who occupy buildings of this class ever realize or think of the enormous amount of metal work involved in the construction. They notice and admire the high facade, the handsome stone pillars, the noble masonry and the expensive and beautiful interior ornamentation; but they see nothing of the great steel skeleton which forms the framework of the whole structure and of which the visible walls and interior finish are but the clothing and decoration. In the Astor Hotel the structural iron work will aggregate about 10,000 tons, as against about 60,000 tons for the completed structure (exclusive of the load), and its cost will be about one-tenth of the cost of the whole building. In the Park Row Building (for office purposes), the structural iron work will aggregate 9,000 tons, or nearly one-seventh of the total weight of the completed building, while its cost will be about one-fifth ($500,000 against $2,500,000) of that of the completed building. The cost of the steel construction is exclusive of elevators, elevator enclosures, stairs, or any work of an ornamental character, while the cost of the building does not include that of the site. In a large warehouse building several stories high, recently erected on Broadway, the cost of the structural work amounts to one-fourth of that of the completed building. This difference in cost is, of course, due to the difference in the character of the "clothing" of the skeleton. In the Astor Hotel a maximum of elegance, profusion and cost will probably be reached, while in the warehouse building (with plain brick and fireproof clothing and little architectural treatment) the proportion of cost will approximate to the minimum. The office building forms a mean between these extremes, having a handsome and expensive finish, but much less costly decoration than will be found in the magnificent hotel. In ordinary types of buildings it has often been the practice to estimate a cost per cubic foot of the entire structure for different kinds of buildings. While this method has probably little application to such special structures we have been considering, it may be of interest to note that the cost of office buildings of this type figures out at from 20 to 25 cts. per cu. ft.

LETTERS TO THE EDITOR.

Wanted, a Test for Tin-Plate.

Sir: There is a well-founded belief that tin-plate is not so good as it used to be, the reason probably being that in modern methods of making it the coating of tin which is put on the iron or steel is carefully brushed off except just enough to make a bare coating without appreciable thickness, while in former times most of the tin which stuck to the iron when it came from the melting pot was allowed to stay on. Tin-plate as now made consists of two things, a sheet of low-priced steel and a coating of high-priced tin. The object of the maker is to sell for so much a pound as much steel and as little tin as possible. The object of the buyer is generally to buy a tin at the market price which will last the longest without having holes rust through it. If he builds a house the architect specifies the best X Y Z's I. C. charcoal tin, but how can he know that the tin he receives is the best or is even of a fairly good quality? Can any of your readers give me a standard of quality of tin-plate for roofing and other purposes, and a method of testing to determine quality? I have a rough idea of a kind of test which might be applied, but before it could be adopted a little chemical research would be needed to establish the details. It is to take a piece of plate, say 2½ ins. square, and by bending the edges ¼-in. wide at right angles, to form a small tray 2 ins. square and ¼-in. deep. Put in this tray a measured quantity of nitric acid of a certain dilution and note the time it takes to eat a hole through the tray. The chemical research needed would be to procure samples of as many different brands and quantities of tin-plate as possible, to expose small samples of each to a number of different corrosive influences, such as salt and water, sea air, distilled water, rain water, dilute acids, etc., and to determine from the results what was the endurance of each under the different circumstances, which samples should be called respectively good, medium and poor, and then to determine just what kind of test could be conveniently applied to any specimen which would infallibly prove whether it should be placed in the good, medium, or poor class. Tester.

New York, Dec. 21, 1896.

Sewage Filtration at Meriden, Conn.

Sir: In the Engineering News of July 18, 1895, a history of the Meriden sewage disposal ground, from the time investigations for the system were commenced up to that date, was given. Thinking you may like to continue the history up to the present time I send you the following facts: The ten new filtration beds referred to in your article were completed about Dec. 15, 1895, at a cost of $9,483. Since that date the sewage has been confined entirely to the beds, as the filtration system appeared to give better satisfaction to the general public than did the irrigation area.

The sewage is allowed to run on a bed 24 hours at a time, and the beds are thoroughly cleaned before being used again. The inlets to all the beds have been provided with wire screens, which are placed about 20 ft. from the inlet pipe. These screens stop most of the paper and solid matter, and greatly facilitate cleaning the beds.

The solid material removed from the beds is composted and covered with sand, so that we have no trouble from odor.

Up to within the last few months two of the large beds were used at a time; since that date two of the large beds and one of the small ones have usually been used together. The beds were graded level, and with the six inlets at no time has sufficient water accumulated to cover the entire bed, and no water has appeared at the underdrains at any time. As was stated in your article, no underdrains were laid in the new beds. Under the treatment described above, the beds are working as well to-day as they were a year ago, and have not given us the slightest trouble. The following letter accompanied Dr. Herbert E. Smith's report on the beds:

> Yale Medical School, New Haven, Conn.,
> Nov. 9, 1896.
>
> Mr. E. B. Moss, City Engineer, Meriden, Conn.
>
> My dear Sir: Enclosed I send a statement of the results of my examination of the samples of water. I included in the series the examination of the sample sent me by Mr. Schleiter and taken the day before we took our samples. I found out from him exactly where he took the specimen, and find that it is another of the outbreaks of the effluent from the bed, and it seems to me that it adds strength to the case to include that analysis.
>
> The analysis of Nos. 2 and 3 show conclusively that the purification effected at the beds is remarkably good, the organic matter being reduced to a point very close to that which we find in the best spring waters. That the water coming out at the bottom of the ledge is chiefly the effluent from the beds is seen in a study of the amount of chlorine. The average of the composite samples of the Meriden sewage gives 46.3 parts of chlorine per 1,000,000. Assuming this average as about the amount of chlorine in the sewage, it is easy to calculate that the effluent which contains about 33.5 parts must consist of about three-fourths sewage; of course there is some ground water coming from rain in these springs.
>
> The examination, then, is very satisfactory in showing that the effluent is chiefly composed of the sewage water and that it is highly purified. The results from No. 4, which is the sample taken from the small stream just before it enters the river, seems to show that the bulk of that water comes from the sewage beds after purification. It would be interesting to have that flow measured with a view of ascertaining how much of the purified sewage is accounted for at that point. Comparing the two samples from the Quinnipiac River, it is seen at once that the addition of the purified sewage does not in any way increase the objectionable contamination in the stream, but on the contrary it slightly improves the water, as far as its organic contents goes, adding nothing to it except the mineral matter, which of course is not objectionable.
>
> The samples from the little stream flowing into the Quinnipiac above the filter beds gave only 3.8 parts of chlorine per 1,000,000, showing conclusively that none of the sewage effluent shows in that direction. I think the examination must be accepted as satisfactorily proving that the discharge of the water from the filter beds is not a source of contamination to the river, and that also the beds are working in a very efficient manner. If there are any points concerning the examination which requires further explanation from me I shall be pleased to hear from you. Very truly yours,
> Herbert E. Smith.

The effluent referred to in Dr. Smith's report comes out of the ground 21 ft. lower than the grade of the lowest bed. The following will give you some idea of the amount of sewage disposed of: May 23, 1895, 9 a. m., 68,460 gallons per hour; Oct. 31, 1895, Friday, at 2 p. m., 99,276 gallons per hour; July 20, 1896, at 4 p. m., Monday, 70,988 gallons per hour; Oct. 15, 1896, Thursday, at 2 p. m., 81,360 gallons per hour.

It was planned to keep all surface water out of the sewers, but the difference between the amount of sewage in dry and wet weather shows conclusively that a large amount of ground water finds it way into the pipes. Nearly all the factories and large blocks in the city have been connected. Five men and a one-horse dump cart are constantly employed at the disposal area.

Yours truly,
E. B. Moss, City Engineer.

Meriden, Conn., Dec. 7, 1896.

NOTES OF A TRANSCONTINENTAL TRIP.

VI.

San Francisco to Portland; Southern Pacific Ry.

In going from San Francisco to Portland the railway crosses the Siskiyou Mountains. At Chico, 186 miles from San Francisco, the railway is at an elevation of only 193 ft. above sea level. From thence there is an almost continuous up-grade to Siskiyou, where an elevation of 4,130 ft. is attained, 414 miles from San Francisco. From Siskiyou the grade falls to 1,898 ft. at Ashland, Ore., 17 miles further, and continues to fall all the way to Portland, which is only 53 ft. above sea level. The total distance is 772 miles, and the time occupied by the trip is 37 hours 10 minutes. The steepest part of the grade going north is from Red Bluff to Sissons, 113 miles, in which distance the line rises 3,245 ft. The line follows the valley of the Sacramento River on the south side of the range, crossing the river 18 times in 80 miles, and passing through about twelve tunnels through the rocky spurs, while there are numerous loops giving the necessary development to keep within the permissible rate of grade. In one place, near McCloud, the line has a course of five miles to gain an advance of half a mile, but ascending nearly 600 ft. in this distance. All trains stop at Soda Springs to allow passengers to get out and taste the natural soda water which springs up here.

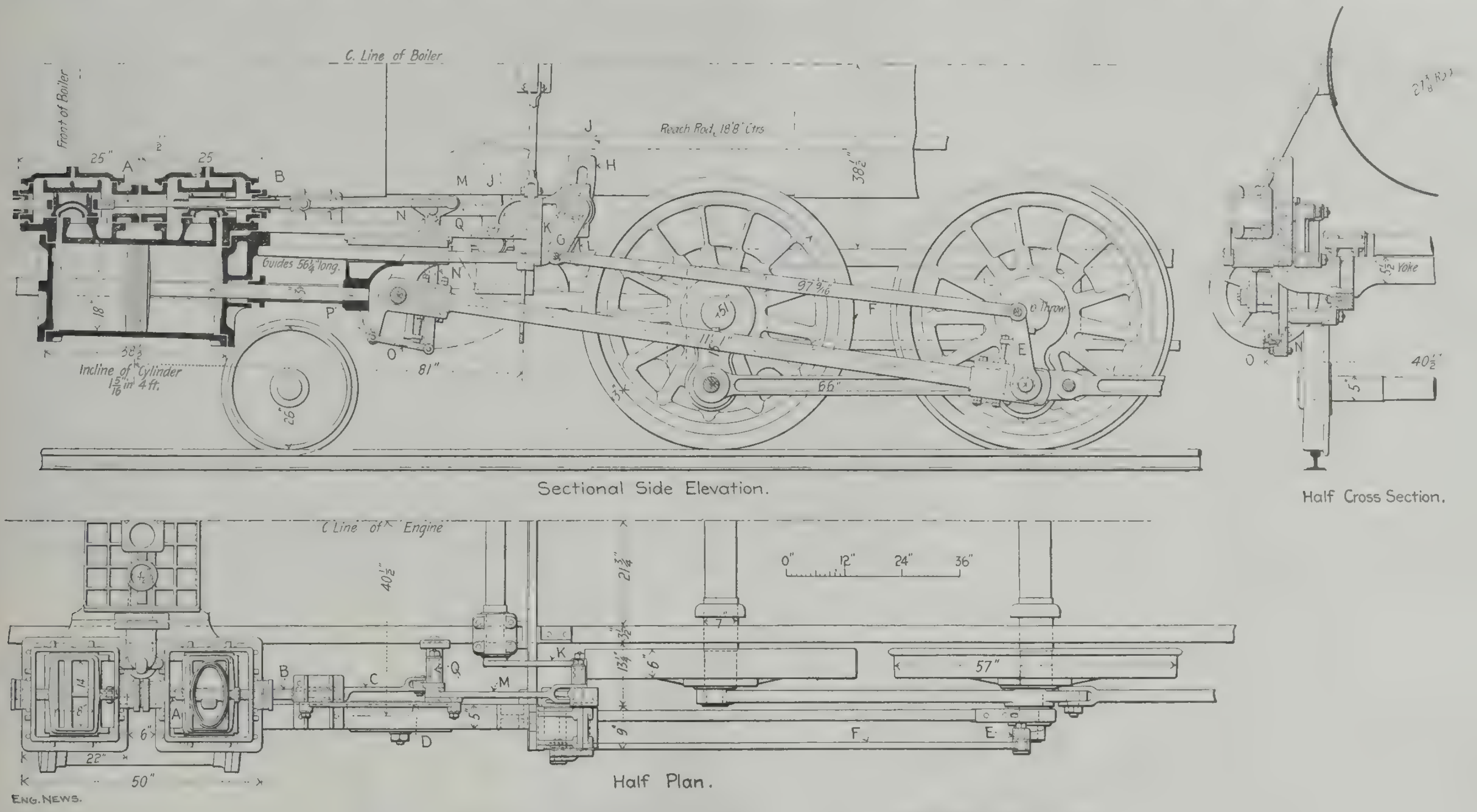
The line presents some very interesting engineering features in crossing the Siskiyou range, and affords some wonderful views of mountain scenery. At Ashland, at the foot of the eastern slope, the last spike of this part of the Southern Pacific Ry. was driven by Mr. Charles Crocker, on Dec. 17, 1887. From here the line follows the Rogue River valley, taking nearly every curve and turn of the river, the railway being for a great part of its length on an embankment right at the side of the river or benched out of the side-hill slopes.

The Oregon division of the Southern Pacific Ry. was completed in 1887, connecting with the Oregon & California Ry. to form a through route to Portland. On the first part of the line the track is fairly good and easy riding, though it is laid with rather light rails and the square suspended joints are spliced by 18-in. angle bars inside the rails and 18-in. fish-plates outside. There are four bolts, 4½ ins., c. to c., with nuts on the outside. Square sawed ties are used, the joint ties being placed quite close together. The ballast is largely of broken stone, shaped to the section usually employed for gravel, and neatly dressed to slope, the toes being lined up with larger stones. In some places, however, the joints are notably defective, and even in the heavy Pullman cars, with their easy springs, the sharp, sudden shocks are felt, which are an indication of particularly bad joints. The superelevation of the track seems to be too high, at least for the speed of the northbound trains. It is interesting to note the great extent to which the Southern Pacific Ry. is using tie-plates. On the Atlantic system it uses 32 plates to a rail (or on every tie) in renewing rails; while on the Pacific system, with fir ties and broken joints, the plates are used on all joint or shoulder ties. In applying the plates, the ties are turned upside down instead of having seats for the plates adzed out of the worn face of the tie.

All bridges and openings are numbered from the mile posts, as "501 A," etc. Iron guard rails are used on trestles, placed about 8 ins. inside the track rails, and they are extended about 200 ft. on the approaches, being brought to a point at the end. Some of the trestles have the mudsills laid in sheathed trenches, open to the air and to inspection; while some of the large wooden bridges are having the piers and trusses sheathed with planking. There is practically no longitudinal diagonal bracing on the trestles of the Southern Pacific Ry., all reliance for longitudinal rigidity being placed upon the track stringers and the stringers or waling pieces at panel heights, There are several tunnels on this route, most of them having a timber lining. On the Shasta division wood burning engines are used, and it was curious to see the immense balloon smokestacks and the cord wood piled high up on the tenders. Wood fuel is used only on this division and the lines in Oregon. The diamond stack is not used, as all wood burning engines have balloon stacks, and on coal burning divisions the engines have straight cast-iron stacks and extension smokeboxes. The Oregon Express, a train of nine to ten cars, is hauled over the heavy grades of the Shasta division by two powerful ten-wheel engines built at the shops of the Southern Pacific Ry. at Sacramento, Cal.

A noticeable feature of these locomotives was a peculiar valve gear, which is shown on the accompanying cut, Fig. 1. This is known among the enginemen as the "monkey gear," and was designed by Mr. A. J. Stevens, formerly General Master Mechanic of this road. There are about 60 engines equipped with the gear, but it is not being applied to any other engines. While it was undoubtedly a step in the right direction for fuel saving, the valve is very severe on the running parts of the locomotive, owing to the very rapid admission of steam to the cylinders. The effect of this is to very soon pound out the driving boxes, resulting in heavy maintenance expenses. A report on this valve, by Mr. H. J. Small, Superintendent of Motive Power, is given in the Proceedings of the American Master Mechanics' Association for 1890. It will be seen that there are two separate balanced slide valves to each cylinder, the stem of the rear valve A passing through the hollow stem of the forward valve B. The stems are operated respectively by the valve rods C and D. The valves are driven by a return crank E on the main driving crank-pin. This return crank is set at 90° with the main crank, and from it extends the rod F to the arm G, by which motion is imparted to the link H which has a curved slot in which works the slide-block. The position of this slide-block is regulated from the reach-rod by the vertical arm J, the curved arm K, and the lifting link, L. To the slide-block is attached the radius rod M, the opposite end of which is connected to the vertical lever N. The upper end of this lever has arms to which are attached the valve rods C and D, while the lower end is connected by the rod O to the crosshead P.

The lever is supported by the link Q. The cost of this gear is about 25% greater than that of the ordinary gear, and the cost for maintenance and repairs is also considerably higher, apart from the increase in cost for the general maintenance and repair of the engine. In a comparison of eight ten-wheel engines (cylinders 18 × 30 ins.), fitted with the Stevens gear, and eight ten-wheel engines (18 × 24 ins.), with the ordinary link motion, the former showed a decrease of 18% in fuel consumption and an increase of 41% in cost of repairs. The engines with the Stevens gear made 33.93 miles per ton of coal, as against 27.92 miles by the other engines. At 23 cts. per engine-mile for fuel, the former engines showed a gain of 4.14 cts. per mile; while at 6 cts. per mile for engine repairs the latter showed a gain of 2.46 cts., leaving a final gain of 1.68 cts. per mile run in favor of the Stevens gear.



Sectional Side Elevation.

Half Cross Section.

Half Plan.

FIG. 1.—STEVENS VALVE GEAR AND DUPLEX VALVES; SOUTHERN PACIFIC RY.

Portland, Ore.

This city is one of the largest and busiest of the Pacific northwest, and has a population of about 82,000. It is situated on the west bank of the Willamette River, about 12 miles south of its junction with the great Columbia River, and is 115 miles from the ocean, having good terminals and navigation facilities for river and ocean steamers. The city is about 53 ft. above sea level. It is an important railway center, the Southern Pacific and Northern Pacific railways meet here, and the Union Pacific Ry. has an entrance over the line of the Oregon Railway & Navigation Co. (formerly a part of the U. P. Ry. system) which follows the course of the Columbia River. A railway is now being built to connect Portland with Astoria, at the mouth of the Columbia River, a distance of about 110 miles. The contractors are Honeyman, De Hart & Glenn, and their contract calls for the completion of the road by May, 1897. At the mouth of the Columbia River are the celebrated pile and rock Columbia River jetties (now practically completed), while up the river (above the Willamette) are the Cascade locks (also practically completed) and the site of the Dalles ship railway, which is to give a through route for river navigation. The U. S. Engineer Office, at Portland, is now at work on the drawings for this ship railway or boat railway, and land is being secured for the right of way.

There is a good system of water-works, supplied by an excellent quality of water from Bull Run River. The headworks consist of a canal 400 ft. long, terminating in a funnel-shaped chamber 9 ft. long, which tapers from 60 ins. to 42 ins. in diameter, the latter being that of the discharge pipe. From this chamber extends a riveted steel discharge main, 42, 35 and 33 ins. diameter, 24 miles long, ending in the Mt. Tabor reservoir on the east side of the Willamette River. From this reservoir a 32-in. main leads to the upper of the two City Park reservoirs on the west side of the river, crossing the river by a 28-in. submerged pipe 2,006 ft. long. This was laid in lengths of about 17 ft. by means of a curved apron behind the pipe-laying boat or scow. The Wolff & Zwicker Iron Works (which are briefly described below) made the steel pipe and the Oregon Iron & Steel Co. made the cast-iron pipe. A plan and profile of the pipe line are given in Fig. 2, and the following tabular statement of the bends was taken from a paper on "Flow of Water in Wrought and Cast-Iron Pipes from 28 to 42 ins. Diameter," by Mr. Isaac W. Smith, M. Am. Soc. C. E., which was presented at the San Francisco convention of the American Society of Civil Engineers in June. Mr. Smith is Chief Engineer and General Superintendent of the Water-Works, and Mr. D. D. Clark, M. Am. Soc. C. E., is Principal Assistant Engineer.

	28-in.	32-in.	33-in:	35-in.	42-in.
Length of pipe, ft.....	2,006	31,073	34,345	41,034	52,915
Total number of bends	2	17	85	141	225
Total degs. curvature.	21°	800°	404°	782°	1,913°
Ave. curvature pr mile	6°	14°	62°	101°	191°
Extra joints, per mile for bends	..	..	11	29	42
Maximum radius, ...	11	11	38	38	38
Minimum radius	11	11	14	38	14

The two reservoirs in City Park are not now used for storage, partly on account of the trouble with the creeping of the asphalt lining, and partly on account of some fears for the stability of the ground upon which the reservoirs are built. This matter is now the subject of investigation.* At present, the water from the pipe line flows over a weir and through screens into a vertical cylindrical distributing tank, whence it flows to the gate-house of the lower reservoir. A similar arrangement is provided at the other reservoirs, the water flowing from the distributing tank to the mains. The flow from the upper to the lower reservoir, with a head of 62 ft., drives Pelton water wheels which operate two Fraser & Chalmers pumps of 500,000 and 1,000,000 gallons capacity, these supplying the high-service system at an elevation of 600 to 650 ft. above the reservoir level.

Monolithic concrete is used for the head gate-house of the upper reservoir, for part of the reservoir wall, etc. It is finished off and pointed to resemble masonry, and gives a very good-looking rock-faced surface. The Mt. Tabor reservoir has a fountain with a 5-in. nozzle discharging a stream of water to a height of 125 ft.

There are several cable and electric railways, and in some cases electric traction has superseded cable traction. The Portland Traction Co. has a cable line with a grade of 21½% on a viaduct of considerable length. The cars on this particular line have track brakes with wooden blocks, a slot-wedge brake, and independent wheel brakes on the front and back trucks. Turntables are used for turning cars at some of the terminals, but they are considered objectionable on account of the cost of repair and the time occupied in turning the cars. Watering cars are run on the electric lines, resembling large double-truck cars, but without windows. The East Side Ry. has some of the Lovejoy convertible summer and winter cars, the sides of which are formed of panels hinged at the eaves line, these panels being folded up against the inside of the roof during the summer. On the cable line of the Portland Traction Co. the yokes are 4 ft. 6 ins. apart, and for rail joints coming between the yokes, a special joint with a support formed by a piece of reversed rail 4 ft. long, has been designed by the general manager, Mr. F. I. Fuller, M. Am. Soc. C. E.

There is no official with the title of City Engineer, but the Superintendent of Streets (Mr. Chase) is practically the city engineer, being in charge of the design and construction of streets, sewers and general municipal work. He is elected by popular vote, as is also the City Surveyor, who is practically a subordinate of the Superintendent of Streets.

On Fourth St. a wood pavement has recently been laid on a 6-in. concrete foundation, with concrete curb. The blocks are 4¼ × 3¾ × 8 ins., made from fir stumps, laid close together on a 1-in. bed of gray sand, and grouted with pitch. There are 8-in. planks laid longitudinally between and outside the rails, upon these being laid cross-planks beveled at the ends to form a flangeway. The track is laid with T-rails, having square joints, spliced with four bolts, the longitudinal timbers being notched or boxed out to allow of access to the nuts. Honeyman, De Hart & Co., of Portland, are the contractors. Some streets are paved with transverse timbers 6 × 6 ins. or 5 × 5 ins., resting on mudsills; such a pavement will last about seven years, and with traffic that will wear it out in that time it is cheaper than brick, asphalt, etc. Square sticks are used, so that they can be laid with the grain edge up, in which position they give much better wear. California bituminous rock has been tried, but it does not give good service, even on concrete or macadam foundation. The material wears in holes, and it is to be stripped off the concrete and Trinidad asphalt laid in its place.

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*The reservoirs and the evidences of movement have been described in Engineering News, Jan. 10, 1895, Feb. 7 and 21, 1895, and June 11, 1896.

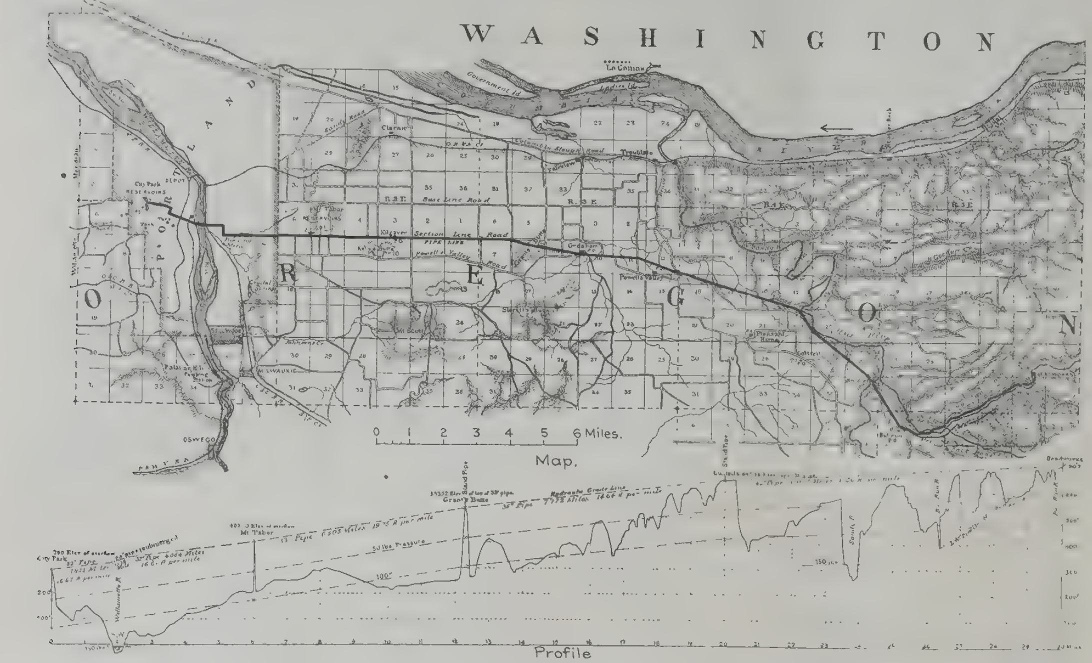


FIG. 2.—PLAN AND PROFILE OF THE BULL RUN PIPE LINE FOR THE WATER SUPPLY OF PORTLAND, ORE.

The city has a garbage crematory, which was built by a local firm. It works well, destroying even carcasses of horses satisfactorily, but repairs are required frequently. This furnace was described in Engineering News of Aug. 20, 1896, and there is talk now of replacing it with an Engle furnace.

About twelve miles south from Portland is the town of Oregon City (reached by an electric railway), at which place the power of the falls of the Willamette River, with a head of 40 ft., is utilized by a water-power plant generating electricity which is transmitted to Portland and used for railway, lighting and power purposes. The power house is to be built in sections, and the part thus far completed is equipped with three pair of Victor turbines, a 42-in. and a 60-in. turbine to each pair for high and low-water service. The vertical shafts of the turbines drive three 600 HP. generators, the armatures of which (7 ft. diameter and 2 ft. high) revolve in a horizontal plane. The oil bearings on the vertical shafts are filled with oil at 175 lbs. pressure. A large amount of machinery is on hand for extensions to the plant, and contracts are to be let for the concrete superstructure of the new part of the building and for new cribwork along the boat canal which passes the falls. This plant is similar to that at Niagara Falls, and antedates the latter, but while at Oregon City the armatures of the generators revolve, at Niagara Falls the fields revolve. The plant was put in by the Portland General Electric Co., of which Mr. Sullivan is the engineer, and was described in Engineering News of Oct. 10, 1895.

Portland has a very fine union station of recent construction, but there is no trainshed, though it is said that one is to be built when times are better. The station was built by the Portland Terminal Co., of which Mr. E. Lyons is Manager.

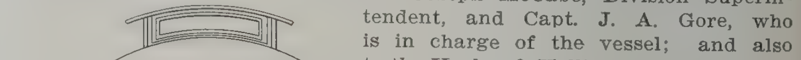
The Wolff & Zwicker Iron Works, of Portland, have a very complete plant for the manufacture of riveted steel pipe. The special tools for this work include two automatic feed punch machines, capable of handling 60 tons of material per day. From the punches, the plates are lifted and carried by a hydraulic crane to the vertical rollers. After being rolled, the pipe is bolted and rounded up, and the longitudinal seams are riveted by bull riveting machines, of which there are eight, all operated by hydraulic power. The courses are then pressed together with hydraulic presses and carried forward by the trolleys to the round-seam riveting machines. After being riveted they are calked with pneumatic calking tools, and then rolled to dipping tanks to be coated with asphaltum. Their largest contract was the pipe for the Bull Run water supply for the city of Portland, of which there were 24 miles, from 33 to 42 ins. diameter, and made from plate from No. 6 gage to ⅜-in. in thickness. They have, however, manufactured within the past four years, over 65 miles of pipe of all diameters and gages for mining and water-works purposes.

Portland to Tacoma and Seattle.

At 5 p. m. I went from Portland northward by the through transcontinental train of the Northern Pacific R. R., which is a solid train for the entire run of 2,056 miles between Portland, Ore., and St. Paul, Minn. The train was hauled by a fine Baldwin ten-wheel engine (187,980 lbs., with tender) and was made up as follows: Mail car, baggage car, express car (60,666 lbs. each), colonist sleeping car (63,650 lbs.), two day cars (64,900 lbs.), dining car (90,110 lbs.), and sleeping car (98,310 lbs.), or eight cars in all (weighing 564,168 lbs). In connection with the remarks on dining-car service, in the first part of these "Notes" (Engineering News, Sept. 3) it may be stated that the Northern Pacific R. R. follows the practice of running through dining cars on all its transcontinental trains, an arrangement which conduces largely to the comfort of passengers, ensuring them against the unpleasant delays in getting meals due to trains being late or detained. The sleeping-car service on this line is also worthy of note in that three classes of cars are run. Ordinary sleeping cars are available only for persons holding first-class or "regular" tickets, but this road also runs Pullman "tourist" sleepers for the use of holders of second-class or cheap-rate tickets, these cars being fully as comfortable as and but little plainer than the ordinary sleeping cars, while a uniformed porter looks after the comfort of the passengers. For the use of colonists, etc., the train has, on three days in the week, a free colonist sleeping car, the arrangement of which is similar to that of the other cars, but having a very much plainer finish, with no upholstering or bedding, these materials being supplied by the passengers, who can purchase them at the principal railway stations. A second-class sleeping car is frequently engaged for a tourist or prospecting party, and the car porters find this service more remunerative in the way of "tips" than the more aristocratic first-class car with its more exclusive passengers.

At Kalama the railway reaches the great Columbia River, and here the train is run onto a large steam transfer boat and ferried across the river.

This boat resembles the larger steamer of the Southern Pacific Ry., described in Engineering News, Nov. 5, 1896. The length of the trip is 1.1 miles, and the boat has a speed of twelve miles per hour. The total time occupied, from stop to start of train at the landing stages, is about 30 minutes. The boat was put in service in August, 1884, and has been running regularly ever since without an accident. There are three tracks, united at each end of the boat, to connect with the single track on the landing stage apron, and these tracks can accomodate 27 freight cars (33 ft. long), 15 Pullman cars or 18 ordinary cars. The boat was built by the Harlan & Hollingsworth Co., of Wilmington, Del., in 1883, and Capt. J. A. Gore, who is now in charge, states that it was sent round Cape Horn in sections on the "Tillie Starbuck," being put together by Smith Bros. & Watson, of Portland. It was originally named the "Kalama," but this was changed to the "Tacoma" before the boat was put in service. For the particulars as to this interesting vessel I am indebted to Mr. Charles S. Fee, General Passenger Agent; Mr. Joseph McCabe, Division Superintendent, and Capt. J. A. Gore, who is in charge of the vessel; and also to the Harlan & Hollingsworth Co. There are two horizontal jet-condensing engines, each having a cylinder 36 × 108 ins. The Sickles valve gear is used, with half-stroke poppet valves. Steam is supplied by two boilers of the locomotive type, having an aggregate heating surface of 3,210 sq. ft., and a grate area of 100 sq. ft. The boiler pressure is 65 lbs. There is a single rudder at each end, and the steering gear is operated by hand. The general dimensions are as follows:



DESIGN FOR A COMBINED SURFACE AND EXPRESS SUBWAY RAPID TRANSIT SYSTEM WITH ELECTRIC TRACTION RY. W. I. AIMS, C. E.

Length of deck	340 ft.
Length between perpendiculars	300 "
Beam of hull	42 "
Width of deck over guards	76 "
Depth of hull, below deck	13 ft. 6 ins.
Height of superstructure, above deck	12 ft.
Draft, light	7 "
Draft, loaded	9 "
Tonnage, gross	1,362 gross tons.
Engine cylinders	36 × 108 ins.
Boilers, number	2
Boilers, capacity of each boiler	300 HP.
Heating surface of each boiler	1,605 sq. ft.
Grate area of each boiler	50 " "
Boiler pressure	65 lbs.
Wheels, diameter	28 ft.
Wheels, width	8 "

A PROPOSED PLAN FOR RAPID TRANSIT SERVICE IN CITY STREETS.

We illustrate in the accompanying cut a proposal for a system of rapid transit in city streets which has been submitted to us by Mr. Walton I. Aims, C. E., of 35 Broadway, New York city. It consists of a double-track tunnel just beneath the street surface, and with the track centers directly below the centers of surface tracks in the street above. The plan is to operate express trains upon the tunnel tracks and utilize the surface cars to conduct the local or short distance traffic and to carry passengers to the express stations. Both lines would be operated by electric traction, the surface cars taking current through a slot from conductors which would be readily accessible from the tunnel below. The conduit for the conductors, it will be seen, would open directly into the tunnel and all difficulties with respect to drainage would be obviated. The slot in the conduit, Mr. Aims thinks, would furnish ventilation for the tunnel.

In places where this construction was impracticable on account of local conditions, the subways could be depressed, passing into circular shield tunnels (if in soft ground), and even passing one on top of the other, if necessary, as at some places in the London subways.

Mr. Aims suggests that the construction which he has designed would be a better solution of the rapid transit problem in New York city than the four-track subway which is the plan that has been adopted. In this matter we are unable to agree with him. As a practical question, the city could not annul the franchises of the companies which already operate railways on the surface of the streets, and it is evident that the same corporation should own and operate both the surface and tunnel tracks to make Mr. Aims' plan a success. Again as a purely engineering question, the distances to be overcome by rapid transit lines in New York city are so great and the streets are so crowded that to rely on surface cars to carry passengers to the express stations of a rapid transit system would rob the express service of a large part of its efficiency. But for cities where the distances to be overcome are less than in New York, but still great enough to demand rapid transit, the plan of Mr. Aims seems to be excellently adapted, as it effects the combination of local and express service on parallel tracks, which we believe is the only satisfactory solution of the rapid transit problem in large cities.

* * *

A LARGE DIRECT-DRIVEN CENTRIFUGAL PUMP.

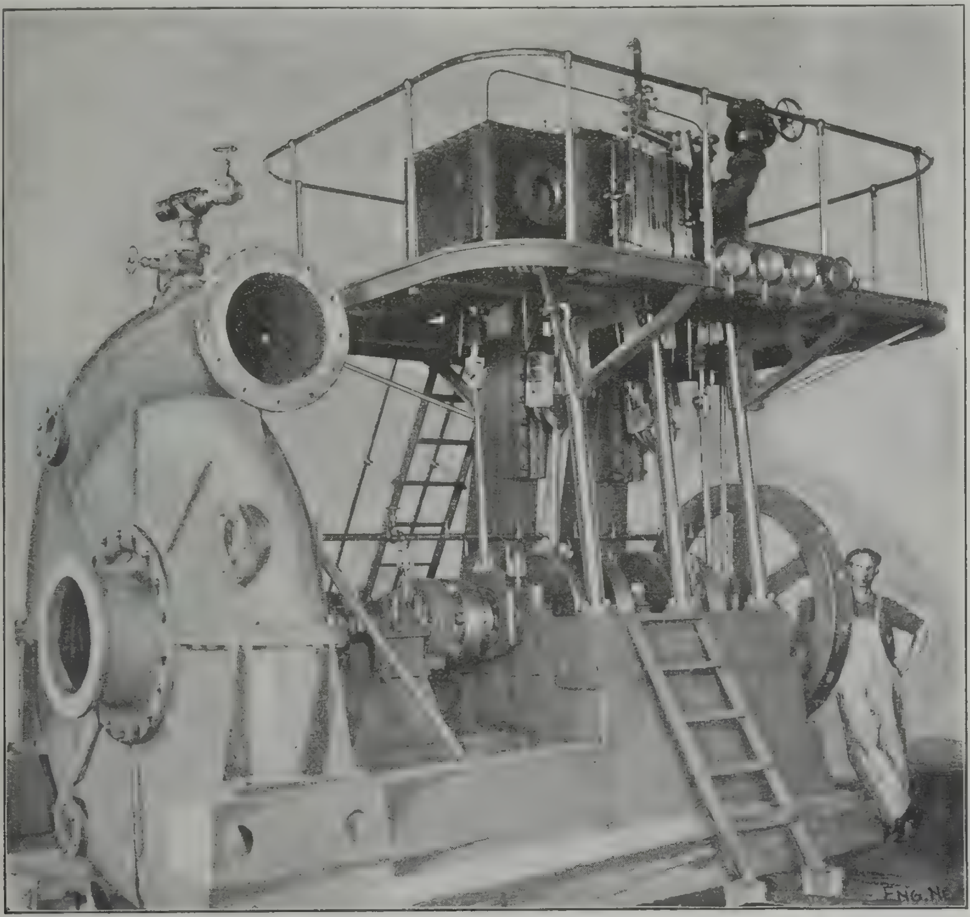


FIG. 1.—CENTRIFUGAL SEWAGE PUMPING ENGINE AT NORFOLK, VA.
Designed and Built by the Morris Machine Works, Baldwinsville, N. Y.

We illustrate herewith a centrifugal sewage pump designed and built for the city of Norfolk, Va., by the Morris Machine Works, Baldwinsville, N. Y. The pump has 20-in. suction and 18-in. discharge, the latter connected to a 20-in. piping. The actual head worked against is 26 ft., but when the pump is driven to its maximum capacity, discharging about 9,000 gallons of water per minute and forcing it through the discharge pipe, which is 1,600 ft. long, the total head pumped against is equivalent to about 5 ft. Inasmuch as this pumping outfit will often be required to run night and day, it was thought advisable in designing the machine to make the pump runner of large diameter so as to keep the engine speed moderately low. The engine, which has 14 and 28-in. cylinders by 18-in. stroke, will, therefore, under average work only run at a speed of from 120 to 140 revolutions per minute and its maximum speed is 180 revolutions per minute. The sewage and drainage from the city flows into a well from which the pump takes its supply, discharging it in the river. The side and sectional views, Fig. 2, show the construction of the pump. The runner is made completely of bronze, so as to withstand the corroding action of sewage and the gases contained therein. The pump shaft is made of steel covered with bronze where it passes through the stuffing box into the pump. In order to keep the sewage from working back into the stuffing box a fresh water injection is arranged which is continually forcing a stream of water through the bearing into the pump, thereby preventing sewage water from working in.

The vanes on the runner are made rather wide apart so as to pass through pieces of wood, rags or other solid matter that may be pumped with the sewage. The high-pressure cylinder on the engine is fitted with a Meyer adjustable cut-off so that the steam consumption can be regulated according to the amount of work the pump is doing.

The engine is throughout very substantially built; the crank shaft is made of steel, counterbalanced; connecting rods are of the forked type, also made of steel; as are also the cross-head, piston rods and valve motion. About a year and a half ago a machine similar in general design to the one here illustrated was furnished for the city of Norfolk, which has, since it was put in, been running almost day and night, giving the best of satisfaction. It can be depended upon, in case the quantity of sewage is small, to work successfully handling a small amount of it, or can be speeded up until without difficulty it takes care of all the sewage which flows into the receiving well. The engine here illustrated is run condensing, exhausting into a jet condenser.

We are indebted to the builders of the pump and engine for the photographs and drawing from which our illustrations are prepared.

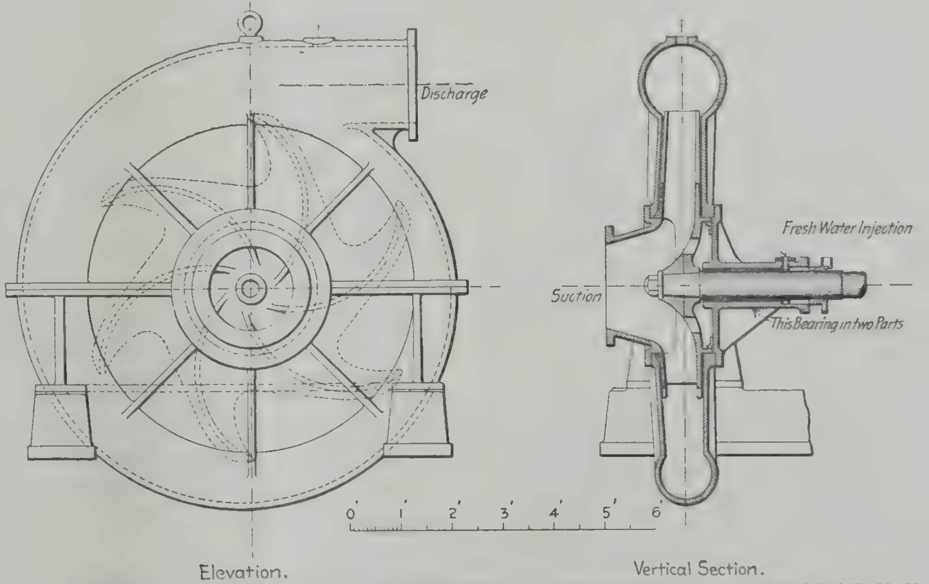


FIG. 2.—CENTRIFUGAL PUMP BUILT BY THE MORRIS MACHINE WORKS, BALDWINSVILLE, N. Y.

* * *

ALUMINUM BRONZE SEAMLESS TUBING.*

By Leonard Waldo, M. Am. Soc. M. E.**

The so-called alloys of copper and aluminum must be considered as radically different from the various metallic mixtures of copper, zinc, tin, nickel, manganese, and lead which have made the bulk of the copper alloys of commerce. There are, as is well enough known, certain chemical compounds among these last-mentioned alloys. In the aluminum bronzes or aluminides of copper there is no commercial method of separating the two constituents.

The results of the chemical [illegible] of aluminum and copper is the strongest of the copper compounds or alloys. Wire is readily drawn from it with a tensile strength of 180,000 lbs. per sq. in.

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*Abstract of a paper presented at the New York meeting of the American Society of Mechanical Engineers.

**Secy. Waldo. Foundry Co., Bridgeport, Ct.

But there are points in which aluminum bronze seems mechanically superior to any steel. It cannot, at present, be tempered, but it does not seem to show any change in the nature of crystallization under stress or shock. Thin, soft ribbon may be indefinitely coiled and uncoiled or run over rollers. A bar may be struck indefinitely upon one end. A rifle firing-pin was struck over 120,000 blows without apparently changing its molecular condition. It can be made of all degrees of hardness, and its strength and percentage elongation varied from 40,000 to 100,000 lbs. per sq. in., and from 70% to 1% in 10-in. bars. As an illustration of this combination of strength with ductility, I cite the fact that aluminum-bronze cartridges made for the new small-caliber low-trajectory rifle were fired for more than 90 consecutive rounds, charged with smokeless powder, at the Frankford Arsenal, for a firing test. Added to these mechanical values are the chemical resistance to corrosive influences, and the small electric potential of the combined aluminum and copper. The non-corrosiveness is only excelled by that of the noble metals; and the low, almost zero, electric potential of the aluminum bronze gives it a value in structural engineering which peculiarly fits it for acid industrial works or water-tube boilers and condensers. This value has already been tested on a large scale in underground tide-water retaining bolts in our seacoast batteries and in sulphite pulp mills and the electrolytic vats of large copper refineries. As its cost is reduced by improved methods of working, it is finding its way into many uses where steel or iron has a short life from rust, inability to resist corrosion, or lack of density and strength.

It has long been evident that aluminum bronze was an ideal metal for drawn tubes; but serious difficulties presented themselves at every stage of production, from the ingot down. It was my belief that the Mannesmann or some kindred process presented the most feasible solution of getting the cylindrical ingot in a sufficiently economical way, and after the ingot was obtained that some plant capable of cold-drawing the higher grades of steel was necessary to produce the finished tube. Experiment had shown that aluminum bronze was not to be economically worked, or even worked at all with many grades, on draw benches originally planned for copper or brass. The hardness and high tensile strength combined were found to be destructive to the dies used in the best hydraulic benches for brass and copper. It remained, therefore, for the combination of the casting plant of the Waldo Foundry, under the direction of its superintendent, Mr. E. S. Sperry, to furnish the solid billet; for the newly-introduced Mannesmann plant at the rolling mills of Benedict & Burnham at Waterbury, under the superintendence of Mr. Chas. S. Morse, to convert the solid ingot into a cylindrical tube; and for the new Pope Tube Works, built to cold-draw the nickel and other strong steels, under the superintendence of Mr. H. H. Eames, to convert the cylindrical tube billet of the Mannesmann process into the finished tube for the market. To these three gentlemen is due the success of the process.

The process of making the solid aluminum-bronze ingot has not yet been described. The system of solid hot tubular ingot-rolling known as the Mannesmann process is outlined in some detail at page 384 of the "Transactions, American Institute of Mining Engineers," Vol. XIX., 1891. The Benedict & Burnham Co. have introduced benefiting changes in the details of the process there described, and the Waterbury plant is a model of its kind. From one to two minutes is the time required to reduce a solid three-inch billet to a cylindrical forging ready for the draw bench.

After leaving the Mannesmann rolls the cylindrical aluminum-bronze ingots were given several passes on the draw benches at Benedict & Burnham's, to lessen their size to a point where they could be taken by the Pope company's benches, as at that time completed, the larger Pope company's benches not yet being in place.

The new hydraulic cold-drawing plant of the Pope Tube Works is driven by two triple-expansion, single-acting Riedler pumping engines rated at 500 HP. each, but which can work up to 1,000 HP. each. The arrangement is designed by E. D. Leavitt, and an idea of the total efficiency may be had from the fact that 1 HP. is obtained for somewhat less than 12 lbs. of steam with 135 lbs. initial pressure. These engines work through two hydraulic accumulators having 16-in. rams, and working the 8 and 6-in. draw benches with a maximum pressure at the benches of 1,280 lbs. per sq. in.

Aluminum-bronze tubes require frequent annealing during the process of drawing, and this is especially true of the higher compounds, such as Cu$_4$A, which are as difficult to draw as nickel steel.

It is known that, up to the limit of commercial temperatures—say 400° to 500° F.—that aluminum bronze retains its initial strength. In this respect it shows its great superiority to ordinary brasses and bronzes.

Table I. gives the chemical analysis and the tests of the best brass tubes the market now affords, together with the tests of the same size tubes of open-hearth Swedish steel and a low aluminum-bronze—about Cu$_9$Al, or a 4½% bronze.

TABLE I.—Tests of Tubes at Ordinary Temperatures, Cold-Drawn and Not Annealed.

Analyses Pope Mfg. Co.'s Laboratory, H. Souther, Engr. Tests, Nov., 1896.	A. Government brass tube. %	C. Ordinary brass tube. %	S. Swedish open-hearth steel. %	P. Aluminum bronze, Cu$_9$Al. %
	[1]59.86	[1]67.58	[5]0.420	[1]95.79
	[2]39.82	[2]31.67	[6]0.031	[10]4.35
	[3]0.35	[3]0.85	[7]0.500	[9]0.05
	[4]0.013	[4]0.01	[8]0.031	......
	......	......	[9]0.110	......
	......	......	[10]0.007	......
	Ins.	Ins.	Ins.	Ins.
Outside diam.	1.502	1.5000	1.504	1.491
Inside diam.	1.348	1.332	1.342	1.311
Area in sq. in.	0.38692	0.39584	0.3427	0.42157
Gage length	10.	10.	10.	10.
	lbs.	lbs.	lbs.	lbs.
Yield point	*	63,100	64,200	68,700
Strength per sq. in.	77,900	81,900	79,300	96,000
Elongation in 10 ins.	5.4%	9.3%	5.4%	4.9%

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[1]Copper; [2]zinc; [3]lead; [4]tin; [5]carbon; [6]phosphorus; [7]manganese; [8]sulphur; [9]silicon; [10]aluminum; *not defined.

Table II. shows the effect of heating the aluminum-bronze tube of Table I. to a bright red and then plunging it into water. The ultimate strength of 96,000 lbs. per sq. in. and 4.9% elongation becomes changed to about one-half this strength, 47,600 lbs., and to 13 times the per cent. elongation. This ratio of change is at its maximum in the low compounds and reaches a minimum in the high compounds at about Cu$_4$Al.

TABLE II.—Tests of Tubes at Ordinary Temperatures, Cold-Drawn and Annealed at a Red Teat.

Cold-drawn and annealed at a red heat:

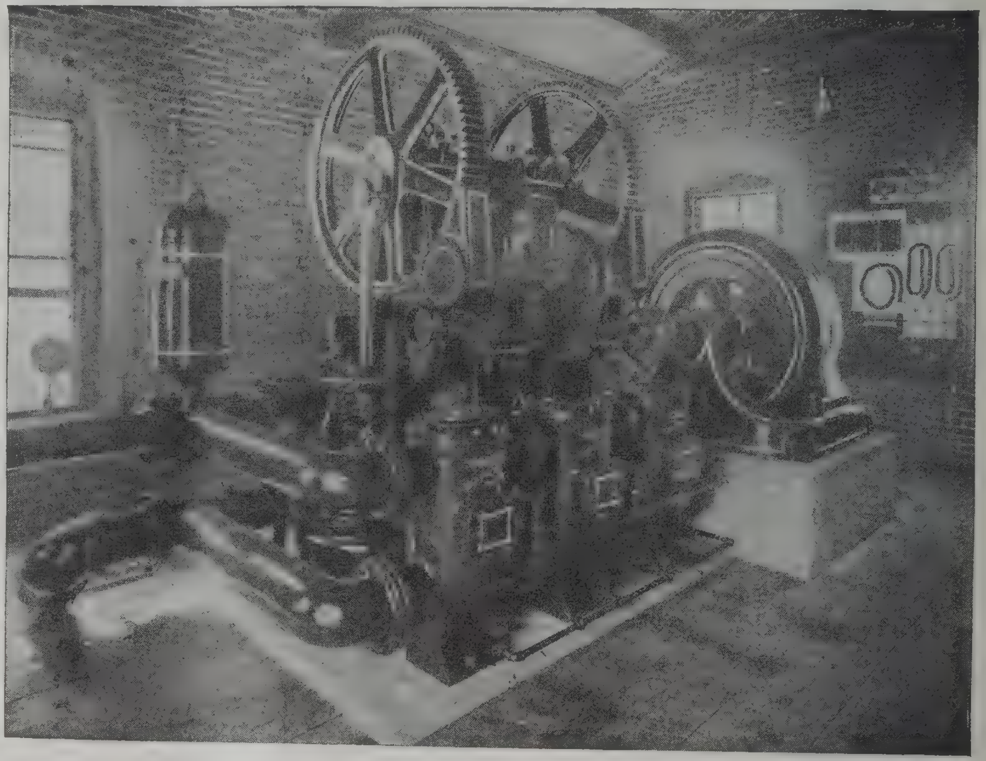
	Aluminum bronze, Cu$_9$Al.
Outside diameter	1.625 ins.
Inside "	1.415 "
Area in square inches	0.508 sq. in.
Gage length	10 ins.
Yield point	24,200 lbs.
Strength per square inch	47,600 "
Elongation in 10 inches	64.9%

A THREE-PHASE ELECTRIC TRANSMISSION SUPPLYING BOTH LIGHTING AND FIRE-PUMP SERVICE.

An interesting three-phase power transmission plant, which furnishes current for both arc and incandescent lighting and for a 750-gallon fire pump, has been installed by the General Electric Co., at Itasca, Wis., just east of Superior, the headquarters of the Chicago, St. Paul, Minneapolis & Omaha R. R. Co.

The railway shops, roundhouses and storerooms are located at Itasca, and about a mile and a quarter distant extensive docks have recently been built, with a warehouse 1,500 feet long and 300 feet wide. Boats are loaded and unloaded on one side of the dock, tracks are laid on the opposite side, and the cars are loaded and unloaded at any point in the warehouse.

The protection of the warehouse from fire, and its lighting by arc and incandescent lights would have required, by the usual method, the installation at the dock of a complete plant of boilers, engines and their accessory apparatus, in addition to the fire pump and electric generator. By the plan adopted, the cost of an engine and boiler plant at the dock, together with the expense of its superintendence and a large part of the operating expenses, have been saved. By this plan the power for driving the pump and furnishing the lights is obtained from the railway shops in the shape of a three-phase current, produced by a General Electric 100 K. W. three-phase generator, at a pressure of 2,000 volts; this voltage having been adopted in order to do away with the necessity of step-up transformers. The engine is driven at 900 revolutions per minute, by a 110 H.P. Ball & Wood engine. The pumping plant installed at the dock is shown in the accompanying illustration. It consists of a 75 K. W. General Electric 2,000-volt induction motor, coupled to a Gould triplex pump of 750 gallons capacity per minute, operating at 80 lbs. water pressure and able to throw four effective fire streams upon the docks and into the warehouse.



AN ELECTRIC PUMPING STATION FOR FIRE PROTECTION AT THE DOCKS OF THE CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA R. R., ITASCA, WIS.

The inside of the warehouse is provided with five fire stations, fitted with electric fire alarm apparatus for transmitting signals between the docks and the engine house; also switches connecting the motor and pump to the power wires. Hydrants and reels are suspended from the walls, each reel having 100 ft. of hose, so that, after the fire signal has been given from the engine house, one man can carry hose and water to the fire in from 10 to 30 seconds. A fire corps has been organized, and the men are drilled three times each week. In addition to current furnished to the pump, the generator also supplies electricity to 12 alternating current arc lamps, 6 on each side of the dock, supported on brackets from the sides of the building. Over 200 16 c. p. lamps are required to light the warehouse; and in Itasca itself about 150 more 16 c. p. incandescent lamps are also installed.

RAMIE AND CANAIGRE IN MEXICO.

Sir Henry Dering, the English Minister to Mexico, has lately forwarded to the British Foreign Office, an extended report upon the vegetable products of Mexico, and the portion relating to the cultivation of ramie and canaigre is briefly abstracted as follows:

Ramie was introduced into Mexico from Java in 1867, and various companies are now engaged in raising the plant and extracting its fiber. There

WEATHER TABLE FOR NOVEMBER, 1896. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.)				Wind.			Precipitation—rain or melted snow—inches.		
		Average.	Max.	Min.	Range.	Velocity in miles per hour. Average.	Velocity in miles per hour. Max.	Direction at time of max. velocity.	Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt........	37.1	69	— 3	72	10.8	42	SE	3.55	1.53	13
	Portland, Me.........	40.4	72	15	57	7.3	34	S	2.45	1.02	13
	New York City.......	48.0	70	27	43	14.5	52	SE	2.12	0.89	10
	Pittsburg, Pa....	48.5	74	19	55	7.0	26	SW	2.76	0.69	11
	Chicago, Ill....	38.4	70	6	64	19.5	53	W	2.16	0.57	12
	Omaha, Neb.	29.9	72	— 2	74	7.5	24	N	2.02	1.59	6
	St. Paul, Minn.	21.8	50	— 10	60	8.1	29	SW	5 07	2.77	15
	Duluth, Minn........	21.0	44	— 20	64	10.7	46	NE	3.42	1.09	14
	Bismarck, N. Dak....	7.2	48	— 22	70	10.4	54	NW	3.10	0.77	14
	Average............	32.5	63	2	62	10.6	40		2.96	1.21	12
Southern Cities.	Washington, D. C....	50.6	77	26	51	6.7	30	NW	2.54	0.91	12
	Louisville, Ky........	50.4	75	14	61	8.2	39	SE	4.62	2.32	11
	St. Louis, Mo.........	46.2	78	13	65	13.2	36	S	3.70	1.07	13
	Savannah, Ga........	63.4	83	40	43	7.4	27	NE	2.42	1.37	7
	Kansas City, Mo.	40.5	75	4	71	11.0	28	SW	1.38	1.20	5
	Jacksonville, Fla	67.4	85	45	40	7.1	25	S	4.55	1.32	14
	Chattanooga, Tenn..	54.2	76	28	48	6.8	30	W	5.51	2.73	13
	New Orleans. La.....	65.2	84	35	49	10.5	32	N	2.82	1.62	10
	Memphis, Tenn......	53.2	76	19	57	11.5	38	SE	7.47	5 10	8
	Palestine, Tex.	59.2	83	28	55	7.9	28	S	1 67	1.01	6
	Average............	55 0	79	25	54	9.0	31		3 67	1.86	10
Western Cities.	Helena, Mont........	18.4	63	— 22	85	6.8	42	SW	3.29	1.30	12
	Port Angeles, Wash..	*37.0	*53	*12	*41	6.1	*36	*NE	7.48	1.94	*16
	San Francisco, Cal ..	53.4	66	38	28	7.9	33	W	4.56	2.76	8
	Salt Lake City, Utah.	37.2	65	— 2	67	5.8	39	NW	3.15	1.08	11
	Santa Fe, N. Mex....	39.2	64	7	57	6.6	33	SW	0.25	0 10	5
	Denver, Colo.........	35.9	75	— 9	84	7.8	44	W	0.10	0 09	2
	Yuma, Ariz	63.2	86	42	44	6 5	38	N	0.06	0.06	1
	Average............	40.6	67	9	58	6.8	38		2.70	1.05	8

* For 24 days.

are two distinct plants, China grass (Boehmeria nivea) and ramie, or rhea (B. tenacicsima), the stalks of which reach 3 to 5 ft. in height. The best climate for its cultivation seems to be one that has a mean temperature of 36° Fahr. and an altitude of about 800 ft. above the sea. The land must be damp or easily irrigated, rich in humidity and perfectly permeable so that the accumulated dampness may not rot the roots. The fiber produced is fine, silky and brilliant, and superior to all other vegetable fiber in length, strength and beauty. It is used in rope-making and in the manufacture of handkerchiefs, curtains, carpets, tablecloths, etc. Textiles made from it have the strength of linen, and a luster resembling that of silk.

The Mexican Department of Public Works says that from one square league of ground 1,936 tons of ramie can be produced and transported to New York for $203,007; and the price in New York is given as $250 per ton. The capital invested in this particular undertaking was $30,000 for machinery, in addition to the sum named above, or $233,007 in all.

A very interesting part of the report is that referring to canaigre, a tanning material of great value now grown extensively in Mexico, and in certain parts of the United States. This plant is known botanically as Rumex Hymenosepalus and it grows wild in western Texas, Arizona, New Mexico, Mexico and California. It is found generally on sandy loam and in moderately moist localities, and is described as a "many-headed root, black externally and yellow within." Its value lies in the fact that its tubers contain from 23 to 33% of tannic acid, and it has been fully proved to be a most valuable material for making leather. The Mexicans and Indians employ it to some extent as a purgative, and the leaves are used as food, having the general taste and properties of rhubarb, or "pie-plant."

Hemlock bark contains only 14% of tannic acid, and though canaigre has long been used by the Mexicans, both for medicinal and tanning purposes, its use as a substitute for hemlock bark has only recently attracted the attention of the general commercial world, as a valuable source of tannic acid. It is stated that one acre of canaigre, properly cultivated, will yield from 20 to 30 tons of green roots, equal to 7 tons of the dried material ready for shipment. The prices of this product are from $25 to $30 per ton in the United States, and $60 to $80 per ton in Europe. At the lowest estimate of both yield and profits, says the report, one acre of canaigre should bring in $175, and $225 is believed to be a safe and reasonable estimate.

The value of canaigre as a tanning medium is settled, and the only question now is to obtain enough of it at satisfactory prices. Sir Henry believes that an extract containing the tanning properties could be readily manufactured in Mexico, and money thus be saved in transport. The older the root the heavier is the percentage of tannic acid; roots one year old yield 20 to 25%, and older roots yield from 25 to 40%.

◆

THE U. S. BATTLESHIP "TEXAS," says Secretary of the Navy Herbert in an official statement, instead of being in any degree a failure, as has been currently reported, ranks with the best ships of her class in the world. He admits original structural defects in her hull and some of her machinery, but he says these defects have been remedied, except those relating to her water-tight bulkheads, as developed by the recent flooding of the vessel. The Department has issued orders to have these latter deficiencies made good and the work can be done in a few weeks at a comparatively small cost. Mr. Herbert also publishes a letter from Mr. Chas. H. Cramp, treating of the trouble with the "Texas." This letter says that the design submitted by Mr. John, the eminent English naval architect, was the best of all plans submitted at that time to the Navy Department; and though the scantling was light, this lightness was then in accord with the best foreign practice, and the "whole hull construction involved the best mechanical distribution of minimum weight" Mr. Cramp had ever seen. This lightness was a result of the introduction of steel and an undue faith in the effect of this then new material upon the general strength and rigidity of the hull, as compared with iron.

◆

THE BAZIN ROLLER-BOAT is now at Rouen, says the London "Telegraph," with its engines in place and all fittings nearly ready for the trial trip across the English Channel, which it is proposed to make in January next. M. Bazin is as sanguine as ever as to the success of his enterprise, and predicts that ships with rollers 65 ft. in diameter can cross the Atlantic in 96 hours. The experimental boat has three pairs of 32-ft. rollers, with a screw in addition.

◆

AN EXTRAORDINARY FEAT OF DEEP-SEA DIVING is reported from Hong Kong by "Chambers' Journal." In August, 1895, the steamer "Catterthun," on the way from Sydney to Hong Kong, struck upon a submerged rock and was sunk about 3 or 4 miles from Seal Rocks Bay, off the mainland of New South Wales. On board this ship were $45,000 in gold, and the insurance companies determined to make an effort to recover this treasure. Capt. John Hall, of Sydney, was commissioned to perform this service, and by skillful work he located the wreck and found that the bottom of the iron tank chamber containing the gold was 165 ft. below the surface of the sea. The door of the manhole was blown off by dynamite; but the hole was too small to admit a man in a diving dress. But after numerous failures seven boxes of gold were fished up in a kind of basket-net and $39,710 were thus recovered. The wreck was located by trailing a steel cable over the supposed route of the ship, and diver Briggs, with his assistant, descended 9 times to the deck of the ship in one day, remaining as long as 15 minutes on one occasion. Adverse weather, local currents and the extreme general difficulty of the operation consumed the time between May 4 and August 18, of the present year, in the recovery of the treasure after the wreck was located.

◆

A RAILWAY WITH SUBMERGED TRACK, at Brighton, England, called the Brighton & Rottingdean Electric Ry. was opened to traffic on Nov. 28. The peculiarity of this line, 3 miles in length, lies in the fact that the railway is located in the sea parallel to the coast line, and at high tide the road is operated in from 10 to 12 ft. of water. To meet this condition two parallel tracks, of 2 ft. 8½ in. gage each and 18 ft. between outer rails, are laid upon blocks of concrete deeply bedded in the beach and spaced 3 ft. apart. The car, with a capacity for 150 passengers, rests upon a platform supported by four tubular inclined posts, 24 ft. long and well braced at the bottom and top. At the foot of each of these posts is a four-wheeled truck completely boxed in to protect the wheels from obstruction. Down two of the legs pass two shafts, each driven by a 30-HP. electric motor, which takes current from an overhead wire. Down two other posts pass rods operating powerful brakes. The maximum speed attained in the official trial trip was 6 miles per hour. A somewhat similar railway, shorter but running in a much greater depth of water, has been in use for some years past in connecting two villages on the French coast, separated by a narrow tidal stream.

◆

CAR LIGHTING BY ELECTRICITY is in use on the express trains of vestibuled corridor cars now being run by the Southeastern Ry. (England) between London, Hastings and St. Leonards. Each train has five cars, each 50 ft. long, mounted on four-wheel trucks. There are 16 lights in the car, including 1 in the lavatory and 3 in the smoking room. Each car has its own dynamo and accumulators, the dynamo being driven by a 2½ in. link belt from a pulley on one of the axles. The novelty in the system is the means of getting constant voltage independent of the speed at which the train is going. Instead of allowing the speed of the dynamo to vary, and regulating the magnetic field to correct for this, the dynamo is suspended so that its weight gives the necessary tension to the belt. The weight of the machine and the torque on the armature then exactly balance each other at normal output. Any further effort causes the dynamo to be pulled nearer to the driving axle. This slackens the belt and allows it to slip over the dynamo pulley. Thus a condition of equilibrium is reached, and a further increase of speed is impossible. The armature connections are reversed with a reversal of direction of rotation. An automatic switch, worked by a small governor on the shaft, closes first the shunt circuit and then the main circuit as the speed incrases to the normal. The inverse operation takes place as the train slows up. The accumulators are placed in two wooden boxes under the middle of the car, one on each side. There are 16 of these to each car, the plates being contained in teak boxes. The dynamos on the car give about 35 amperes at full load. The lamps used throughout are of 10 c. p. at 30 volts, and are controlled from the attendant's recess. A switch turns on one-half or the whole of the lamps as may be required. The equipment was built by J. Stone & Co., to the specifications of Mr. W. Lennard, Telegraph Engineer of the Southeastern Ry.

◆

FOUR MONSTER DYNAMOS are now being placed in the Allegheny County Light Co.'s station at 12th and Elm St., Pittsburg, Pa., by the Westinghouse Electric Co. Each of the dynamos is 30 ft. long and 24 ft. high, and weighs over 110 tons. Each armature is 16 ft. 8 ins. diameter and weighs over 30 tons. Each dynamo is driven by a 2,000-HP. Westinghouse double-acting vertical compound engine. The four machines are designed to furnish current for 20,000 incandescent and 5,000 arc lights.

◆

A ST. LAWRENCE RIVER WATER-POWER PLANT is projected, to be established at Massena, N. Y., and it is said that 100,000 to 200,000 HP. can be developed. A canal will supply the inlet pipes, and the flumes from the turbines will discharge into Grass River, the difference in level between the two rivers being about 45 ft. Stewart & Co., of Wall St., New York, are said to be behind the enterprise; with Mr. John Bogart, M. Am. Soc. C. E., as Consulting Engineer, and Mr. James Patten in charge of the design of the electrical plant.

◆

WATER RIGHTS IN CALIFORNIA are not subject to charges in addition to the amounts paid for the water itself, according to a recent decision of Judge Ross, of the State Supreme Court. The decision was rendered in a suit brought by Mr. Chas. D. Lanning, Receiver of the San Diego Land & Town Co., against one of its consumers. The company sought, it appears, to collect money for the right to use water, as well as for water used. The state constitution provides for the fixing of water rates by County Boards of Supervisors, and the practice which the company sought to follow, and which others have followed, is considered as evading this regulation.

◆

GASOLINE PUMPING PLANTS are said to be under consideration by the Atchison, Topeka & Santa Fe R. R.

as substitutes for the present steam plants at the numerous water stations on the road.

◆

EXAMINATIONS OF ENGINEERS who are applicants for government engineering positions will be held by the Civil Service Commission at Washington, D. C., in January. Those who pass will be placed on the eligible list for the positions of inspector, surveyor, topographer, hydrographer, transitman, levelman, etc. Particulars may be obtained by addressing "The Civil Service Commission, Washington, D. C."

◆

LOCOMOTIVES FOR JAPAN are now being built by the Rogers Locomotive Works, Paterson, N. J., to general specifications prepared by the authorities of the Japanese Government Railways, the details of the design being prepared by the builders. There are 18 of these engines, all of the mogul type, with eight-wheel tenders. They are for tracks of 3 ft. 6 ins. gage. The leading dimensions are as follows:

Driving wheels	4 ft. 0 ins.
Truck wheels	2 " 4 "
Wheelbase, driving	11 " 6 "
" total of engine	18 " 8 "
" total of engine and tender	40 " 0 "
Weight in working order	92,000 lbs.
Cylinders	16 × 22 ins.
Valve gear	Stephenson link.
Boiler	Straight top.
" diameter	4 ft. 8 ins.
" thickness of barrel plates	9-16-in.
Working steam pressure	170 lbs.
Firebox	Radial-stayed.
" length	8 ft. 6 ins.
" width at grate	2 " 0 "
" width at crown sheet	3 " 9 "
" depth at front	4 " 8 "
" depth at back	4 " 0 "
Tubes, 173; diameter	2 "
Tubes, length	10 ft. 3 "
Capacity of tender tank	2,600 gallons.

◆

THE LARGEST FREIGHT CARS yet built are said to be two box cars for the Mansur & Tebbetts Implement Co., of St. Louis, Mo., and the Hutchinson Cooperage Co., of Peoria. They are of 40,000 lbs. carrying capacity and weigh about 40,000 lbs. The former has a truck wheelbase of 8 ft. and axle journals 4¼ × 8 ins. The top arch bars are 1¼ × 4 ins.; lower arch bars, 1⅛ × 4 ins.; tie-bars, ½ × 4 ins. The cars were built by the Missouri Car & Foundry Co., of St. Louis, Mo., and their dimensions are given as follows in an article in the "Car Jorunal":

	M. & T. I. Co.	H. C. Co.
Length over end sills	60 ft. 0 ins.	59 ft. 3 ins.
Width over side sills	8 " 10 "	9 " 2½"
Height from sill to side plate	9 " 2 "	10 " 9¾"
End sills	7 × 13 "	7 × 13 "
Center sills	4¾ × 9 "	5 × 8½"
Side sills	5¾ × 9 "	5 × 10 "
Intermediate sills	4¾ × 8 "	5 × 10 "
Transoms	11 × 5 "	....
Side plates	4 × 8 "	4 × 8 "
Number of truss rods	6	6
Diameter of truss rods	1¼ ins.	1¼ ins.
Diam. truss rods at upset ends.	1⅛ "	1⅛ "

◆

RAILWAY EMPLOYEES AS STOCKHOLDERS will be a feature of the Illinois Central R. R. Co., the directors having adopted plans by which its employees can purchase stock. The plan has been prepared by the President, Mr. Stuyvesant Fish, and over 1,500 applications have already been received.

◆

THE ABANDONMENT OF A RAILWAY LINE 30 miles long is recorded in the recent report of the Railroad Commissioners of Connecticut. The Meriden, Waterbury & Connecticut River R. R. was built eight years ago, and was leased to the New York & New England R. R. for the term of ninety-nine years from Sept. 1, 1892, at an annual rental of $22,500, though it had never earned its operating expenses. The rent was only paid till July 1, 1894, and the reorganization committee of the New York & New England R. R. purchased all the outstanding bonds, and delivered them to the New England R. R., which foreclosed the mortgage. The road was sold under order of the Court, and the New England R. R. ceased to operate it, nor has it been operated by the purchaser. Nothing has as yet, however, been done toward taking up the track or removing the bridges or disposing of the station buildings.

BOOK REVIEWS.

THE STORY OF THE MINE as Illustrated by the Great Comstock Lode of Nevada.—By Charles Howard Shinn. New York: D. Appleton & Co. 8vo.; pp. 272; illustrated. $1.50.

This is not a technical treatise upon mining operations, but an exceedingly readable sketch of the discovery of gold in California, and of the palmy days of silver-mining in Nevada. The author seems to write from the standpoint of intimate personal acquaintance with the pioneers and prospectors of '49; and in any event he has closely studied their character and tells of their personal peculiarities, their trials, suffering and success, or ill fortune, with a delightful freshness. As a history of gold-hunting in California, of bonanzas and of speculation in mining shares, as controlled by the ups and downs of famous mines, it is well worth reading. And the reader of this book will better appreciate the fact that for every dollar in gold or silver thus won there is a counter-balancing amount of human toil, privation, suffering and disappointment somewhere.

THE MECHANICAL WORLD POCKET DIARY AND YEAR BOOK FOR 1897.—Tenth Year of Publication. The "Mechanical World," Manchester, Eng. Boards; 4 × 6½ ins.; pp. 202. Price, 6d.

This little book contains a very good collection of useful notes, rules, tables and data, for the use of engineers, draftsmen, mechanics, etc., together with 52 blank pages for a diary, and about 30 pages of advertisements. The notes, rules, tables, etc., appear to be compiled chiefly from D. K. Clark's works and other English authorities.

RETAINING WALLS FOR EARTH, Including the Theory of Earth-pressure as developed from the ellipse of stress, with a short treatise on foundations, illustrated with examples from practice.—By Malverd A. Howe, C. E., Professor of Civil Engineering, Rose Polytechnic Institute, Member of American Society of Civil Engineers. Third edition revised and enlarged. New York: John Wiley & Sons. 12mo.; 132 pp.; illustrated; $1.25.

In this new edition Prof. Howe has added throughout the text a number of examples of retaining walls and foundations as taken from actual practice, and the treatise on foundations is entirely new. The latter, while very concise, covers the general principles of foundations upon rock, earth and soft earth, and the supporting power of piles. Foundations under water and deep foundations are also discussed and illustrated by existing examples. This work has been reviewed by us before and it only remains to say that it is made more valuable still by the revisions and additions.

CATALOGUE OF THE PUBLIC DOCUMENTS OF THE 53D CONGRESS and of all Departments of the Government of the United States for the Period from March 4, 1893, to June 30, 1895.—Prepared under the supervision of the Superintendent of Documents. Washington, Government Printing Office. Large 8vo.; pp. 638.

This is the "Comprehensive Index" provided for by the act approved Jan. 12, 1895, requiring the Superintendent of Documents to issue such an index at the close of each regular session of Congress. As the first issue of a work brought out with a newly organized staff, and in the absence of any previous systematic index of departmental documents, Mr. Crandall has done an excellent work. The arrangement of the Index is entirely alphabetical, covering authors and subjects, and sometimes titles. It is strictly a "dictionary catalogue," without index, side columns, or attempt at complicated chronological or numerical classification. But there are cross references, and with each subject or author is a brief synopsis of the matter dealt with; enough to give an idea of contents and the size and importance of the document. It is in itself an extremely valuable record of government publications, and so far as we have attempted to use it the arrangement is very satisfactory for the purpose intended.

CHEMISTRY FOR ENGINEERS AND MANUFACTURES.—A Practical Text-Book. By Bertram Blount and A. G. Bloxam. With illustrations. Vol. II., Chemistry of Manufacturing Processes. London: Chas. Griffin & Co., Ltd. 1896. 8vo.; pp. 484; $4.50.

We had occasion recently to review Vol. I. of this work, which treats of the chemistry of engineering, building and metallurgy, and expressed our opinion that it was too much condensed to be of great service to engineers engaged in any particular specialty. The same criticism might be made of this second volume, but the authors forestall it by the following paragraphs in their preface:

> The sole object of the chapters comprising this volume is to give the reader a general view of the principles which underlie the several manufactures described. It is in no way intended to present such an account of details as will suffice for the student of any particular industry, as indeed must be obvious from the size of the book.
>
> The usefulness with which the authors venture to accredit their work is to be found in the fact that it seeks to expound those dominant principles which are too often hidden beneath masses of mere detail, and are consequently apt to be overlooked by the specialist in any one branch, to his detriment, in that he frequently fails to apply to his own work principles which are matters of common knowledge elsewhere.
>
> These remarks are rendered necessary by the fact that the scope and intention of the first volume of this book appear to have been occasionally misunderstood.

With this explanation before us we are disposed to be rather lenient with this second volume. It treats briefly of the chemistry of the manufacture of sulphuric acid, alkali, artificial manure, lime and cement, glass, sugar and starch, oils, resins and varnishes, soap and candles, coloring matters, paper and pasteboard, pigments and paints, leather, glue and size, and minor chemical manufactures, also of destructive distillation, petroleum, clay industries, brewing and distilling, textiles and bleaching, and is probably as good a handy manual on this variety of subjects for the use of a general reader as can be expected in a work of its size. A bibliography at the end of the work is useful in giving sources of information for those who desire further details on any particular subject.

A TEXT-BOOK OF PLANE SURVEYING.—By William G. Raymond, C. E., M. Am. Soc. C. E., Professor of Geodesy, Road Engineering and Topographical Drawing, in the Rensselaer Polytechnic Institute. New York, Cincinnati, and Chicago: American Book Co. 8vo.; pp. 484; with illustrations and diagrams; $3.

In this work Prof. Raymond has set forth, in an exceedingly clear and simple manner, the whole art of plane surveying. It is especially designed as a text-book for beginners, leaving to the teacher the work of amplification rather than that of explanation of the subject. With the exception of two formulas only, a knowledge of trignometry is all that is required by the reader or student. The work commences with a very complete illustrated description of the instruments and appliances used, with directions for their adjustment and care, practical hints as to their handling, and the various degrees of accuracy attainable under different conditions of use. This matter takes up the first 140 pages and includes an excellent special chapter on stadia measurements. Land survey computations follow, with a full treatment of the computation of areas by the modern method of co-ordinates; and in this connection there is an illustrated description of the use of planimeters of various types, and an unusually full treatment of the slide-rule, as designed by Gunter, Mannheim, Thacher and Fuller, with clear directions for their use. Book II. applies to general surveying methods, presenting and discussing common problems of land surveying, for both private and public lands and for city work. The laying out of curves is briefly described, in principle and practice, and then follow topographical surveying, simple triangulation and map-making, including the use of the plane-table, etc. Chapter X. takes up earthwork computations, by ordinary methods and by estimation from maps. Under the head of hydrographic surveying are described the methods and location of soundings, the use of the sextant, and the measurement of velocities and discharge. Underground surveying, for mines, etc., and the instruments and methods employed, complete the more technical portion of the work. In an appendix are included a large number of problems and examples, and articles on the judicial functions of surveyors, the ownership of surveys, and the geographical positions of base lines and principal meridians governing the public surveys. A full series of tables applicable to land surveying finish the volume, including those of the common logorithms of numbers and the logorithms of trigonometric functions. This work is to be especially commended for the fullness and clearness of its text, its excellent illustrations, and its modern treatment of the problems of plane surveying.

AMERICAN HIGHWAYS.—A popular account of their conditions and of the means by which they may be bettered. By N. S. Shaler, Dean of the Lawrence Scientific School of Harvard University. New York: The Century Co. 12mo.; cloth; 293 pp.; illustrated; $1.50.

Prof. Shaler, as a member of the Massachusetts Highway Commission, engaged in the actual work of laying out and building country roads in that state, and as a geologist and a close student of roadway practice here and in Europe, is well fitted to write upon this subject. Commencing with a general history of roadmaking, from the Romans to Telford and Macadam, this work takes up the early American roads, and the effect of climate and influence of topography and forests upon roads. The nature and distribution of road materials and their method of use are very fully discussed by this competent authority; and as these materials cover about all that is available in almost every section of the United States the hints given as to their best use and the methods for testing their suitability for roadmaking purposes, are exceedingly valuable. The difficult problem of road maintenance, by the government, by states and by private corporations, is next taken up, with an expressed preference for state administration, somewhat after the manner adopted for Massachusetts and here described. The preliminary study for and the construction and repair of roads forms another long chapter, teeming with practical suggestions and advice deduced from modern practice. Supplementary to this is another chapter on road administration and inspection, the Commonwealth system being here again advocated. Following this are chapters on road machines, cost of road-building and the importance of specific training and education in highway engineering. In his summary and conclusions Prof. Shaler says that the failure of the Americans to attain success in the management of their highways is not due to any lack of public spirit or to any incapacity to deal with public affairs, but is mainly to be ascribed to the exceeding popular ignorance as to the nature and value of good roads. Consequently the first important step towards the amendment of our system is the education of the people as to the means whereby roads may be improved. His book is one of the best means towards this end; for while it is written for popular use, it is the work of one who knows whereof he speaks, and it is quite as useful, in its practical hints and directions, to the engineer as it undoubtedly is to those who wish to be better informed as to the material value of good roads as compared with bad ones.

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THE ROEBLING CONCRETE FLOOR, whose test by fire was described in our issue of Nov. 5, was subjected to a test load of 4,000 lbs. per sq. ft. on Dec. 11, by the Building Department of New York city. As shown in the report in our issue of Nov. 5, the floor forming the roof of a brick building, 12 × 16 ft. floor area and 12 ft. high, was made of 10-in. I beams, 25 lbs. per ft., spaced 4 ft. between centres, with concrete arches 3 ins. thick at the crown sprung across the space. The concrete was made of 1 part Aalborg Portland cement, 2 parts sand, and 5 parts ashes from steam boiler furnaces. A wood fire was maintained under this floor for five hours, during the last three of which it was held at over 2,000° F., and at the end of the time a stream of water from a fire engine was applied to the under side. During this test the floor sustained a load of 150 lbs. per sq. ft. On the next day the load was increased to 600 lbs. per sq. ft. without injury.

A test of the floor to destruction was determined upon by the builders. The test was begun on Dec. 11, and continued on Dec. 12 and 14. A section of the middle arch 4 ft. wide between the I beams, and 2 ft. 6 in. in length, making 10 sq. ft. area, was isolated from the remainder of the floor by cutting openings at each end of its length. On this section a brick pier 1 ft. high was built, and over it was placed a platform of heavy plank 7½ ft. square. This was loaded with brick and stone until 40,000 lbs. was supported by the loaded area of 10 sq. ft., or 4,000 lbs. per sq. ft., when the load became so top-heavy it was considered dangerous to continue the test further. The deflection of the center of the arch under this load was just one inch; after the load was removed it decreased to ⅝ in.

◆

A TEST OF A CONCRETE FIREPROOF FLOOR constructed by the Columbian Fireproofing Co., 156 5th Ave., New York city, was made by the Building Department of the city at 68th St. and Avenue A on Dec. 23. The test was conducted in the same manner as the other tests that have been made by the department during the last four months, which have been described in our columns. The floor was loaded to 150 lbs. per sq. ft. and subjected to a heavy fire for five hours, and then suddenly cooled by a stream from a fire engine. The floor sustained its load throughout the test, the maximum deflection being about 3 ins. We shall give in next week's issue a more detailed account of this test, with a drawing showing the construction of the floor.

◆

A LIMIT FOR THE HEIGHT OF BUILDINGS is demanded by the New York fire and health officials, in answer to queries submitted by the Committee of the New York Board of Trade and Transportation now investigating this subject. The Fire Department favors a limit of 85 ft., as provided for in the building laws. So-called fireproof buildings do not come under this law and some of them are 300 ft. high. Chief Bonner does not believe these buildings are fireproof, and said that when the height exceeded 125 ft. there should be an auxiliary fire plant on each floor handled by trained men. He recommended that no office building be more than 12 stories high for a street not less than 85 ft. wide; commercial buildings should not exceed 10 stories, with 70 ft. as a minimum street width; and apartment house 7 stories on a 60 ft. street. The Board of Health objected to high buildings from a sanitary point of view, stating that they restricted sunlight; they made artificial light necessary, and were difficult to supply with good water on the higher floors. Statistics were submitted showing that in all foreign cities there were restrictions keeping the height below the width of the streets, and that the greatest height, 82 ft., was in Vienna.

◆

THE BOSTON TERMINAL PLANS have been submitted to the mayor for approval, and are found to embody some highly interesting features. There will be two floors, one slightly above and the other slightly below the street level, reached by easy inclines instead of stairs. On the upper level will be 28 parallel tracks, leading out to two four-track main lines (one for the New York, New Haven & Hartford R. R., and one for the Boston & Albany R. R.). On the lower level is a double track loop with three platforms, this being intended for the suburban traffic (which, it is expected, will be operated by electric traction). Each of the two tracks can accommodate 20 cars. No switching will be required, the trains coming in on the two inbound tracks, passing round the loop, and going out on the two outbound tracks. The trainshed will be 700 ft. long and 650 ft. wide, having a central span of 228 ft 6 ins., and two side spans of 165 ft. 9 ins. The plans have been prepared by Mr. George B. Francis, M. Am. Soc. C. E., Resident Engineer for the Boston Terminal Co.

◆

THE EAST RIVER TUNNEL scheme has received the approval of the Railroad Commissioners, and the New York & Brooklyn R. R. Co. has been authorized to proceed with the work of construction. The tunnel is proposed to extend from Fulton St., Brooklyn, to Ann St. and Broadway, in New York city. Messrs. Sooysmith & Son, of New York, are the consulting engineers.

◆

THE MOST SERIOUS RAILWAY ACCIDENT of the week, and the worst that we have had to record for some time, was the derailment of a local train on the Birmingham Mineral R. R., near Birmingham, Ala., Dec. 27. The train was derailed on the Cahaba River bridge, and fell to the ground, 120 ft. below. The wreckage caught fire, and 23 persons were killed by the fall or in the burning of the wreck. It is said that train wreckers had loosened or taken up a rail. The bridge is about 800 ft. long, with a central span of 110 ft., and was built four years ago.

◆

A LOCOMOTIVE BOILER EXPLOSION occurred Dec. 19 on the St. Louis, Iron Mountain & Southern Ry. at Gad's Hill, Mo. Two men were killed and one injured. The engine was standing on a sidetrack at the time.

◆

A GRADE CROSSING COLLISION between an electric car and a passenger train of the Central R. R. of New Jersey, occurred Dec. 25, at East Allentown, Pa. The conductor signaled the motorman to come on, and then saw the train, but too late to warn the motorman. The train struck the front end of the car, killing the motorman and injuring five of the passengers.

◆

THE MIAMI & ERIE CANAL broke its bank near Dayton, O., recently, and the water ran out into the Miami River. It is said that the bank had been badly weakened by rats.

◆

THE FERRYBOAT "NEW BRUNSWICK," of the Pennsylvania R. R., was burned at her slip in Jersey City on Dec. 28. The boat was burned in 1889 and was then rebuilt as a double deck boat. It was one of the older type, having sidewheels instead of twin screws.

◆

A COLLIERY EXPLOSION occurred Dec. 26 in the mine of Maule & Son, at Princeton, Ind., by which six men were killed and eight injured.

◆

A FIRE IN A WORKED-OUT COAL MINE, located in the 13th Ward of Pittsburg, Pa., is causing much trouble to the authorities of that city, who have thus far failed to check it. It is now proposed to call in consultation a number of mining experts, including the State mining inspectors, and to act according to their advice.

◆

A STRIKE OF EMPLOYEES occurred last week on the West End Street Ry., of Boston, Mass. Traffic on the suburban lines was largely stopped for a time, but cars were running again as usual by Dec. 26. The company employed many new men, and is giving them preference over the former employees who apply to be reinstated.

◆

THE SOUTH 22D ST. BRIDGE, in Pittsburg, Pa., completed less than one year ago, is said, by the Pittsburg "Dispatch," to show two cracks in each of its piers, and some settlement of the foundations is feared. The matter is being investigated.

◆

ENGLISH RAILWAY ACCIDENTS are reported upon by the Board of Trade for the 6 months ending June 30, 1896. These accidents to trains, rolling stock, permanent way, etc., caused the death of 2 passengers and 1 employee and 54 passengers, 49 employees and 5 other persons were injured. In the 6 months there were 9 collisions between passenger trains or parts of them; 15 collisions between passenger trains, and goods trains or light engines, and 13 collisions between goods trains, or parts of such trains. Trains running into stations at too high a speed, and into buffers or vehicles at rest, injured 20 passengers and 3 employees. There were 33 cases of passenger trains leaving the rails, and 8 similar cases for goods trains. In addition to the above, there were reported 259 failures of tires, 136 failures of rails, and 79 failures of axles in the 6 months. Of the axles failing, 50 were locomotive axles, and of these 31 were crank, or driving axles, and 18 trailing axles. The failing rails were all steel, except 4, and of these 36 were double-headed (of which 24 had been turned), 77 were single-headed, and 23 were Vignoles rails. The average mileage of the 13 iron crank axles that failed was 269,511 miles; that of 18 failing steel crank axles was 267,550 miles.

◆

SOME BADLY SCAMPED SEWER WORK at Manchester, Eng., is described in the London "Surveyor" for Nov. 6. Extensive sewer building has been under way for some time past under the direction of the Rivers Committee. A recent report by the city surveyor describes the character of some of the work done. The "Surveyor" says that "miles of sewers have been formed of half, or even less than half, the correct thickness," and presents illustrations showing vacant spaces about the sewer lining nearly as large as the sewer itself.

◆

A DEVICE FOR TESTING THE TIGHTNESS of sewerage plumbing work of houses and other buildings is now being made by the Rossman & Bracker Co., plumbing contractors, 132 East 42d st., New York city. While we have not seen the machine in operation, the descriptive matter sent out by the makers indicates that it is a handy and serviceable apparatus for use where either the smoke or peppermint test of completed plumbing is ordinarily employed. The essential part of the device is a series of trays for developing a dark-colored vapor, with or without a pungent odor, and a 13-in. fan blower, driven by a hand crank, for forcing the vapor into the pipes to be tested. The vapor, when odorless, is formed by passing air over muriatic acid and then over ammonia. When a pungent odor is desired a third pan, filled with ether, is used. The trays and fan, with spaces for tools, are placed in a box about 28 in. sq. and 18 in. high, with the crank and wheel on top, and the whole mounted on a tricycle for convenience and rapid transportation.

◆

IMPROVEMENTS TO THE GARBAGE DISPOSAL plant of the St. Louis (Mo.) Sanitary Co. must be made within six months, in accordance with a recent court order. The order is the result of a suit brought by citizens to compel the closing down of the works on the ground that the odors arising from the plant constitute a nuisance.

◆

INVESTIGATION OF MUNICIPAL OWNERSHIP OF gas works in Brooklyn was voted down, 16 to 8, by the aldermen on the day following the adoption of a resolution ordering such an investigation by the aldermen of New York city.

◆

THE 4-CT. STREET RAILWAY FARE ORDINANCE in Chicago, recently passed, has been vetoed by the Mayor, and the veto has been sustained by the council. The Mayor urges that better service is needed more than lower fares, and that it would be delayed by the proposed reduction. He also advocates the exacting of a percentage on the gross receipts of street railway companies.

◆

THE DISADVANTAGES OF DRAWBRIDGES near railway terminals are commented upon by some of the Boston papers in connection with the new Boston Terminal Station, in consequence of a recent disabling of the low level bridge carrying the present lines over the Fort Point channel, which channel will be crossed by the line to the new terminal. It is suggested that the railway should be elevated so as to allow mastless vessels and barges to pass under it, or else that the channel should be filled in.

◆

THE ALABAMA IRON EXPORT TRADE is rapidly developing, says a Birmingham, Ala., news item. This opinion is based upon the fact that the Tennessee Coal, Iron & Railway Co., the largest iron producer in the South, in November last sold more iron to foreign consumers than to the home trade. The exact figures are not given, however, and without them the statement means little.

◆

A NEW PIG IRON TONNAGE RECORD has been made by the Carnegie Steel Co.'s new furnace, No. 1, located at Duquesne, Pa. In 30 days it produced 17,195 gross tons, an average of 574 tons per day. Two of the Duquesne furnaces are now in operation, and two others are in an advanced stage of construction.

MOVABLE DAMS ON THE GREAT KANAWHA RIVER, WEST VIRGINIA.

The construction, operation and general appearance of the movable dams, now being built by government engineers on the western rivers, will be novel and interesting to many engineers. As a rule the greater part of the trestles and wickets forming these dams are placed by divers after the coffer dams are removed, and the photographs here reproduced are the first we have ever seen that show clearly the various parts of the dams connected and in position. We are indebted to the courtesy of Mr. Addison M. Scott, U. S. Resident Engineer, for the use of these photographs and for the general elevation, and the notes which we have made use of in describing this work.

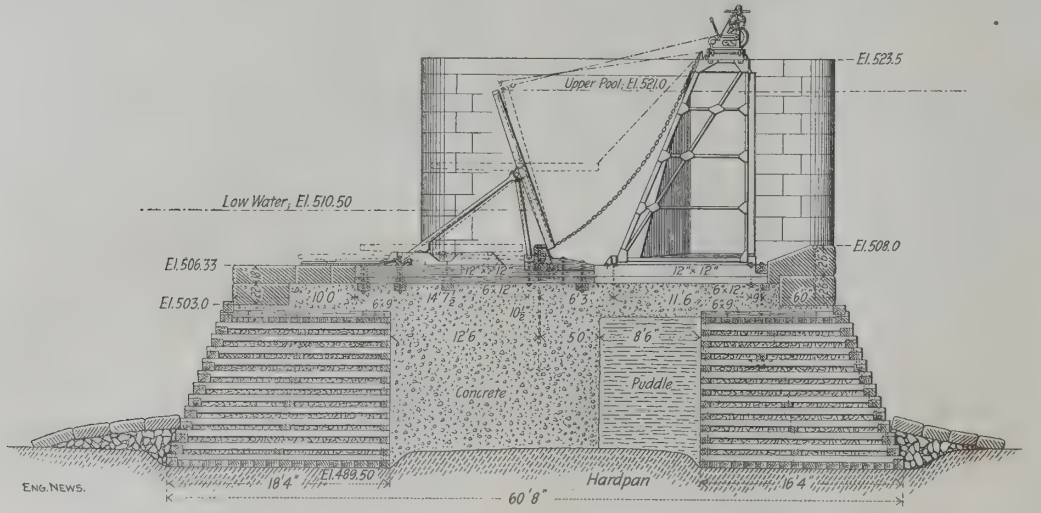

FIG. 1.—GENERAL SECTION OF NAVIGATION PASS, WITH CENTER PIER IN ELEVATION; GREAT KANAWHA RIVER IMPROVEMENT.

Dam No. 11, where these photographs were taken, is within 1¾ miles of the mouth of the river and is the lowest lock and dam in the Great Kanawha system. While all the other dams are founded upon rock, lying from 5 to 13 ft. below low water, this dam rests upon a compact indurated clay, or hard pan, lying from 19 to 24 ft. below low water mark. The character and depth of the river bottom at this point called for a material modification in the foundation plans; and the methods plainly shown in Fig. 1 were adopted.

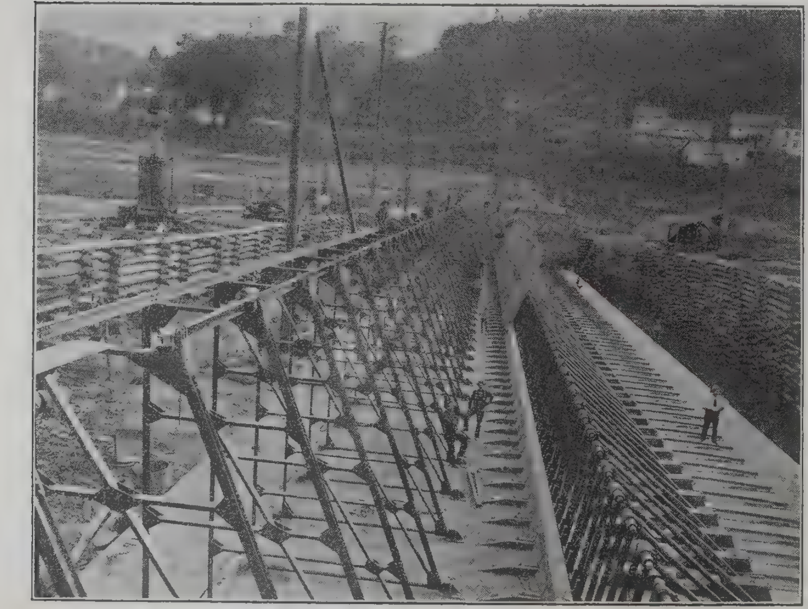

FIG. 2.—NAVIGATION PASS, DAM NO. 11; LOOKING TOWARDS LOCK, FOOT-BRIDGE TRESTLES AND WICKET-TRESTLES RAISED AND PART OF THE WICKETS IN PLACE.

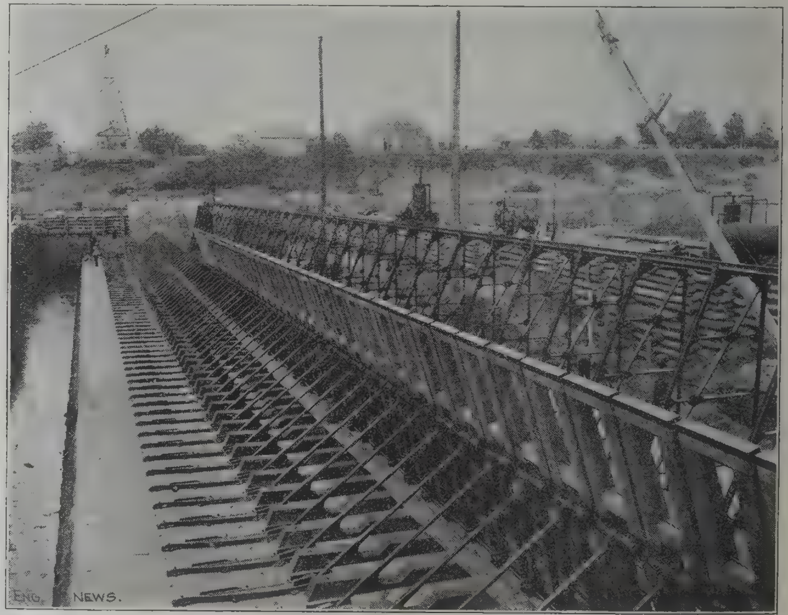

FIG. 3.—NAVIGATION PASS, DAM NO. 11, LOOKING TOWARDS CENTER PIER; SHOWING UNDER SIDE OF WICKETS AND WICKET-TRESTLES, AND THE PASQUEAU HURTERS.

It may be stated here that the improvements on the Great Kanawha River when completed will include ten locks and dams, covering 90½ miles of the river. The two upper dams in this system are fixed, with a maximum lift of 12 ft.; but all below that are movable with lifts varying from 6½ to 10 ft., and giving a navigation pass generally 248 ft. wide, and a weir from 210 to 372 ft. wide. Dam No. 11, however, provides a pass 304 ft. wide, and Dam No. 5 has a pass 250 ft. wide. With the fixed and movable dams are locks, 50 ft. wide at Dam No. 6, and 55 ft. wide below that, and 342 ft. long between quoins for all locks below Dam No. 6, inclusive. Locks and dams Nos. 4 and 5 were completed and put into operation in July, 1880, and were the first movable dams for slackwater navigation in America. Three other movable and the two fixed dams have also been completed and three others are now under construction. This improvement of the Great Kanawha River is mainly designed to facilitate the transport of coal carried down the river in barges usually 130 ft. long by 25 ft. wide, and drawing 6½ ft. The minimum low water depth on mitersills is 7 ft.

Returning to the description of Dam No. 11, we find a navigation pass 304 ft. wide closed by 76 Chanoine wickets operated by a service bridge. These wickets are 14 ft. 1 in. long and 3 ft. 8 ins. wide each, with their tops 13 ft. vertically above the sill. The bridge trestles are 8 ft. apart between centers, and they are 16 ft. 10 ins. high; thus placing the foot-bridge 2 ft. 6 ins. above the level of the upper pool, with the wickets closed. With the exception of the La Mulatiere dam, at Lyons, France, which has wickets 14 ft. 3½ ins. long, these are the largest wickets ever built.

The lowering of the wickets is performed by means of the winch and chains shown in Fig. 1. Each wicket is first put on the swing, as shown by the dotted lines, and then pulled up-stream far enough to free the end of the prop from its seat in the Pasqueau hurter, and it is then lowered by the winch and butt chain. This method is shown in Fig. 1; but the general Kanawha River practice is to place a clutch and double line over the top of the wicket, as is shown, and to pull the standing wicket by the top until the prop is free, and then to disengage the clutch and let the wicket fall. The advantage of the second method is a great saving in time, as the operation of lowering can be done in about one-fourth of the time, and the two or three hours thus saved may be of great importance when a quick rise in the river occurs. No injury is done to the wickets by this method, as the water below soon checks the rapidity of the fall, and the wicket settles down on the cushions without any noticeable shock. As is more plainly shown in the photographs, the bottom of each wicket-trestle is hinged to the dam and the top carries two journals, upon which the wicket is articulated, and a third journal which carries the prop for supporting the wicket. When the wickets are down the wicket-trestle and the props lie in the same line on the floor and the wickets themselves lie flat above them. When the dam is to be raised, a strong pull on the up-stream end of the wicket raises the trestle and the wicket and the prop follow until the foot of the latter drops into the notch in the hurter provided for it. The up-stream end of the wicket is then depressed until it strikes the wooden sill shown, and the wicket stands in a nearly vertical position and does duty as part of the dam. The wickets, when raised, do not touch each other by one or two inches, and this space is usually closed by a scantling dropped into the opening on its diagonal.

The peculiarity of the Pasqueau hurter here employed is that the prop pursues one path while the trestle is rising, and another while it is being lowered. In the rising path is the notch, or step which engages the prop, when it has reached the proper height, and holds the wicket firmly. When the trestle is pulled slightly up-stream, however, the foot of the prop follows and reaches a point where the track terminates; it then slides sideways into the second and unobstructed track and moving down it, allows the trestle and wicket to fall freely. As will be seen in the photographs, the trestles carrying the operating foot-bridge are also hinged on the line of the dam, and when the wickets are all down and the navigation pass is opened these trestles can also be let fall so as to fold one over the other and present no obstruction. For a more detailed description of the operation of these dams we would refer our readers to a paper read by Mr. Scott before the American Society of Civil Engineers and published in the Transactions, vol. xxxi., p. 539.

The construction of the lock and dam here described was commenced in 1893. At the present time the lock masonry is nearly completed and the navigation pass is practically so, and since the photographs were taken the cofferdams have been removed. Assuming a fairly good season for river work the locks and dams Nos. 9, 10 and 11 will be completed next year. From the beginning of work upon this slackwater improvement, in 1874, up to 1894, Gen. William P. Craighill, the present Chief of Engineers, U. S. A., was in charge of this work. Since 1894 Col. Peter C. Hains, Corps of Engineers, U. S. A., has had charge. The construction of dams Nos. 9 and 10, with their locks on this same stream, were described and illustrated in our issue of Aug. 13, 1896.

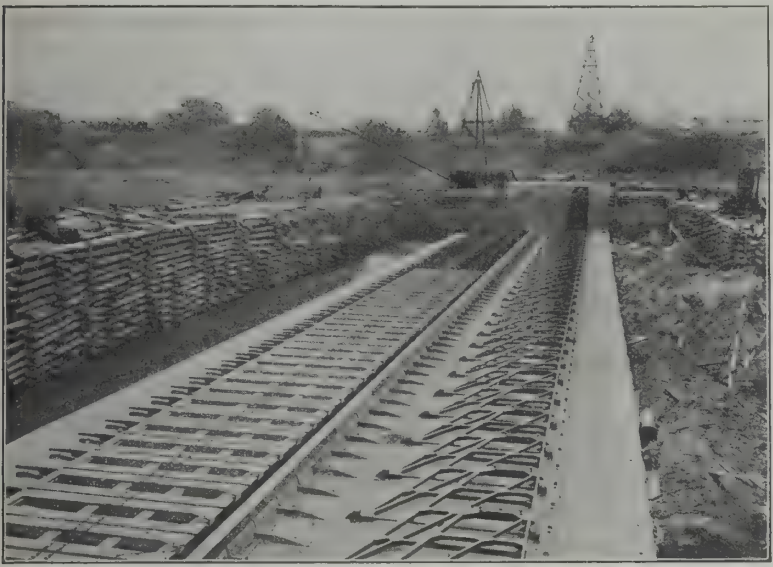

FIG. 4.-NAVIGATION PASS, DAM NO. 11, LOOKING TOWARDS CENTER PIER; WICKET AND OPERATING BRIDGE TRESTLES LOWERED. ONLY PART OF THE WICKETS IN PLACE.

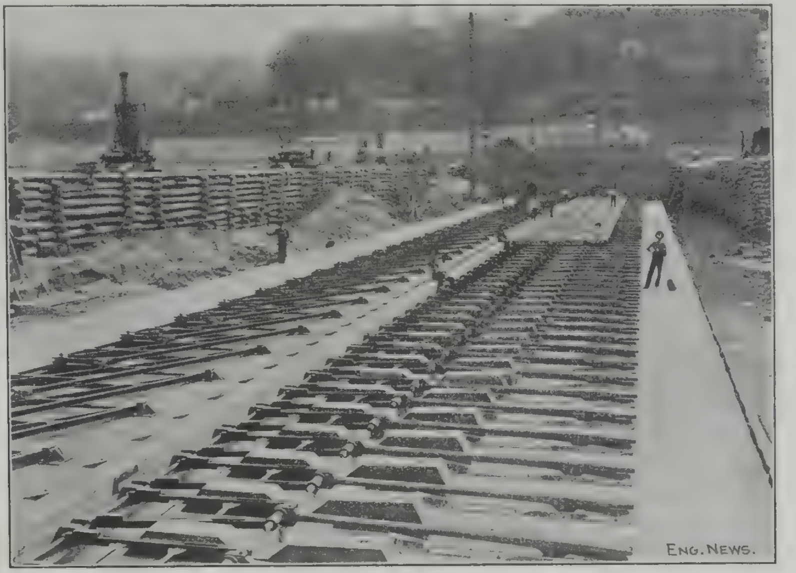

FIG. 5.—NAVIGATION PASS, DAM NO. 11, LOOKING TOWARDS LOCK; WICKET-TRESTLES AND PROPS DOWN; SHOWING THE CONSTRUCTION OF THE WICKET-TRESTLES AND THE PROPS AND HURTERS.

* * *

COMPARATIVE COST OF ENGLISH AND AMERICAN BOILERS.

We have received some data from Mr. Geo. I. Rockwood, M. Am. Soc. M. E., of Worcester, Mass., who has recently returned from a three months' visit to Europe, concerning the relative prices of steam boilers in England and in the United States, which are of interest as illustrating the wide difference in the practice of the two countries. Comparing the ordinary horizontal fire-tube externally fired boiler, which is most common in this country but is almost unknown in England, with the Lancashire internally fired boiler, which is the old-time English favorite but is not used at all in this country, Mr. Rockwood says:

> In Worcester or Boston the price, for instance, of a 72-in. × 20-ft. horizontal return tubular fire-tube boiler, f. o. b. cars, with all fixtures, is $1,000. This boiler has about 2,000 sq. ft. of heating surface, giving, at 12 sq. ft. allowed for one boiler horse power, a total of 166 HP. $1,000 divided by 166 gives $6.25 as the cost per HP. The price of a 66-in. × 18-ft. boiler, f. o. b. cars, with all fixtures, is $800. This boiler has about 1,550 sq. ft. heating surface, or 130 HP. $800 divided by 130 gives again $6.25 as the cost per HP.
>
> These boilers are made to first-class specifications having ½-in. shells of best fire-box steel, triple-riveted butt-strap joints, with rivet holes drilled. They are guaranteed "drop-dry" at 225 lbs. water pressure, and to withstand a working pressure of 150 lbs. steam all their lives.
>
> Now the price quoted me for the 8 ft. diam. × 30 ft. length Lancashire boiler was 20% and 2½% off from £585 [(585 — 117) — 11.7] = £456.3. Calling £1 $4.90 in round numbers, gives $2,235, f. o. b. cars, as the cost of the Lancashire boiler in American money. The total heating surface is 1,080 sq. ft., which makes the boiler cost $2.07 per sq. ft. as compared with 52 cts. a sq. ft. for each of the two American boilers; thus the Lancashire boiler is about four times as expensive per sq. ft. of heating surface. But, on the other hand, the heating surface of the English boiler is more effective than it is in the return tubular boiler; not only because the Lancashire fire-box is inside instead of outside the shell, but also because of the higher temperature at which the flue gases escape.
>
> The claim is made that the English boiler will evaporate economically 6,500 lbs. of water from and at 212° per hour, the maximum evaporation being 8,000 lbs. Taking 8,000 lbs. = 230 boiler HP. gives 2,235 ÷ 230 = $9.75 as the cost per HP. If we take the maximum power of the 66-in. × 18-ft. boiler as 175 HP. (obtained with a combustion of 18 lbs. of coal per sq. ft. of grate per hour) then the comparative cost of the American boiler is less than half that of the English type. Whether the Lancashire boiler could be made in the United States at a price less than it can be purchased for now in England is an open question, as we have no data or experience from which to form an opinion; it seems to me not impossible, as the prices of all steam goods in this country are so much depressed by the severe domestic competition which has developed at a rapid rate within a comparatively recent period.
>
> The only internally-fired boiler which is used much in the factories of the United States—the Manning type—is still much cheaper than the Lancashire boiler, costing but $7.70 per HP. when built for the highest pressures, and requiring no brick work. The item of brick work should also be considered in estimating the comparative cost of the return tubular and Lancashire boilers. On account of the great weight per HP. of the Lancashire when filled with water, and also on account of its great length, 30 ft., it is necessary to provide much deeper and better foundations for it than we provide for the American type, and in addition, separate brick return-flues must be used for the Lancashire, as it is not economical to operate the boiler without the use of an economizer. The reason for this appears when one takes into account the relative cost of the heating surface in the Lancashire boiler and in the Green economizer. The cost of the economizer, all erected ready to be operated except for the brick setting, is 30 shillings per tube, $7.35. This makes the cost per square foot of heating surface 73 cts., as the tubes are 4 ins. diam. × 10 ft. long, and thus have about 10 sq. ft. of surface per tube. As the heating surface in the boiler costs 8.4 shillings, or $2.07 per foot, whereas that in the economizer costs 3 shillings or 73 cts. per foot, it is plainly to the advantage of the Englishman to buy as much economizer and as little boiler as he can use. The dividing line comes in at about the middle of the whole amount of surface needed; that is, the economizer is given the same number of square feet of heating surface as is provided in the boiler.
>
> In this country the economizer costs something more than double the cost of the boiler per square foot of heating surface, and is, therefore, of more specialized utility than must be the case in England.
>
> It should be said that brick work is done far cheaper in England than in the United States, a "one hundred yards" chimney costing less than half what we should pay. The same ratio of cost obtains, of course, in brick boiler settings.

To further exemplify Mr. Rockwood's comparison we may compare the combination of the Lancashire boiler and its economizer, which will evaporate economically 6,500 lbs. of water per hour from and at 212°, with an American tubular boiler designed to do the same work without an economizer; one horse power being taken at 34½ lbs. evaporation per hour from and at 212°, and American practice giving 12 sq. ft. of heating surface per HP. This gives an evaporation of 2.875 lbs. per sq. ft. of heating surface per hour. The American boiler would, therefore, have 6,500 ÷ 2.875 = 2,295 sq. ft. heating surface, which would ordinarily be furnished in two boilers. At the price given by Mr. Rockwood, 52 cts. per sq. ft., this would cost $2,295 × $0.52 = $1,193. The English boiler for the same service would have 1,080 sq. ft., costing $2,235. But the English boiler, in order to operate economically, needs to be provided with an economizer. The heating surface of the required economizer is equal to that of the boiler, or 1,080 sq. ft., at 3 shillings or 73 cts. a foot, equals $788, which, added to $2,235, gives $3,023 as the cost of the boiler and economizer without brickwork, or nearly three times the cost of the American boilers.

As to the relative economy of fuel of the two systems, there is probably little difference. The American boiler, when run at an economical rate of less than three lbs. evaporation per sq. ft. of heating surface, will discharge its gases at about 400° F. The Lancashire boiler will discharge them at 800° or 900°, and the economizer will, when it is kept clean, reduce them to 300°, an advantage of 100° in favor of the English system. The English system undoubtedly has the advantage on the points of safety and durability, and it is a characteristic of the Englishman that he is willing to pay a good round price for what he considers the best article, while the American is apt to consider first cost as the prime consideration.

* * *

HOLLOW FORGED STEEL SHAFTS, made by the Bethlehem Iron Co., South Bethlehem, Pa., have been introduced on stern wheel steamboats on the Ohio and Mississippi Rivers. The company recently closed a contract with the Pittsburg & Cincinnati Packet Line, of Cincinnati, O., for a hollow forged nickel steel oil tempered shaft, 38 ft. 9 ins. long, 14 ins. outside diameter, with a 7-in. hole running through it. Such a shaft is 3,500 lbs. lighter and 3½ times stronger than the solid wrought iron shaft which ordinarily would be placed in such a vessel. This shaft is for a new vessel which the line is having built by the Cincinnati Marine Railway Co., of Cincinnati, O. A similar shaft is to be put into the new steamer which the Mississippi Valley Packet Line, of New Orleans, La., will shortly build.

THE WOODILINE PRESERVATIVE FOR TIES AND TIMBER.

In most of the processes of treating railway ties and timber with preservative compounds, considerable time and care are expended in first extracting the sap and then forcing in the preservative compound under heavy pressure, such processes requiring the establishment of extensive and costly plants. A process which is now being brought to the attention of railway officers, and which has already been used to a large extent by a prominent eastern railway, consists in immersing the timber in a hot bath of a liquid called woodiline, which readily penetrates even such hard wood as white oak. The actual composition of the liquid is not made public, but we are informed that it is a mixture of certain powerful antiseptics with wood-creosote, and other ingredients. The liquid is said to solidify and harden after entering the timber, so that the timber is not only made materially tougher in its outer fibers, but the wood-creosote is not liable to be washed out under the action of moisture, or to be evaporated. While the best method for impregnating the timber is by dipping it into the liquid, good results have been obtained by applying the preservative hot, with a brush, three coats being used. Some 800 gallons were used in this way in treating the white oak ties and guard timbers used on a bridge built by the Cincinnati, New Orleans & Texas Pacific Ry. over the Cumberland River last summer. Which ever way is used, the cost per tie varies from 15 to 19 cts., including material and labor.

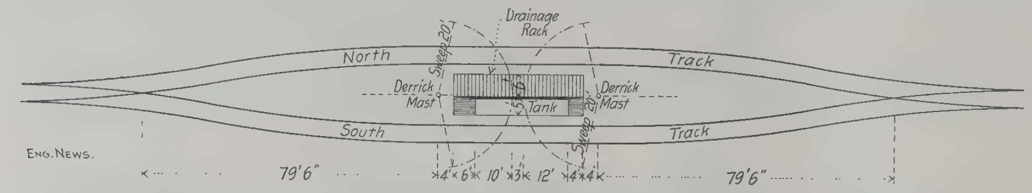

FIG. 2.—PLAN OF TRACKS AND DERRICKS AT THE TREATING TANK.

It is desirable that the timber should be dry before being treated, and all the experiments made indicate that one gallon of the liquid will adequately treat 40 to 50 sq. ft. of surface. If desired, more may be used, but it is not considered necessary. The liquid does not form a surface coating upon the wood, but penetrates it more or less deeply, depending on the duration of treatment, kind of timber, etc. The pores, however, are not sealed up, and if there is moisture at the heart of the wood, it may escape, so that dry rot is avoided.

Regarding the penetration of the material into such hard woods as oak by simple immersion, it is of interest to note that several prominent railways have used woodiline to a considerable extent in the treatment of oak, one road in particular having used somewhat over 12,000 gallons during the first half of the present year, largely on oak ties and bridge timbers.

The treatment of timber in this way requires only very simple and inexpensive apparatus, such as may readily be duplicated at as many points as desired. The first cost of a treating plant, and the cost of transporting timber to and from the plant are considerations to be taken into account in estimating the cost of treating timber, and in this process the liquid is supplied ready for use and can be readily and cheaply applied at any convenient point. The treatment, we are informed, does not impair the strength of the wood or render it brittle.

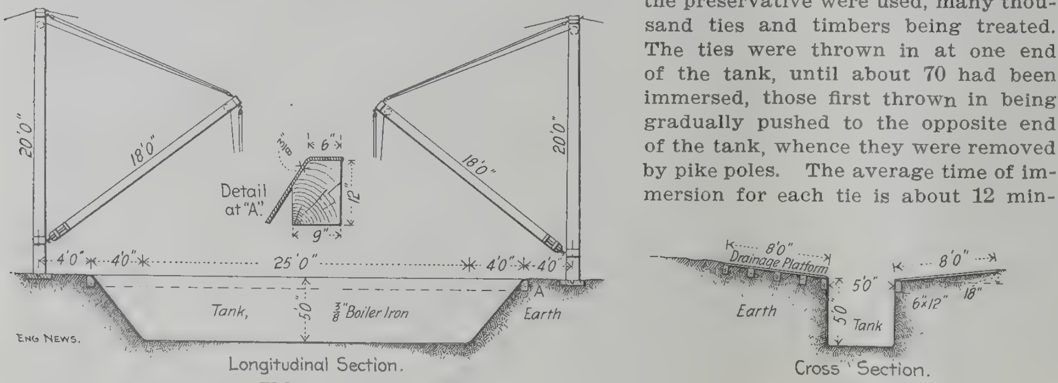

FIG. 3.—SECTIONAL VIEWS OF TREATING PLANT.

The first important use of woodiline in railway work, was on the Amboy Division of the Pennsylvania R. R., where some treated ties of red and black oak were laid in 1883. These ties are just outside of the station at Camden, N. J., in a rather unfavorable location. The traffic over them is heavy, but they are still sound, and in place in the track, after a service of about 13 years, and while there has been some slight cutting under the rails, this has not been sufficient to warrant the removal of the ties. This fact is regarded by the makers as a striking proof of the hardening and toughening effect of the treatment on the fibres of the wood. It is interesting, by way of comparison, to note that two, and in some cases three, sets of untreated white oak ties have been removed from positions immediately adjoining these treated ties.

To obtain further evidence as to the probable value of woodiline, other tests, of a similar nature, but including white oak ties, were made from time to time, at various points along the line of the road. The uniformly good results obtained caused the officials of the road to look with increasing favor on the process, especially for such work as bridge ties, trestle timbers, guard timbers, etc. In 1895 plans were made for a treating tank to accommodate ties and timbers up to 30 ft. in length, and this was built during the latter part of that year. This tank, shown in Fig. 1, is 35 ft. long, 5 ft. wide and 6 ft. deep, built of ⅜-in. iron. Its edges are supported by heavy timbers, and a coil of 1½-in. steam pipe, laid inside, around the bottom, serves to heat the liquid to about 150 deg. F. A small, upright boiler, placed in the boiler house near by, supplies steam. Plank platforms surround the tank, and it is provided with a removable cover to keep out rain. The cost, with all details, exclusive of the boiler, was about $390.

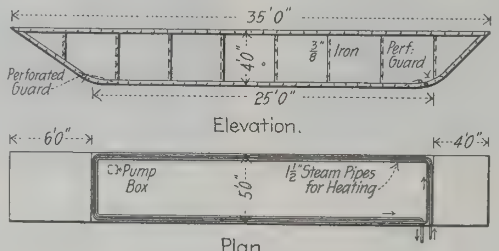

Fig. 1.—Tank for Treating Ties and Timber with Woodiline; Pennsylvania R. R.

During the spring and summer following the completion of this tank, about 12,000 gallons of the preservative were used, many thousand ties and timbers being treated. The ties were thrown in at one end of the tank, until about 70 had been immersed, those first thrown in being gradually pushed to the opposite end of the tank, whence they were removed by pike poles. The average time of immersion for each tie is about 12 minutes, during which time about ½ gallon of the liquid per tie is absorbed. The experiments made indicate that this amount is sufficient for a tie of standard size. It is, of course, evident, however, that by increasing the time of immersion, a greater amount of the liquid may be absorbed. An immersion of three hours, with a close-grained, black oak tie, showed about 1½ gallons absorption. With the bath at a higher temperature, these figures could be increased.

Some objections were found to the treating tank in its original form, and plans were made for an improved plant. It was thought that, with a different arrangement of tracks, and with the addition of derricks for the rapid and economical handling of heavy timbers, the capacity of the plant would not only be increased, but the cost of handling the timber would be reduced. It was also thought best to build an inclined platform alongside the tank, upon which the timber, after treatment, might be allowed to lie for a short time, in order that the superfluous liquid clinging to it might drain back into the tank. This drainage platform, of 2-in. pine planks, with oak battens, 1 × 3 ins., over the joints, to keep the timbers clear of the platform and allow the liquid to drain under them, is shown in the plan of the improved plant, Fig. 2.

The first step in these changes was taken recently, when the old 8 HP. boiler was replaced with one of 20 HP. The first boiler was ample for heating the liquid, but the new one is designed to serve the double purpose of heating the liquid and driving the hoisting engine of the derricks. With a plant such as that just described, the untreated ties delivered at the cars on one track, will be made up into bundles of 10 to 15 ties, secured by chains; the bundles will then be placed in the tank, and after a proper interval will be lifted on to the draining platform and from there loaded onto the cars on the other track. With sawed ties, sticks of wood may be placed between them, or a cast-iron separating frame may be used to keep them apart. Such a tank will hold three bundles of ties at one time, and its capacity should be from 1,200 to 1,500 ties per day. As formerly used, the capacity of the tank was, at a maximum, 600 ties per day. The improved arrangement of tracks and derricks is shown in Fig 2. Fig. 3 shows a section of a tank similar in many respects to that of the Pennsylvania R.R. It is, however, set deeper in the ground, and is a little shorter, and not quite so deep.

A novel form of tank has been suggested, consisting of an ordinary coal or gondola car, lined with sheet iron, thus forming a tank of size to accommodate large timbers. Steam for heating the liquid could be taken from the locomotive drawing the car, and a pole derrick set up at stopping points for handling the timber. Or, if desired, a crane, engine and boiler could be carried on a flat car coupled behind the tank car.

The process is controlled by the American Wood Preserving Co., of Philadelphia, Pa. Mr. Fred A. Kummer, Room 502, 72 Trinity Place, New York city, is the general representative of the company.

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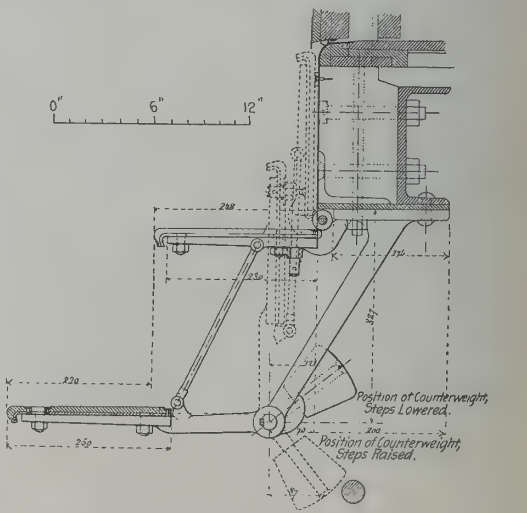
A LET-DOWN STEP FOR A FRENCH RAILWAY CAR.

On the occasion of the late visit of the Tsar of Russia to France the Compagnie Internationale des Wagons-Lit built a special train for the use of the imperial party, which train was made up of sleeping and dining cars, and a car especially arranged for receptions, etc., or seven cars in all. The majority of these cars had end-entrances, with a passage way down one side in the case of


0"
6"
12"
268
230
175
327
220
250
200
Position of Counterweight, Steps Lowered.
Position of Counterweight, Steps Raised.

A French Adjustable Car Step.

doors with steps were necessary, and to make these latter easy of ascent and yet capable of being folded up out of the way of station platforms, etc., a special step was devised.

This step is here illustrated from a cut in "Le Genie Civil," and practically describes itself. It is a counter-poised, double, folding step, requiring a force of only 5 kilograms, or 11 lbs., to operate it. When the train is in motion the steps take the position indicated by the dotted lines.

A HYDRAULIC RAM PLANT FOR A PUBLIC WATER SUPPLY.

The hydraulic ram has been used in a small way ever since its invention by Joseph Michael de Montgolfier, in 1796, to whom credit is given for having first perfected the automatic machine. John Whitehurst, of Derby, England, is said, however, to have understood the principle as early as 1775, but his machine required an attendant who opened and closed the waste valve by hand.

Hydraulic rams are in quite common use, but they are practically all of small size, designed to raise but small quantities of water and that to small heights.

The Power Specialty Co., 126 Liberty St., New York city, however, is manufacturing an improved ram, which is of sufficient size and capacity to deserve the name of engine. A section of the so-called double acting or double supply type, to be described later, is shown in Fig. 1. Considering it first without regard to the double supply feature, suppose the opening at H to be closed. The valve at B being open, the water from the source of supply at more or less elevation above the machine flows down the drive pipe A, and escapes through the opening at B until the pressure due to the increasing velocity of the water is sufficient to close the valve B. At the moment when the flow through this valve ceases, the inertia of the moving column of water produces the so-called ramming stroke which opens the valve at C and compresses the air in the air chamber D until the pressure of the air plus the pressure due to the head of water in the main is sufficient to overcome the inertia of the moving column of water in the drive pipe. This motion may be likened to the oscillation of water in an U-tube. At this instant the column of water in the drive-pipe has come to rest, and the air pressure being greater than the static head alone the direction of motion of the moving column is reversed and the valve C closes. The water in the drive-pipe is then moving backward and with the closing of C a tendency to a vacuum is produced at the base of the drive-pipe; this negative pressure causes the valve B to again open, completing the cycle of operations. At the moment of negative pressure the little snifting valve E admits a small quantity of air, and at the following stroke this passes into the air chamber which would otherwise gradually fill with water, the air being gradually taken up by the water.

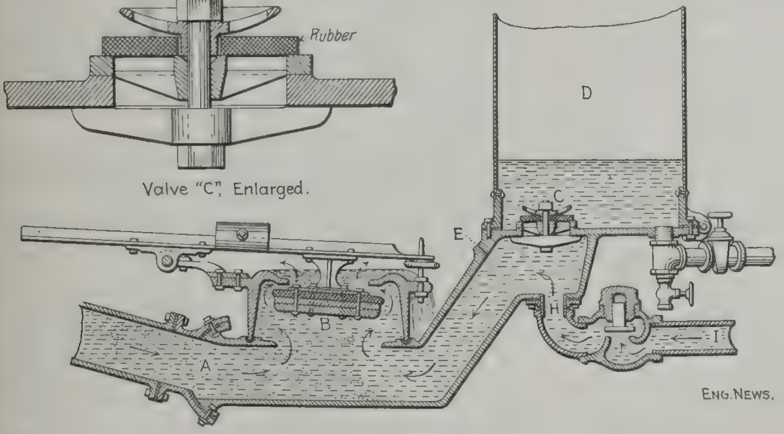


FIG. 1.—SECTION OF RIFE HYDRAULIC RAM FOR PUMPING PURE WATER, USING IMPURE WATER FOR POWER.

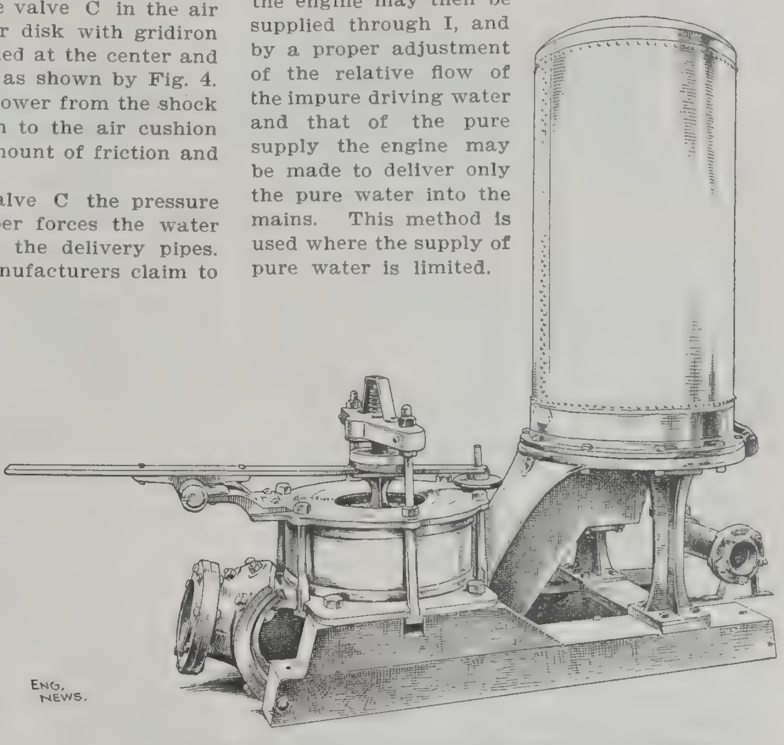


FIG. 2.—PERSPECTIVE VIEW OF THE RIFE HYDRAULIC ENGINE. Made by The Power Specialty Co., 126 Liberty St., New York City.

In many machines the mistake is made of making the waste valve B sufficiently heavy to overcome the static head of water in the drive-pipe. In fact most writers on this subject, including the "Encyclopedia Brittanica," state that the weight of the waste valve B must be greater than the pressure of the statical head of water on its under side, so that it may open when the column of water comes to rest. In the machine which we are describing this would be practically impossible on account of the large area of the opening at B.

In this machine the valve B is made as light as is consistent with the necessary strength; the negative pressure at the end of the stroke is relied upon to open the valve. With the largest size of these machines this valve is 18 ins. in diameter, and with a head of 8 ft., which is a common head for use with hydraulic rams the static pressure on the under side of this valve is 883 lbs.; it can be seen that the great shock of a valve of this weight would rapidly destroy the valve and its seat.

The waste mechanism of the Rife engine consists of a large port with flat ample opening and a large rubber valve with a balance counterweight and spring seating, removing almost entirely the jar of closing. The valve C in the air chamber consists of a rubber disk with gridiron ports and convex seat, fastened at the center and lifting at the circumference, as shown by Fig. 4. The effort is to transfer the power from the shock of the driving water through to the air cushion with the smallest possible amount of friction and jar.

After the closing of the valve C the pressure of the air in the air chamber forces the water in the air chamber out into the delivery pipes. With the Rife engine the manufacturers claim to elevate water 30 ft. for every foot of fall in the driving head; the machine is built in capacities as high as 150,000 gallons per day and the efficiency of 82% is claimed.

The engine illustrated in Fig. 2 weighs 2,800 lbs.; the capacity of the air chamber is 20¾ cu. ft.; diameter of drive pipe, 8 ins.; diameter of waste valve, 18 ins.; weight of waste valve, 50 lbs.; diameter of delivery pipe, 4 ins.; height to top of air chamber, 7½ ft.

To the reader who has carefully followed the above description, it will be clear that the most important detail in which the Rife engine differs from the ordinary hydraulic ram is the waste valve. It will be seen by the drawing that the counterweight on the projecting arm of this valve permits the adjustment of this valve to suit varying heads and lengths of drive pipe. By adjusting the counterweight so that the valve is nearly balanced the valve comes to its seat very quickly after the flow past it begins. The result is that the ram makes a great number of short, quick strokes, which are much easier on the mechanism than slower and heavier strokes. Of course the stroke must be sufficiently powerful to act efficiently in overcoming the head in the delivery pipe. The adjustable weight permits this to be effected with the greatest nicety.

The question of efficiency of hydraulic rams has been much discussed, and such authorities as Rankine and D'Aubisson differ considerably in their calculations. The Power Specialty Co. uses Rankine's formula in calculating efficiency, which is

$$E = \frac{q\ h}{(Q - q)\ H},$$

where Q is the quantity of water flowing per second in the drive pipe; q, the quantity flowing per second to the stand-pipe through the discharge pipe; H, the height from the escape valve to the level of the reservoir which feeds the drive pipe; and h the difference in level of the water supply reservoir and the water in the stand-pipe. D'Aubisson states the formula for efficiency as

$$E = \frac{q\ (H + h)}{Q\ H}.$$

D'Aubisson's is the correct one, considering the mechanism as a machine receiving energy at one end and delivering it at the other, while if the machine is considered as elevating water only from the one reservoir to the other, Rankine's formula is the correct one to use.

When a pipe is attached at H (Fig. 1), the engine is termed double acting; spring water or that which is purer than the water used to drive the engine may then be supplied through I, and by a proper adjustment of the relative flow of the impure driving water and that of the pure supply the engine may be made to deliver only the pure water into the mains. This method is used where the supply of pure water is limited.

A battery of five Rife engines is now being installed in connection with a water-works plant at West Reading, Pa. The driving water is supplied from Wyomissing Lake, which delivers 810 gallons per minute. The battery of engines which will consist of three large and two small rams is located nearly 200 ft. from the lake; a fall of 8 ft. is obtained by a 4 ft. dam across the outlet of the lake and by sinking the engines in a pit; this pit is drained into the stream at a point further down. Each of the three large engines has a separate wrought iron drive pipe 194 ft. long and 8 ins. diameter.

The water to be delivered to the city stand-pipe comes from a spring 1,000 ft. away and at an elevation of 8 ft. above the level of the lake. The spring water is carried by a 6-in. pipe to a small stand-pipe, situated on the dam. Under the conditions of the contract this spring water had to be delivered to the city stand-pipe without mixing with the water from the lake. With a fall of 8 ft. from the surface of the lake to the engines, the spring water must be delivered to the base of the large No. 80 engines under a head of only 2½ ft. in order to avoid wasting the spring water, and at the same time prevent lake water passing into the city mains. From the spring level to the base of the No. 80 engines there is a fall of 16 ft. To reduce this head from 16 to 2½ ft., two so-called single acting engines, No. 40, are interposed, which are driven by spring water alone. The spring flows about 120 gallons per minute. Half of this is delivered to each No. 40 engine under a head of 13 ft., and they pump directly into the main. The waste spring water from the No. 40 engines is delivered into a small reservoir in the corner of the pit where the three large engines are situated. This reservoir overflows at a point which maintains a constant head of 2½ ft. on the three No. 80 engines. The main which leads to the stand-pipe is 6 ins. diameter and 1½ miles long. The elevation of the water in the city stand-pipe above the engine pit is 175 ft. The two No. 40 engines pump into the main six gallons per minute, or 8,640 gallons per day, and discharge by waste 114 gallons per minute into the reservoir, which supplies the three large engines. The three No. 80 engines receive 810 gallons per minute of lake water and 114 gallons per minute of spring water. They force into the main 25 gallons of spring water per minute, 36,000 gallons per day; the combined delivery of the five engines is 44,640 gallons.

The figures given above are the contract requirements, and it is stated that they will be exceeded in practice.

The cost of this pumping plant was $3,000. The cost of operation will be nothing, as no attendance is required, and the cost of maintenance will be $32 per year for new valves.

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THE MIRA RIVER BRIDGE, NOVA SCOTIA.

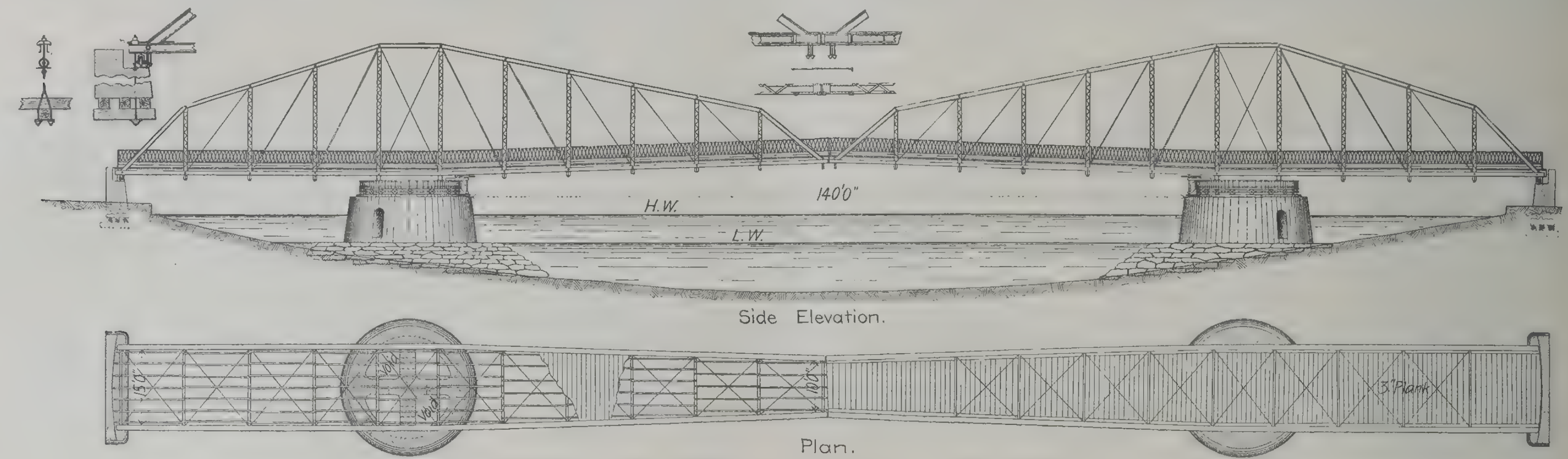
By M. Murphy.*

The highway bridge over the Mira River is not remarkable for its size, nor for the difficulties attending its erection, but for the cheapness with which it was constructed. The Mira River is navigable for small craft for a distance of about 20 miles from its mouth. Its width is irregular, narrowing between cliffs of sandstone for some miles up, and extending into lakes still further up. Heavy ice forms in the still waters of these basins in the winter season, and is carried downwards with the stream in the spring, with sufficient velocity to destroy an ordinary structure, where the channel is contracted and the current is strong. For this reason, a bridge spanning the whole stream was considered the most advisable to adopt. The span is 140 ft. between piers, so that a vessel can beat through against the wind and tide. The highway traffic is of a light, rural character, hence the lightness of the design.

The construction of the circular pivot piers for the bridge may be worthy of remark. They are founded on flat stones, placed as regularly as possible without the aid of dams in the stream, up to extreme low tide. Upon this foundation is spread a 2 ft. bed of Portland cement concrete, covering the whole base of the pier. From thence, up to the top the pier is built hollow, as shown by the plan. A passage communicates with each open space, so as to allow a man to examine the machinery of the swing span and paint it when necessary. The walls are of Portland cement rubble concrete, faced with Portland cement fine concrete. The plan shows the temporary wooden casing, within which the walls were built.

The bridge is located near the mouth of the river, where it empties through a shingle beach into Mira Bay.

The bridge crosses the stream by two cantilever draw spans, on pivot piers of concrete on each side of the stream, the short lever arm of each truss being anchored to the abutments, when the bridge is closed across the river. The roadway is 15 ft. at pivot piers and 10 ft. in the clear at the center, so as to prevent two teams from passing each other on the extreme points of the lever arms at one time.



THE MIRA RIVER BRIDGE, CAPE BRETON CO., NOVA SCOTIA.
M. Murphy, M. Can. Soc. C. E., Provincial Government Engineer.

The bridge is proportioned to carry a rolling load of 80 lbs. per sq. ft. of roadway, plus the static load of the bridge. The specifications included the following requirements:

Ultimate strength of iron	50,000	lbs. per sq. in.
Compressive strength of iron	40,000	" "
Greatest tensile strain must not exceed	10,000	" "
Shearing across grain must not exceed	7,500	" "
Pinhole intrados bearing must not exceed	12,500	" "

The cost of the bridge was as follows:

Metal work	$6,700
Piers, abutments and approaches	2,318
Total	$9,018

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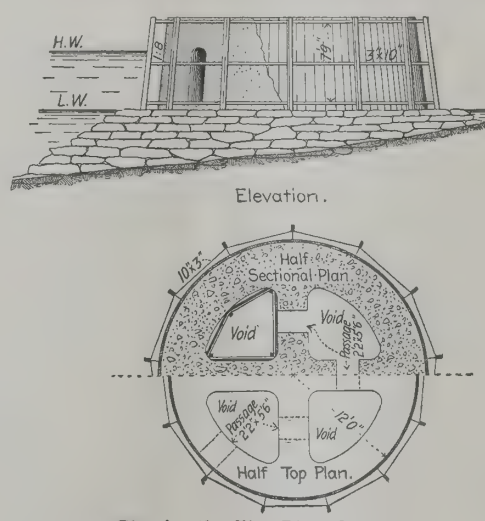
A METHOD OF DETERMINING SELLING PRICE.*

By H. M. Lane, M. Am. Soc. M. E.**

In business it is necessary that both ends meet, and desirable that they overlap. To accomplish this, receipts or value produced must exceed expenditure. It is customary to transact business for a year, and then ascertain the results from the records, at a time when it is too late to apply remedies which would affect the result of that year. It is the purpose of this paper to propose a method by which the conditions affecting the final result of a year's business may be shown in a simple manner at the end of each month or week. It is in no sense a substitute for the usual bookkeeping and inventory, but an auxiliary for the convenience of the manager relating to organization and operation.



Pier for the Mira River Bridge.

There are in these close times concerns of which it is true that 25 years ago a difference of 10% in the result of a year's business would have been a profit of 25 instead of 35%, while now a difference of 10% would probably mean a loss of 5% instead of a profit of the same amount.

It is the purpose here to show what the volume of product must be, and what value must be placed upon it unsold, or what selling price when sold, in order to make both ends meet and to overlap for a given organization and general expense.

First, an annual estimate or prospectus, Table I., for the succeeding year, is prepared, based upon experience and judgment. In this case the capital invested in the business is assumed to be $100,000, and the annual payroll to be $50,000, equally divided between producers and non-producers. All those whose time can be directly ascertained and charged against some specific order or article produced for sale are classed as producers, and all others as non-producers, and in case of doubt safety lies in erring on the side of classing an individual as a non-producer rather than a producer. The column, Estimated Expenditure, Table I., requires no explanation. It shows in this assumed case that for the conduct of the business for the succeeding year $156,000 must be secured. The question then arises, from what sources is this sum to be derived?

In the column, Estimated Receipts, adjoining:

(a) Fixed income $600, this being the sum derived from rental of a portion of the factory buildings, interest on bonds or returns from investments.

(b) Interest $400 is the estimated sum to be derived from notes given for deferred payments, overdue accounts, etc.

(c) It is assumed that in case of a machine shop with tools varying greatly in size, value, floor space occupied, and power required, that there should be a separation of the charge for the workman and for the tool. The hourly charge for a man at 25 cts. working on a $5,000 horizontal boring-mill should not be the same as for the same priced man working on a $300 lathe. Separating tool time from workman's time, it is estimated that the tools would yield a plant charge of $5,000.

(d) Material and merchandise are estimated at $75,000. This item is the same as in the column of estimated expenditures, to which is added, say, 20% (e), which yields $15,000.

(f) Producer's wages is the estimated amount to be derived by charging producer's actual time at his actual rate against the product. The sum of all these estimated receipts is $121,000, while the sum of the estimated expenditures is $156,000, which would show a deficit of $35,000 on the year's business. Now from what source is it possible to secure this $35,000? Clearly from a percentage added to producer's wages. In this case producer's wages are $25,000, and in order to derive there-

TABLE I.—Annual Estimate. Assume Capital $100,000. Annual Pay-Roll, Producers, $25,000; Non-Producers, $25,000.

Estimated Receipts.		Estimated Expenditures.	
a—Fixed Income	$600	Profit	$10,000
b—Interest	400	Losses	500
c—Plant charge	5,000	Renewals	2,000
d—M't'rial and mdse	75,000	Depreciation	2,000
e—20% to material & mdse	15,000	Producers' wages	25,000
f—Producers' wages	25,000	Non-producers' wges.	25,000
		Material and mdse.	75,000
	$121,000	General expense	10,000
g—140% to producers' wages to balance	35,000	Stable and hauling.	500
		Printing and stationery	300
		Freight and express.	500
		Advertising	1,000
		Postage	200
		Insurance	1,000
		Commissions	200
		Interest & discounts	800
		Charity	200
		Legal	300
		Fuel	500
		Contingent	1,000
	$156,000		$156,000

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*Provincial Government Engineer of Nova Scotia.

*A paper presented at the New York meeting (Dec., 1896) of the American Society of Mechanical Engineers.

**President The Lane & Bodley Co., Cincinnati, O.

TABLE II.—FORM FOR TABULATED MONTHLY STATEMENT OF RECEIPTS AND EXPENDITURES, ESTIMATED AND ACTUAL, IN A MANUFACTURING BUSINESS.

	Month Ending.		Jan. 31.	Feb. 28.	Mch. 31.	April 30.	May 31.	June 30.	July 31.	Aug. 31.	Sept. 30.	Oct. 31.	Nov. 30.	Dec. 31.
Expenditures read down.	Profit	Estimated	833.33	1,666.67	2,500.00	3,333.33	4,166.67	5,000.00	5,833.33	6,666.67	7,500.00	8,333.33	9,166.67	10,000.00
		Actual	833.33	1,666.67	2,500.00	3,333.33	4,166.67	5,000.00						
	Losses	Estimated	41.66	83.33	125.00	166.66	208.33	250.00	291.66	333.33	375.00	416.66	458.33	500.00
		Actual	....	....	....	100	100	100						
	Renewals	Estimated	166.66	333.33	500.00	666.66	833.33	1,000.00	1,166.66	1,333.33	1,500.00	1,666.66	1,833.33	2,000.00
		Actual	50.60	175.30	450.90	730.60	850.48	1,033.70						
	Depreciation	Estimated	166.66	333.33	500.00	666.66	833.33	1,000.00	1,166.66	1,333.33	1,500.00	1,666.66	1,833.33	2,000.00
		Actual	166.66	333.33	500.00	666.66	833.33	1,000.00						
	Producers' Wages	Estimated	2,083.33	4,166.67	6,250.00	8,333.33	10,416.67	12,500.00	14,583.33	16,666.67	18,750.00	20,833.33	22,916.67	25,000.00
		Actual	2,137.68	4,687.50	6,448.90	8,431.57	11,032.21	13,117.60						
	Non. Pro. Wages	Estimated	2,083.33	4,166.67	6,250.00	8,333.33	10,416.67	12,500.00	14,583.33	16,666.67	18,750.00	20,833.33	22,916.67	25,000.00
		Actual	2,075.61	4,212.18	6,323.00	8,357.91	10,961.13	12,968.90						
	Material & Mdse.	Estimated	6,250.00	12,500.00	18,750.00	25,000.00	31,250.00	37,500.00	43,750.00	50,000.00	56,250.00	62,500.00	68,750.00	75,000.00
		Actual	6,111.98	11,361.91	17,321.20	23,911.33	30,671.80	36,439.10						
	General Expense	Estimated	833.33	1,666.67	2,500.00	3,333.33	4,166.67	5,000.00	5,833.33	6,666.67	7,500.00	8,333.33	9,166.67	10,000.00
		Actual	891.78	1,741.30	2,684.20	3,465.20	4.364.90	5,236.20						
	Stable and Hauling	Estimated	41.66	83.33	125.00	166.66	208.33	250.00	291.66	333.33	375.00	416.66	458.33	500.00
		Actual	42.30	85.40	128.30	160.84	202.90	231.92						
	Printing and Stationery	Estimated	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00	275.00	300.00
		Actual	23.90	51.90	75.60	96.30	131.60	148.40						
	Freight and Express	Estimated	41.66	83.33	125.00	166.66	208.33	250.00	291.66	333.33	375.00	416.66	458.33	500.00
		Actual	49.53	96.49	138.60	155.91	201.90	241.60						
	Advertising	Estimated	83.33	166.67	250.00	333.33	416.67	500.00	583.33	666.67	750.00	833.33	916.67	1,000.00
		Actual	83.33	166.67	250.00	333.33	416.67	500.00						
	Postage	Estimated	16.67	33.34	50.00	66.67	83.34	100.00	116.67	133.33	150.00	166.67	183.33	200.00
		Actual	17.48	38.70	50.68	61.97	81.38	96.40						
	Insurance	Estimated	83.33	166.67	250.00	333.33	416.67	500.00	583.33	666.67	750.00	833.33	916.67	1,000.00
		Actual	83.33	166.67	250.00	333.33	416.67	500.00						
	Commissions	Estimated	16.67	33.34	50.00	66.67	83.34	100.00	167.67	133.33	150.00	166.67	183.33	200.00
		Actual	17.69	33.39	41.60	79.40	96.80	125.60						
	Interest and Discounts	Estimated	66.67	133.34	200.00	266.67	333.34	400.00	466.67	533.34	600.00	666.67	733 33	800.00
		Actual	78.30	174.60	278.30	294.20	397.21	483.20						
	Charity	Estimated	16.67	33.34	50.00	66.67	83.34	100.00	116.66	133.34	150.00	166.67	183.33	200.00
		Actual	16.67	33.34	50.00	66.67	83.34	100.00						
	Legal	Estimated	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00	275.00	300.00
		Actual	25.00	50.00	75.00	101.25	131.25	260.90						
	Fuel	Estimated	41.66	83.33	125.00	166.66	208.33	250.00	291.66	333.33	375.00	416.66	458.33	500.00
		Actual	61.40	98.60	143.80	187.94	210.93	252.40						
	Contingent	Estimated	83.33	166.67	250.00	333.33	416.67	500.00	583.33	666.67	750.00	833.33	916.67	1,000.00
		Actual	....	....	....	340.90	341.67	487.91						
	Total Expenditure	Estimated	13,000.00	26,000.00	39,000.00	52,000.00	65,000.00	78,000.00	91,000.00	104,000.00	117,000.00	130,000.00	143,000.00	156,000.00
		Actual	12,766.87	23,623.60	37,701.08	51,229.54	65,692.79	78,373.83						
Receipts read up.	Total Receipts	Actual	13,655.73	28,088.75	37,846.76	57,228.73	72,904.71	78,215.62						
		Estimated	13,000.00	26.000 00	39,000.00	52,000.00	65,000.00	78,000.00	91,000.00	104,000.00	117,000.00	130,000.00	143,000.00	156,000.00
	140% to Producers' Wages to Balance	Actual	3,072.02	6,050.76	8,590.79	11.881.94	15,185.67	17,901.97						
		Estimated	2,916.66	5,833.34	8,750.00	11,666.66	14,583.34	17,500.00	20,416.66	23,333.34	26,250.00	29,166.66	32,083.34	35,000.00
	Producers' Wages	Actual	2,194.30	4,321.97	6,136.28	8,486.74	10,846.91	12,786.91						
		Estimated	2,083.33	4,166.67	6,250.00	8,333.33	10,416.67	12,500.00	14,583.33	16,666.67	18,750.00	20,833.33	22,916.67	25,000.00
	20% to Material and Merchandise	Actual	1,318.92	2,779.28	3,597.48	5,792.28	7,398.22	7,792.29						
		Estimated	1,250.00	2,500.00	3,750 00	5,000.00	6,250.00	7,500.00	8,750.00	10,000.00	11,250.00	12,500.00	13,750.00	15,000.00
	Material and Merchandise	Actual	6,594.60	13,896.40	17,987.41	28,961.40	36,941.11	38,961.46						
		Estimated	6,250.00	12,500.00	18,750.00	25,000.00	31,250.00	37,500.00	43,750.00	50,000.00	56,250.00	62,500.00	68,750.00	75,000.00
	Plant Charge	Actual	391.68	861.94	1,294.83	1,796.23	2,136.74	278.39						
		Estimated	416.66	833.34	1,250.00	1,666.66	2,083.34	2,500.00	2,916.66	3,333.34	3,750.00	4,166.66	4,583.34	5,000.00
	Interest	Actual	34.21	78.40	89.97	110.14	156.00	194.60						
		Estimated	33.33	66.67	100.00	133.33	166.67	200.00	233.33	266.67	300.00	333.33	366.67	400.00
	Fixed Income	Actual	50.00	100.00	150.00	200.00	250.00	300.00						
		Estimated	50.00	100.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00	500.00	550.00	600.00

from the $35,000, to make good the deficit, 140% must be added.

We have now a sure method of determining the necessary selling price when the actual cost of material and merchandise, the number of hours and rate per hour, and the tool hours and rate per hour are known; thus, material and merchandise, plus 20%, tool hours at their established rate and labor plus 140% equals the selling price under the conditions assumed in the annual estimate.

But, unfortunately, the business manager cannot sit at his desk in December and predict that his losses for the succeeding year will be $500, and his legal expenses $300, and contingent expenses $1,000, and that he will employ and get the benefit of the product of $25,000 expended in producer's wages. It is this difficulty that the method now presented meets and overcomes by the use of the tabulated monthly statement, Table II. This is shown in monthly form, but so little labor is involved that the manager may keep in closer touch with his business by using a weekly form. This sheet provides for bringing the actual receipts and expenditures together with the estimated, item by item and month by month, so that a glance will show if any item of expenditure is actually overrunning the estimated, and if any item of receipts is underrunning the estimated, and show it in time for correction. It will also show for any month if the total actual receipts or expenditures vary from the estimated, and which way and how much. This is desirable, for one item may exceed the estimated and be compensated by another, so that the total shall be unaffected. This table is prepared and used as follows: The items—Estimated Receipts and Expenditures, Sheet I.—are divided by twelve, and one-twelfth of each item entered in the column, "Month Ending January 31," and on its properly designated horizontal line, under February, two-twelfths; March, three-twelfths, etc., the amounts being cumulative until at the end of the year or under December they amount to the sum shown in the annual estimate. These spaces may be all filled out as shown for the last half of the year—Table II.

It will be noticed that in the two horizontal lines of totals (receipts and expenditures), Table II., the estimated amounts are always equal. They must be if both ends are to meet. At the end of the first month of the new year actual figures are available and are filled in the proper spaces, and the items and totals for the year, as far as it has gone, are directly comparable with the corresponding estimates; and right here the manager has a chance to earn his salary by managing. This method gives him eleven more chances and eleven months' time for remedies.

Answering the proper objection, that selling prices are not made by ascertaining the value of material and labor and adding a percentage, but by competition, it is nevertheless true that unless the value of material and labor will admit of the addition of the percentages proved to be necessary by the annual estimate, without making the selling price so high as to keep the goods out of the market, then the end of the year will show a deficit. When it is found that a selling price arrived at by this method is too high, the obvious remedy is to reduce the amount (not necessarily the rate) paid for labor or material until they will bear the addition of the necessary percentage without throwing the article out of the market. It is clear that, other things being equal, twice the producing force will require but one-half of the percentage to be added. It is also clear that a reduction in the total expenditure, or an increase in any items of receipts, will reduce the percentage necessary to be added. This gives the manager a definite method of making readjustments, as he obtains results of actual business as the year advances. In this method one assumption is necessary, but it is a fair one, viz., that the employment of a certain number of dollar's worth of productive labor produces a corresponding value of product plus the percentage shown to be necessary by the estimate. The manager must secure this result. In other words, every dollar paid to producers plus the required percentage must be charged to the product (this together with the plant charge and material plus its percentage), must be the real value of the product, sold or unsold, and all things must be adjusted to this end.

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A NEW METHOD OF EXTRACTING GOLD from quartz has recently been described in England, and said to have been successfully tried on Australian gold-bearing rocks. It is called the "ore-atomic" system. The rock is crushed to lumps of convenient size, it is then, in a closed chamber, from which air is excluded, exposed to the heat of a furnace, and to the action of water, gas, and hydrogen. The sulphur in the ore is thereby eliminated, as sulphuretted hydrogen, and any oxide in the ore is reduced to the metallic state. After being thoroughly heated the material is suddenly quenched by the injection of cold water. This operation is repeated several times, until the quartz is so softened as to be easily crushed by the fingers, and crumbled into powder. The contents of the chamber are then dumped into a tank, and the gold separated by washing. It is claimed that by this process there is absolutely no loss by "float gold" or by oxidation, and that all of the gold in the ore or rock is recovered.

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THE FASTEST TRAINS IN GERMANY, says the "Revue Generale des Chemins de Fer," are the express trains between Berlin and Hamburg. On this 177 miles of line, the grades are very easy and the curves are of large radius. Three trains daily leave Berlin and reach Hamburg in 3 h. 36 m., the average speed being 49 miles per hour, not including a stop of 4 minutes at Wittenberg and another of 1 minute at Friedrichruh. The average speed between these two last stations is 52 miles per hour. The normal train hauled is made up of four heavy "corridor" passenger cars, mounted on trucks, and two baggage cars, on 6 wheels each; the total weight is about 133 metric tons. The locomotive has 4 coupled driving wheels, 6.56 ft. in diameter and is provided with a leading truck. The fastest Austrian train is the "train de luxe," running between Vienna and Carlsbad. The 283 miles is made in 419 minutes, including stops aggregating 40 minutes. Deducting these stops, the average speed is about 44.7 miles per hour; this is very good, as some of the grades are heavy and the curves are sharp. The train weighs 140 tons and the locomotive 80 metric tons.

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THE DEEPEST BORE-HOLE IN THE WORLD, says Mr. C. Zundel, in a late communication to the Industrial Society of Mulhouse, is one of 6,571 ft. below the surface of the soil, made at Paruschowitz, near Rybrick, Upper Silesia. The previous record for depth was the 5.733 ft. hole drilled some years ago at Schladebach, near Leipsig. The later bore-hole was made in a search for coal measures, and 83 seperate seams, some of considerable thickness were penetrated. The hole was 12 ins. in diameter at the beginning and this was lined with a tube about 0.4-in. thick; at a depth of 230 ft., the bore was reduced to 8¼ ins. diameter, and thus continued for 351 ft. At this point the blue marl encountered became so compact that the diamond-drill had to be used and under the action of the water the marl swelled to such a degree that the diameter of the pipe had to be again reduced. The greatest difficulty encountered was the great weight of the boring rods, as the depth increased. Though steel was used, at a depth of 6,560 ft. the total weight of the tools reached 30,155 lbs. Under this weight ruptures of the rods were frequent, and an accident of this nature finally stopped the work; about 4,500 ft. of rods fell to the bottom, and being jammed under a part of the tubing it was impossible to withdraw it. The diameter of the well at the bottom was 2¾ ins. Temperature observations made showed 12° C., or 53.6° F., at the surface, and at the depth of 6.571 ft. the temperature reached 69.3° C., or 157° F. This is equivalent to an average augmentation of heat of 1° C. for every 34.14 m. of depth, or 1° F. for every 63 ft. These figures differ slightly from those obtained in other deep borings. The increase of heat at Schladebach corresponded to 1° C. in 35.45 m.; that at Sperenberg, near Berlin, to 1° C. in 32.51 m.; and at the artesian well of Grenelle, at Paris, which is only 1.797 ft. deep and furnishes water at a temperature of 27.70° C., it is estimated that the increase of heat is equivalent to 1° C. in 31.83 m. The boring at Parnschowitz was commenecd on March 26, 1892, and it reached its maximum depth on May 17, 1893, or in 399 working days. The total cost was $18,800, or about $2.86 per lin. ft.

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ADVERTISING RATES: 20 *cents per line agate measure. Want notices, special rates, see page* 22. *Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

The rapid destruction of the forest resources of the United States has frequently been pointed out in our columns, and we have long advocated the institution of protective measures to check this destruction. A notable example of the enormous consumption of timber for mining purposes is given in the paper which we reprint in another column, giving details of the amount and cost of timber used in the Comstock mines, of California. From 1870 to 1891, it is estimated that there have been used for the mines and mills 674,765,000 ft. B. M. of timbers and lumber, and 391,070,500 cu. ft. of wood, representing a total cost of $46,072,548. About 200,000 acres of forest have been destroyed to operate the mines, and when the remaining 45,000 acres of timber land and wood land are denuded, the timber supply will have to be obtained at a distance of more than a hundred miles from the mines. Even now the bulk of the supply has to be transported 65 miles by railway and flume. Timber is now growing on the area already denuded, but it is said that nearly a century must elapse before this new growth attains the size required for mine timbers. Certainly this area of new growth should be under government care and protection. The paper contains much matter of interest in regard to the supply and consumption of timber and wood for mines, but its most important lesson is that forest protection is a matter of vital importance for this country.

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The importance of securing pure water for cities and towns and of quickly and safely removing it after it becomes fouled by use was never before so fully realized in this country as at present. Massachusetts and New York have for some time past vested in their respective state boards of health a general supervision of this matter, and Ohio not long ago followed their example. The engineering societies of Illinois, together with the State Board of Health and the University of Illinois, have drafted a bill looking to the same end, to be submitted to the coming session of the legislature.

We are heartily in favor of the supervision by state authorities of matters affecting the public health, and we hope that legislation to that end may be enacted in Illinois; but some features of the proposed bill, which are reprinted elsewhere, should be modified before the bill is presented to the legislature, if good results are desired from the law. In the first place, it would be a piece of useless red tape to require the approval of the State Board of Health "before any sewer or extension of sewers" could be constructed. There is not a city of any size in which new sewers are not continually being built. On the other hand, the present draft of the bill requires only that systems of public water supply shall be submitted to the board. It would therefore be possible for any city to alter its water supply and take it from a wholly new source without the approval of the board, which is exactly what it is desired to avoid.

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We understand from the information received that the analyses are to be made not only at the University of Illinois, but by members of the staff of the University. This, coupled with the proposed nomination of the engineer by the Illinois Society of Engineers and Surveyors, would be withholding from the State Board of Health the selection of the working force necessary for the contemplated investigations. We suppose the idea is to utilize laboratories already established for the chemical and bacteriological work, and that it is assumed that these laboratories are, or may be, properly equipped with men and apparatus for the proposed investigations. With all conditions as favorable as possible, this plan might work most admirably. We are not in a position to speak of the conditions existing in Illinois, but elsewhere the views of a State Board of Health and those of the professors of a state university might not always agree as to methods of investigation, and provided the former had pronounced and meritorious views on the subject this might be a serious matter. In the same way the engineer chosen by the board from the three men nominated by the Illinois Society of Engineers and Surveyors might not prove, later on, acceptable, perhaps through no fault of any of the parties concerned. In such a case must the board retain him, whether or no, until the expiration of his term? There seems to be a chance for both political and professional strife within the society if this nominating power is vested in it. In short, there can be no reason for vesting the nominating power in a wholly unofficial body, unless the official body or persons in whom such powers are generally vested are incompetent, or false to their trusts. The Massachusetts State Board of Health selects its own engineers, chemists and bacteriologists. The work of that board is universally recognized as a model of its kind, and in magnitude surpasses anything ever attempted in this country or, we think, in the world. It is true that Massachusetts is noted for the high character and ability of the men who serve on its public commissions, but if the commissions in other states are less able is it likely that amends will be made by taking away from them the selection of their own working staff? Under such circumstances, one of three results may be expected: (1) Conflict; (2) the working force will finally be controlled by the commission; (3) the commission will automatically adopt the recommendations of its engineers and other scientific workers, in which case the work in hand might as well be given outright to those who actually perform it, and the useless body abolished.

PRINCIPLES AND POLICY OF ENGINEERING NEWS

It has seemed to us, in perusing some of the letters that we receive from our readers, that many of the subscribers to this journal sometimes fail to make it as useful to them as it might be, because they do not understand its general aims and policy or the system on which some of its various departments are conducted. We have therefore selected this last issue of another yearly volume as an appropriate time to present some statements, the subject matter of which is indicated by the title above.

This journal aims to cover the entire field of engineering. We do not, of course, pretend to claim that within the limits of its space can be published everything of value in current engineering literature; but it is the purpose of its editors to keep in touch with the whole broad field of engineering work and select for publication the best that they find in every department of engineering.

We are frequently asked whether an article on this or that subject is "in our line." The answer is that all articles on subjects connected with any department of engineering are directly "in our line," and whether they will be acceptable or not depends solely on the editors' judgment as to their interest and value to the readers. All such contributions, from any source whatever, the editors are always pleased to receive. They are examined as soon as time permits, and such as are found unavailable for use in any form are returned to the senders where such a return is requested.

An opinion as to whether an article on a given subject is likely to prove available is given on request; but the final acceptance of an article can in no case be made until the complete manuscript with illustrations, if any, is submitted.

In general, the receipt of matter offered for publication is not acknowledged, unless this is especially requested. Losses in the mails are so rare that it is not deemed worth while to incur the additional labor of such acknowledgment.

In the case of contributions found unavailable and returned to the sender, the editors have found it impossible to state by personal letter the reason which influence their decision. A printed letter accompanies such manuscripts in which it is explained that the return of the article does not necessarily imply that it is lacking in merit or interest, as the amount of matter offered for publication is so large that a rigid selection has to be made and many articles of merit have to be returned.

We may note in passing that this printed note recently brought us an indignant letter from a "scientist," who had offered us a manuscript in which he upset(?) a well-known engineering formula that has been in universal use for half a century. We quote from it verbatim, for our reader's entertainment, the following interesting passage:

> The return of my paper by means of a printed blank, looked to me so mean and insulting that I concluded, to avoid being reminded of the insult, by henceforth considering "Engineering News" as non-existant. * * * * It is hard for an old scientist, to have his work judged of in private by newlings, but harder yet to have it done by printed blanks. The rudeness of it must make enemies unless my nature is all different from that of others.

We regret to be considered "non-existant," and our curiosity is great as to what a "newling" may be. For the reasons above stated, however, we shall continue the use of the printed blanks and run the risk of making enemies of "old scientists" like the one just quoted.

What has been said with reference to the offer and return of articles above, applies, of course, especially to papers which are submitted for publication and for which their writers expect compensation; but the general principles apply also to all classes of matter sent to us. We are frequently asked, for example, what our position is with reference to what are commonly known as "trade write-ups." The same rule applies to this as to the other matter, that the first consideration is the interest of our readers. We fully recognize the fact that outside what is commonly known as "civil engineering," the great bulk of the engineering work that is carried on in this country is done by manufacturing firms. It is to these that we have to look chiefly, therefore, for a great deal of matter of interest and practical value to engineers; and we welcome contributions from such firms on the same basis as those from any other source. If a manufacturer has a new machine or device of interest to engineers, and will furnish us such drawings and particulars concerning it as will enable an engineer to form a judgment as to its merits, we can often prepare an article from it that will be of great practical value to many of our readers. On the other hand, the manufacturer who sends us a cut of a machine which shows nothing except what a wood engraver imagines its external appearance might be, and a so-called description which, in reality, is only a string of vague generalities concerning what he considers its merits, has no cause for complaint at our decision that such matter is not of sufficient interest to our readers to warrant us in giving it space.

A department of this journal which we believe is much appreciated by our readers is that of "Letters to the Editor," and its development during the past two or three years has been a source of much gratification to us. We intend this department to be a place for the open discussion of any and all matters of interest to engineers, and it is our intention to conduct it with entire impartiality, and to permit free expression of contributors, whatever their views or opinions may be, provided their letters come under our rule above stated, i. e., that they are matter of interest to our readers.

It often happens that letters sent to us for publication criticise the work of some person or firm, and in such cases, where the letter is found to be worthy of publication, it is our practice to submit an advance proof to the party who is criticised and afford him an opportunity to make a reply in the same issue in which the criticism appears.

In the case of such a discussion we expect those taking part to observe the usual courtesies of debate and to refrain entirely from personalities.

Contributors either to this or other departments of this paper are at liberty to veil their identity under a nom-de-plume if they choose; but in writing to us, must give their real name; otherwise the waste basket yawns for their contributions.

We sometimes find some misapprehension as to the degree to which the editors assume responsibility for the matter published in various departments of the paper. While the matter published on the editorial pages, and, in fact, all matter not signed or credited to some source, may be understood to be prepared by the editors; the contributed matter and the matter taken from the proceedings of engineering societies represents the views and opinions of those to whom it is credited, and not necessarily the opinions of the editors. Of course, all such matter has been examined by the editors, and has been judged by them to be of sufficient interest to be worth publication; but it does not follow that they approve or agree with the ideas or opinions which the writer may express. In the department of "Letters to the Editor" especially, it is our aim to give a fair field to all who have something to say that is worth saying, whether it coincides with our own opinions or not.

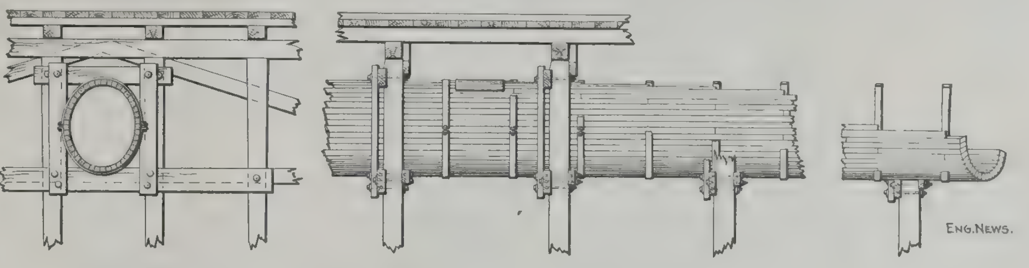
In thus defining the extent to which the editorial responsibility extends, we should not be misunderstood as magnifying the importance of the editors' opinions. The editors are well aware that they are far from infallible, and that they, like the rest of mankind, are prone to err. In fact, they are probably better aware how far their work falls short of the standard which they have set for themselves than are any of their readers. But they are at least conscientious in adhering to the principles they have laid down of impartiality and constancy to the interests of their readers and of the profession which it is the aim of this journal to serve.

The change which we inaugurated two years ago, of separating the Construction News and the other matter which is of little value for binding for permanent reference from the main part of the paper, has, we believe, been generally acceptable to our readers. With the first number of the new year a further change will be made in this department, and this eight-page supplement, which is now printed separately, will be bound with the advertising pages. It is our intention also gradually to change the arrangement of these pages so that eventually all the contents of this supplement will be printed on right-hand pages, while the opposite or left-hand pages will be filled with advertising matter. One reason for making this change is that it will enable us to add extra pages to our Construction News department on weeks when there is a surplus of matter, which we cannot now do, except at considerable expense on account of difficulties in connection with the binding. We find also that many of our readers make a practice of cutting up their Construction News supplement, and when the pages are backed with advertisements they will be able to do this without losing the construction news on the back of the sheet.

We believe this arrangement will be especially advantageous also to those who desire to preserve for reference our department of "Contract Prices." These detailed reports of the unit prices bid at contract lettings in all parts of the United States and on all classes of engineering work and materials are of great value to an engineer in preparing estimates. We advise our readers who do not bind their supplements to preserve these items in a special scrap-book, classifying them by materials, and they will find in the course of a year or two that they have a more valuable and extensive record than anything their own note books can furnish.

There is, perhaps, no department in which we are more dependent upon our readers for assistance in carrying out our ideas of improvement than that of "Personals." We wish to make this as complete a summary as space permits of the items of real personal interest concerning engineers of every class; but in order to do this, we must rely on our readers to furnish us the necessary information. What we especially desire is notices of appointments and changes in official position, but space prevents our making note of reelections and reappointments, under ordinary circumstances.

We desire to call especial attention to the use which readers may make of our departments of "Book Reviews," "New Publications" and "Trade Publications." The first of these departments is included in the body of the paper and will be found exceedingly convenient by purchasers of engineering books, who desire information concerning the merits of recently published treatises. Under "New Publications" are included public documents and publications of societies, corporation reports, pamphlets, etc. In nearly all cases the publications noted under this head are for free distribution, and we believe every engineer will be well repaid if he will make it a rule to look systematically through these and the "Trade Publications," and drop a postal card request to the publisher (whose name and address are in every case given) for such of these pamphlets as may interest him. We may say also respecting the trade publications that many of them nowadays contain matter of much practical interest to engineers, and which can be found nowhere else in technical literature. The engineer who does not aim to keep an up-to-date file of the trade catalogues in connection with his particular specialty is likely to be mortified by finding himself ignorant of some technical matter which the commercial man will have at his fingers' ends.



Cross Section.
Side Elevation.

WOODEN BARREL OUTLET SEWER, USED AT NEW YORK CITY.
Horace Loomis, M. Am. Soc. C. E., Engineer in Charge of Sewers.

We have reason to believe that most of our subscribers preserve and bind their copies of Engineering News; and, while from one point of view it is of no interest to us what becomes of our issues after they reach the subscribers, in pursuance of our purpose to make this journal of the greatest usefulness to the engineering profession, we would strongly advise our readers to preserve their files complete and regularly bind them for reference.

We are aware that some of our readers pursue the practice of cutting from the paper such articles as are in their especial line, which they file on some system or other, and throw away the remainder of the paper. Perhaps if a man were absolutely sure that he would follow a particular specialty all his life long and would never have need of information on any other department of engineering work, this would be a good course to pursue; but very few engineers can map out their future in that way. Ten years ago thousands of engineers were devoting all their attention to steam railway construction. To-day, nine-tenths of them are in other fields of engineering work, and it is quite safe to say that those fared the best in making the change who were the best equipped for these other lines of work and who had kept in touch with them so far as possible during their work on railway construction.

We would advise our readers, for their own interest, to preserve and bind their files of this journal. The time is very likely to come when the information they can find in its pages on other departments of engineering than that on which they are now engaged, will be of the greatest value to them.

In this connection we are pleased to make an announcement, which will be of interest, we are sure, to those who regularly bind and preserve their papers: At present any one who desires to find all that has been published in this journal on a given subject must search through the semi-annual indexes, and where the search extends over the files of a considerable number of years, the labor involved is considerable. To save this labor in our own office, we some time ago began the preparation of a general index to Engineering News, and its usefulness is so great that it is probable that we shall eventually publish it in book form. The work of its compilation is still in progress and we are not yet able to state positively as to its publication. It is our expectation however, eventually to make it available to our readers, and with this aid, the possessor of a file of Engineering News will have at his hand a cyclopedia of modern engineering progress which will be almost as easy of reference as a dictionary, and which will constitute in itself a completed library of engineering literature.

LETTERS TO THE EDITOR.

Formulas for Bridge Expansion Joints—Corrections.

Sir: In the letter which you published in your issue of Dec. 17 over my signature, the formula $Y = \frac{I}{\cos\ \theta}$ should read $Y = \frac{T}{\cos\ \theta}$.

Yours very truly,
F. P. McKibben.
Mass. Inst. of Technology, Boston, Dec. 22, 1896.

Wooden Barrel Outlet Sewers Used at New York City

Sir: There appeared in your issue of Nov. 5, 1896, a description of the wooden barrel sewer as constructed in Brooklyn. This is the same as has been used in this city for many years past. We have found by experience, however, that the construction of these barrels in lengths of say 10 to 15 ft., and putting them together with butt joints supported by cross beams on the piling of the pier is somewhat weak. The impact of large vessels, such as railroad floats and ferry boats, is liable to cause the piers to sway from side to side, opening these joints, and, in some cases, a whole length has been displaced and the barrel collapsed. To obviate these difficulties we think we have improved upon this plan by constructing a continuous barrel, according to the following specifications:

The sewer will be built so as to form one continuous section, each stave will be so placed that there will be a lap of 4 ft. at every stave, and each stave as it is put in place is to be nailed to the next one with 6-in. tinned wire nails, and everything is to be done to make the sewer secure and rigid and to make it impossible for the staves to become loosened.

Under this method of construction the barrel is built continuous, from end to end, as will appear by the sketch which I enclose. This I believe to be a more permanent construction than that formerly employed.

Yours respectfully,
Horace Loomis, Engineer in Charge of Sewers.
New York, Dec. 14, 1896

Dynamite Exploded by Warming.

Sir: It is generally supposed that dynamite will not explode except when used in connection with an exploder cap; in other words, that it will not explode by being ignited by fire. I wish to say that there are exceptions to the above belief.

Some time in October last, while being warmed by an open fire, the dynamite became ignited and thirteen sticks exploded; fortunately no one was near and there were no serious results.

Afterwards a single stick was placed in an open fire as an experiment and it also exploded. There must be a difference in the ingredients used in making dynamite by the different companies, for the writer has often seen dynamite burning where it was being warmed by an open fire.

The above mentioned dynamite was of a black color, "Nonpareil Powder" brand, manufactured by "The Rock Glycerine Co.," of Bradford, Pa.

I am, respectfully,
North Lake, N. Y., Dec. 18, 1896. F. W. S.

[The explosion of dynamite under like conditions is not so rare as our correspondent seems to believe. Warming any dynamite at an open fire is a dangerous operation, to say the least, and that this danger is generally recognized is made evident by the precautions taken in thawing out dynamite by heated water, sand, etc., in specially contrived vessels. Theoretically, dynamite requires a sharp and sudden shock to explode it, but commercial dynamite is seldom theoretically pure, and we advise caution in handling it when frozen, since accidents are constantly occurring from carelessness in thawing the material.—Ed.)

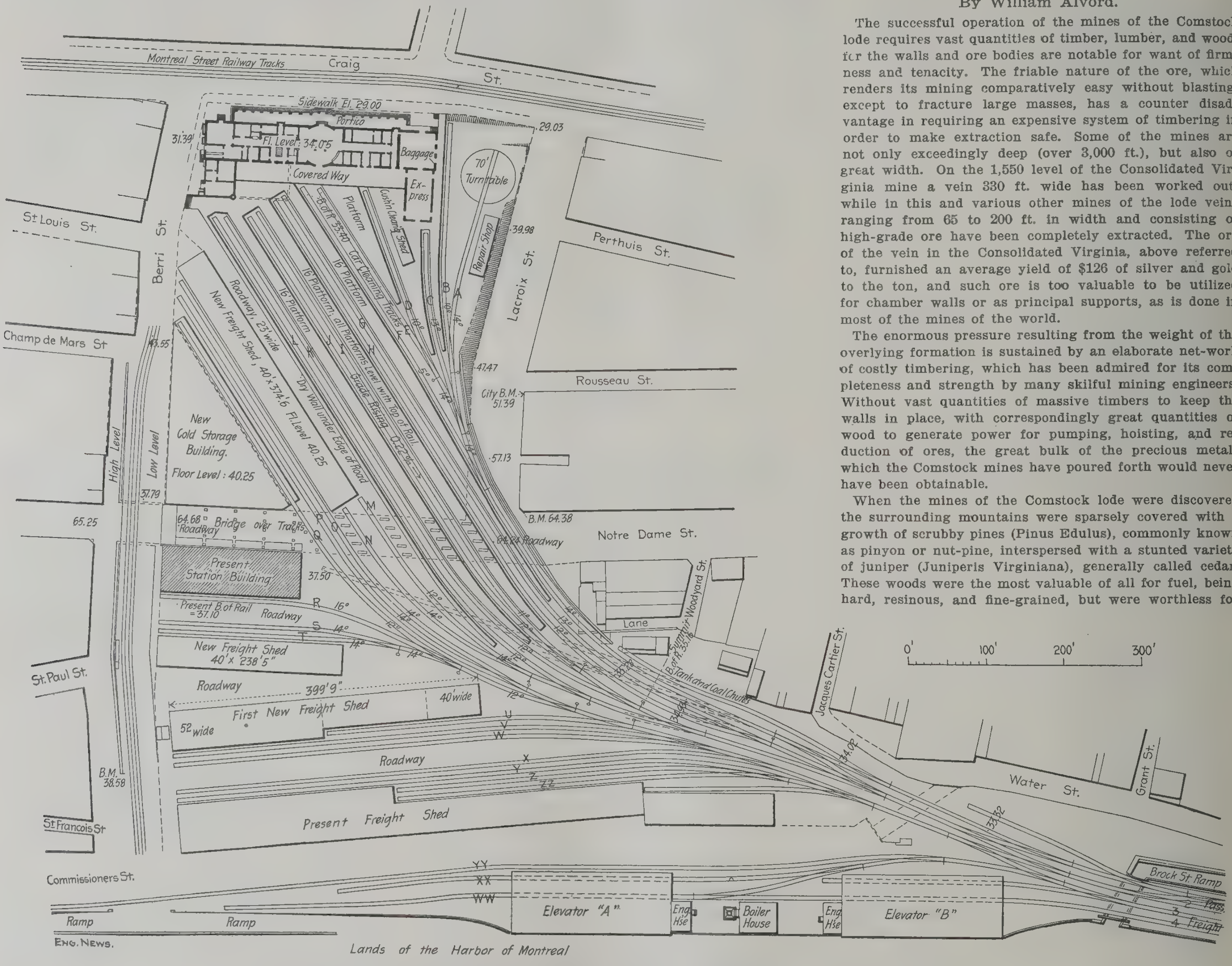
* * *

NEW TERMINAL STATION OF THE CANADIAN PACIFIC RY. AT MONTREAL.

The Canadian Pacific Ry. has at Montreal two important terminal stations, one at the east end and the other at the west end of the city, the only rail connection between which is by a roundabout route outside the city. At the west end of the city is the Windsor St. station (Eng. News, March 3 and 17, 1888), at which is handled all the traffic for the main transcontinental line, the Ontario Division and the south shore lines. At the east end of the city is the Dalhousie Square station, which has a brick station building and no train-shed. At this station is handled all the traffic for the line to Quebec and for several of the small local lines. In the aggregate the traffic is quite considerable and the railway company has for some time been carrying on the preliminary work for a large new station with a headhouse to be utilized for offices and hotel purposes. Additional yard room is also required, the Hochelaga yard being too small and too far away from the terminal. The accompanying plan shows the general arrangement of the tracks, etc., for the new building, being taken from a blue print furnished us by Mr. P. Alex. Peterson, M. Am. Soc. C. E., Chief Engineer of the C. P. Ry.

The present station is situated at the side of Notre Dame St., the offices being on the street level, while the tracks are 27.88 ft. below, the station yard having formerly been bounded by a retaining wall supporting the side of Craig St., and an archway having recently been driven to carry Berri St. under Notre Dame St. at the side of the station. The new station will occupy the entire block bounded by Notre Dame, Craig, Berri and Lacroix Sts., the grade of the ground surface falling away from Notre Dame St. to Craig St., so that the latter is practically on the same level as the present yards. The city gave the necessary authority for the new work, stipulating that a handsome station building and hotel should be built fronting on Craig St. It also gave the land, the railway company giving in exchange land for a small park. The government gave assistance to the project on condition that all trains of the Quebec Division and of the eastern district should run to and from this station. The architect for the headhouse is Mr. Bruce Price, of New York city. The city builds the retaining wall in the eastern boundary of the site, using stone from Terrebonne. Mr. Howard is the engineer in charge of this work for the city.

The first step was to remove the solid ground carrying Craig St. and replace it by a metal viaduct. This work has already been completed, the positions of the piers and columns being shown on the plan. Construction tracks were then laid under this and the grading for the new station was commenced. Of the four main line tracks at Brock St., from which the track system is developed, two (1 and 2) are passenger tracks, and two (3 and 4) are freight tracks. Of the station tracks, these marked A to N (inclusive) will be for passenger service, and those marked O to W W will be for freight service. There will be six main tracks (G to L), in pairs, separated by three platforms 16 ft. wide, the tracks rising from the headhouse on a grade of 0.22%, the summit of this grade being reached near the coal chutes. The platforms will be level with the rail heads. The new arrangements will include ample freight shed capacity; a cold storage building, 70-ft. turntable, repair shop, water tank, coal chutes, etc. The grading is being done by the railway company by day labor.



PLAN OF NEW DALHOUSIE SQUARE TERMINAL STATION AT MONTREAL; CANADIAN PACIFIC RY.
P. A. Peterson, M. Am. Soc. C. E., Chief Engineer.

* * *

TIMBER AND WOOD CONSUMPTION IN THE COMSTOCK MINES*

By William Alvord.

The successful operation of the mines of the Comstock lode requires vast quantities of timber, lumber, and wood, for the walls and ore bodies are notable for want of firmness and tenacity. The friable nature of the ore, which renders its mining comparatively easy without blasting, except to fracture large masses, has a counter disadvantage in requiring an expensive system of timbering in order to make extraction safe. Some of the mines are not only exceedingly deep (over 3,000 ft.), but also of great width. On the 1,550 level of the Consolidated Virginia mine a vein 330 ft. wide has been worked out, while in this and various other mines of the lode veins ranging from 65 to 200 ft. in width and consisting of high-grade ore have been completely extracted. The ore of the vein in the Consolidated Virginia, above referred to, furnished an average yield of $126 of silver and gold to the ton, and such ore is too valuable to be utilized for chamber walls or as principal supports, as is done in most of the mines of the world.

The enormous pressure resulting from the weight of the overlying formation is sustained by an elaborate net-work of costly timbering, which has been admired for its completeness and strength by many skilful mining engineers. Without vast quantities of massive timbers to keep the walls in place, with correspondingly great quantities of wood to generate power for pumping, hoisting, and reduction of ores, the great bulk of the precious metals which the Comstock mines have poured forth would never have been obtainable.

When the mines of the Comstock lode were discovered the surrounding mountains were sparsely covered with a growth of scrubby pines (Pinus Edulus), commonly known as pinyon or nut-pine, interspersed with a stunted variety of juniper (Juniperis Virginiana), generally called cedar. These woods were the most valuable of all for fuel, being hard, resinous, and fine-grained, but were worthless for timbers and lumber, being too small. They supplied the wants of the mines during the prospecting and surface-mining eras and as long as fuel only was wanted. As soon as any considerable depth was reached, the supply was exhausted and the forests of the eastern slope of the Sierra Nevadas, where accessible, were encroached upon. The forest-line of these mountains has receded westward before the woodman's axe until now it is west of the eastern crest of the Sierra range and almost on a line paralleling the western shore of Lake Tahoe, fairly within the limits of the state of California.

Timbers, lumber, and wood are now principally supplied to the Comstock mines from the southern portion of the Lake Tahoe basin, on the California side of the state line, by the Carson & Tahoe Lumber & Flume Co., a corporation entirely independent of the mines. The wood and logs are first transported about twelve miles over the company's railway to the lake shore at Bijou, the railway extending on piles 1,700 ft. out into the lake, to a depth of water where the steamers and barges can moor alongside of the track. The wood is unloaded from the cars on barges having a carrying capacity of from 75 to 140 cords each. The logs are dumped from the cars into the lake and enclosed in boom timbers forming immense rafts.

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*Abstract of a paper in Vol. X. of the Proceedings of the American Forestry Association.

The company has two powerful steamers engaged in towing these barges and log rafts to Glenbrook, on the eastern shore of the lake. At this point the logs are sawed into timbers and lumber which, with the wood, are reloaded on cars and transported up a long incline to the summit, over another railway, about ten miles long, belonging to the company. At the summit these are unloaded and conveyed through a flume for about twelve miles, to the wood and lumber yards at Carson City, Nev., and from there taken by the Virginia & Truckee R.R. 20 miles to the mines, making a total distance of 65 miles from the forest, over two rugged mountain chains. From the forest to the mines the timber, lumber, and wood are necessarily handled thirteen times.

In the operation of its system the Carson & Tahoe Lumber & Fluming Co. owns and uses 30 miles of railway track and switches, 2 locomotives, 40 cars, 2 steamboats, 6 barges, and 25 miles of flume. This flume is in form of a V, and is provided with all of the improvements which the experience of 20 years in flume transportation have suggested. It has 32 to 34-in. sides, a top width of from 45 to 48 ins., and has a diameter in the bottom of from 5 to 7 ins. It was constructed in 1870, has been in use ever since, and has a reliable supply of water from springs and creeks in the high Sierras. It has a carrying capacity of 600 cords of wood a day, and will transport the heaviest mining timbers as well as lumber and cord-wood.

About 15,000 cords of wood are annually supplied from the forests surrounding the headwaters of the Carson river in Alpine county, California, these being floated down the river in drives during the early summer stages of water. About 8,000 cords a year are consumed in the mills along the Carson river, and the remainder is shipped by rail to the Comstock mines. At present, 120,000 acres of the Sierra Nevada's choicest forests around Lake Tahoe and 75,000 acres around the headwaters of the Carson river have been denuded to operate the mines. When it is considered that this area equals an expanse of land 305 miles long by one wile wide, it will be apprehended that there is good reason for calling the Comstock "The tomb of the Sierras."

Not more than 10,000 acres of timber land and 35,000 acres of woodland are now available to supply the mines. Upon the exhaustion of these it will be necessary to develop the timber regions north of the Truckee river in order to obtain an adequate supply of timbers and wood. This will remove the base of supplies more than one hundred miles from the mines, and will require a heavy expenditure to construct lines of transportation. None of the Comstock mining companies have ever owned or controlled their timber supplies, but have relied on independent companies or individuals for the same.

From Jan. 1, 1880, to Jan. 1, 1891, in all, 249,756,000 cu. ft. of timbers and lumber were shipped to and used in and about the Comstock mines. During the same period 100,776,440 cu. ft. of wood were consumed, and to the latter amount should be added 11,264,000 cu. ft. consumed by the Carson River mills, auxiliary to the mines, making a total of 875,316 cords. These figures are taken principally from the books of the Virginia & Truckee R.R. Co., and may be relied upon. For the decade commencing Jan. 1, 1870, and ending Jan. 1, 1880, which includes the period of development and working of the bonanzas in the Crown Point, Belcher, Consolidated Virginia, and California mines, the timber, lumber, and wood used cannot be ascertained with exactitude, but a conservative estimate by men most familiar with the facts and with sufficient data upon which to base a nearly correct estimate, fixes the figures at 425,000,000 ft. of timber and lumber and 268,800,000 cu. ft. of wood, to which should be added 10,240,000 cu. ft. used in and about the Carson River mills.

In 1870 the timber and lumber sold for $35 per M. ft. at the mines, and wood at $13 per cord, but the prices have gradually fallen since that time, until now timber and lumber are sold at the mines for $22 per M. ft., and wood for $9 per cord. A conservative and probably underestimate of the average price paid at the mines for timber and lumber since 1870 is $23 per M. ft., and for wood $10 per cord.

Summarizing the above statistics, the Comstock mines since 1870 have used 674,756,000 ft. of timbers and lumber, and have paid therefor, at $23 per M. ft., $15,519,388. During the same time the mines and mills have used 391,070,488 cu. ft. of wood, costing, at $10 per cord, the sum of $30,553,160; making a grand total cost of $46,072,548. The pumping machinery of the mines was partially stopped in 1882 and entirely shut down in 1884, which accounts for the much smaller quantity of wood used in the last eleven years than was required for the ten years previous thereto.

The consumption of forest products by the mines for the period embraced between the discovery of the Comstock lode and 1870 can hardly be approximated, as there are no data for that time obtainable, but an estimate that the entire cost of timbers, lumber, and wood used in and about the Comstock mines, from the date of their discovery until the present time, is $55,000,000, could hardly exceed the true amount.

With the exception of the shafts and bulkheads, the prevailing system of timbering in the Comstock mines is that devised by Mr. Philip Deidesheimer in 1860 and commonly known as the "Deidesheimer system." It consists of timbers so framed that when a post is set up there is a place on its top for the ends of four caps, and when these are placed in position a mortise is formed into which the end of the next post fits. The same connections are made with each of the four posts, forming a hollow cube, and there is always a place for the caps of the sets to be fitted on any side.

These sets form cribs of timber 6 ft. square, strengthened by timbers connecting opposite corners in the manner of diagonals of squares. These cribs, when completed, make convenient places in which to stow away waste rock, and make the whole almost as firm as the original material. These sets are as compact as the cells of a honeycomb, to which they bear a striking resemblance except in figure, and by repetition may be extended in all directions to any distance that may be required. This system of timbering exemplifies the truth of the old adage that "Necessity is the mother of invention," for without it the Comstock miners could do nothing, but with it, the mines can be safely worked to any depth, width, or length. The seeming endless labyrinths of timbers in the Comstock mines when ignited and beyond control make a subterranean fire which burns and smolders for years. Many lives have been lost in the mines by reason of these fires, but none have been recorded as having been lost because of any inherent defect in the timbers or system of timbering.

A large proportion of the timber and lumber used in these mines has been in the constructing of shafts and bulkheads. Many of these shafts are from 2.000 to more than 3,000 ft. deep, and are completely encased in timbers. In the Consolidated Virginia mine there is one bulkhead 300 ft. long, 200 ft. high, and 80 ft. wide, containing 57,650,000 ft. of timbers. Another bulkhead in the same mine is 150 ft. long, 100 ft. high, and 50 ft. wide, and contains 9,000,000 ft. of timbers. There are other bulkheads of smaller dimensions, but containing in the aggregate vast amounts of heavy timbers.

The sizes of the timbers used in these mines vary from the huge pieces 16 ins. square and 24 ft. long to the smaller pieces 8 ins. square, used in cribbing.

The species used consist of yellow pine (Pinus poderosa), fir, (Picea magnifica), and cedar (Thuya gigantea), of which the latter is found in such small quantities as to be hardly worth considering. Fully two-thirds used is yellow pine, nearly one-third fir, and less than 1% is cedar.

In a comparison of these woods, in point of durability, red fir would rank at 100, yellow pine at 90, and white fir at 65. In a comparison in point of strength, red fir would rank at 100, yellow pine at 90, and white fir at about 90. In the generation of heat, they would rank in the order of yellow pine, red fir, and white fir. Yellow pine is a favorite timber with mire carpenters on account of its exactitude in joining. Cedar is inferior to no known timber, not even excepting redwood, for its lasting qualities underground. Yellow pine has been taken from the lower levels of these mines so compacted by the enormous pressure it has withstood as to have a density and weight exceeding lignum vitae, and has been made into handsome paper weights and other ornaments.

None of the timbers in the Comstock mines have yet badly decayed, and their life there cannot be accurately determined. The heat and the vapors of the mines, surcharged with mineral matter, appear to have a decidedly preservative effect upon the timbers.

Nearly or quite all of the timber cut for these mines is felled during the winter and spring months; it is flumed during the summer and autumn months, but the timber and lumber are in the water only during their passage through the flume—not more than 75 minutes. Upon being discharged at the mouth of the flume in the yards, the timber is at once piled up in such a way as to prevent warping and cracking and so that the air can circulate freely between each piece. The wood remains until shipped as it is discharged by the flume. As it is built up almost to a level with the flume, the latter is extended so that the wood is piled up by the water in long pyramidal masses about 30 ft. wide at the bottom, 10 ft. wide at the top, and about 20 ft. high; being thoroughly wet when discharged by the flume and drenched as piled, it remains more or less wet for several months and sometimes partially sours. For this reason, flume wood will not generate quite as much heat as will wood which has never been in the water. The effect of the water on timbers and lumber, when handled as herein described, is hardly appreciable.

The area upon which the forest has been cut off to supply the mines is now growing up, principally in pine, but the reproductive growth is so slow that it will require more than a century for the trees to attain a size sufficient to furnish the timbers required by the mines. The new growth is very thick, but as it becomes large the economy of nature, "the survival of the fittest," will kill out the weaklings and leave the stronger young trees at a proper distance apart. On some of the lower slopes of the mountains where the new growth is over 20 years old there are few trees 10 ins. in diameter, and the average diameter will not exceed 6 ins. In the Tahoe Basin, which has been cut over principally within the last ten years, the reproductive growth is about 5 ft. high and will average about 4 ins. in diameter. It is especially noticeable that in the Sierra Nevadas fir predominates on the north slopes where the snow remains the longest and the sun shines the least. On the other slopes pine largely predominates. This indicates that the Sierra fir thrives in a colder climate than is congenial to pine. A further fact is noticeable, that the reproductive growth contains a much larger percentage of pine and a less percentage of fir than the original growth contained. This is satisfactorily accounted for by reason of the sun reaching the ground after the primeval forest is cut off. As the new growth becomes larger and the ground is shaded a larger number of young pines than firs die, but a careful observation leads to the conclusion that when the trees become large enough for use the percentage of pine will exceed and that of the fir be less than in the primeval forest.

The present condition of the mines seems to indicate that the timber available will be adequate to their demands, but if extensive ore bodies should be discovered in the lode, or additional lodes within fifty miles of the Comstock, an enormous expenditure must be incurred to supply necessary forest products.

PROPOSED SANITARY SUPERVISION OF WATER SUPPLY AND SEWERAGE SYSTEMS IN ILLINOIS.

The sanitary supervision and control at all times of all public water supplies, both surface and underground, within the state of Illinois, and likewise the supervision and control of the methods and means of collecting and disposing of sewage is placed in the hands of the State Board of Health by a bill which will be introduced into the Illinois State Legislature at its coming session. This bill had its origin in the Illinois Society of Engineers and Surveyors, and has been drafted by a committee made up of members of that society, the Western Society of Engineers, the State Board of Health and of the Faculty of the University of Illinois. In Sec. 2 of the bill the scope of the legislation asked is given as follows:

> No sewer, extension of sewers, system of sewage (sewerage?—Ed.), or system of public water supply, shall be constructed by any city, village or town in this state, or by any corporation, individual or individuals, until the plans and specifications for such sewer, extension of sewers,system of sewage(?), or system of public water supply, shall have been submitted to the State Board of Health, and received its approval. And in addition to the approval of the plans for the development of public water supplies, the State Board of Health shall examine and cause to be made, analyses of the waters from the source, or sources, of supply, and determine their fitness for domestic and culinary purposes before such waters shall be issued to the municipality, corporation, individual or individuals, signed by the president of the board and attested by the secretary, with the seal of the board.

Sec. 3 of the bill provides that the required analyses shall be made at the laboratories of the University of Illinois, and shall be prima facie evidence of the matters therein stated. Secs. 4 and 5 provide for the publication of rules and regulations made by the State Board of Health under this law for three consecutive weeks in at least one newspaper in each county of the state, and orders that the affidavits of the publishers affirming such publication shall be filed with the County Clerk and shall be conclusive evidence of all facts stated therein. Sec. 6 authorizes the State Board of Health to make such inspections as are necessary to determine whether the terms of the law and the regulations of the board have been violated or not. In case of violation, notice to that effect is to be served upon the violators, and if the fault is not corrected, or good reason shown why such correction is not made, within ten days after service, action may be brought against the violators before any Justice of the Peace in the county where the violation occurred for the recovery of the penalties prescribed, and upon proper showing an injunction may be secured restraining continued violation. Sec. 7 provides that the penalties for violation shall not be less than $50, nor more than $200, for every violation, and an extra penalty of $10 per day for every day the violation is continued after conviction. Sec. 8 provides as follows:

> The State Board of Health shall, at its annual meeting, each year, elect a sanitary engineer, to be elected from three persons, recommended by the Illinois Society of Engineers and Surveyors, whose duty it shall be, under the direction of the board, to examine all plans for the construction of proposed sewers, extension of sewers, system of sewage(?) and water supply, and to perform such other duties in the line of his profession, as may be assigned to him by the board; to make report to the secretary before the regular quarterly meetings of the board, of all inspections made by him; for which service he shall be paid a sum not to exceed (sum to be specified by the legislature) dollars, to be paid out of the regular appropriations of the board.

Sec. 9 provides for an annual report of the Board of Health to the Governor of the state of all its acts in reference to this law. Sec. 10 provides that the provisions of the bill shall not apply to cities of the first class. The effect of the last provision is simply to exclude the city of Chicago from the jurisdiction of the law. We have commented on this proposed legislation in our editorial columns.

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NOTES OF A TRANSCONTINENTAL TRIP.

VII.

Tacoma, Wash.

This is one of the new large cities of the Pacific Northwest. It was first founded in 1868, but its history as a place of commercial importance dates from 1873, when the Northern Pacific R. R. made this its Pacific terminus. At the time of my visit, however, the city was quiet and business was dull, owing partly to the general commercial depression and partly to the dullness of the summer season. The city is pleasantly situated at the southeastern extremity of Puget Sound, and has fine facilities as a port. The city itself is mainly on high ground, 80 to 100 ft. above the water, but there are extensive mud flats along the shore which are to be filled in for the extension of the docks, wharves and other terminal structures of the Northern Pacific R. R. At Edison, near by, are the new railway car shops, which have cost nearly $1,250,000, while the total cost of the improvements carried out by the Northern Pacific Railway Co. at this point amounts to nearly $6,000,000, these improvements including grain elevators and warehouses of 3,500,000 bushels capacity, and coal bunkers of 22,000 tons capacity, besides two miles of wharf frontage in 30 ft. of water. In June last a contract for a dry dock was awarded by Capt. John E. Higgins to Dougan, Bringham & Cowen, at $86,000, while the repair shops, machinery, etc., will bring the cost up to $1,250,000. The dock will be 425 ft. long, 21 ft. deep, 50 ft. wide on the bottom and 90 ft. wide on the top. There is now a smaller dock, which was built in 1891.

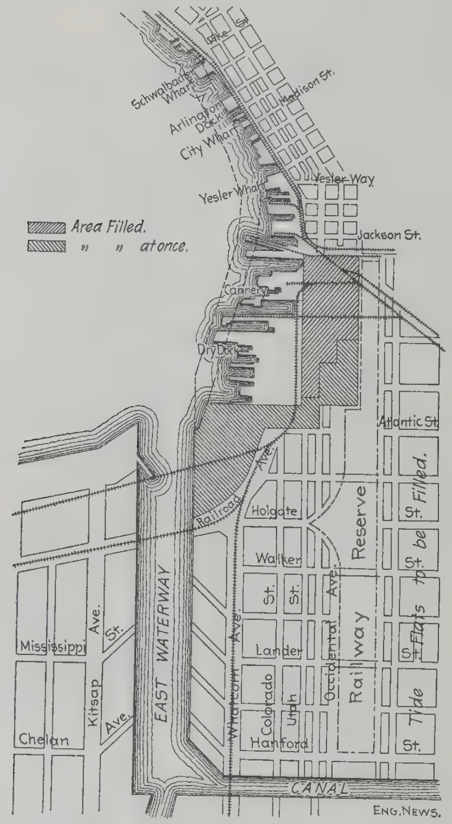


Fig. 1.—Map of Tide-Flat Filling at Seattle, Wash.

The water supply and electric light plant are owned by the city, and there are about 110 miles of graded streets, 54 miles of sewers and 74 miles of cable and electric railways. Wooden block paving and California asphalt paving are used on the main streets, and plank paving is also used on some streets. The Port Defiance, Tacoma & Edison Electric Ry. has box freight motor cars, which haul ordinary railway freight cars. The population was 36,000 in 1890, and is now estimated at 50,000. There is a smelter here at which 17,000 tons of ore were handled in 1895, the value of the output being $739,150. There is a considerable maritime traffic, including a large percentage of the tea imports (639,042 packages in 1895), and the Northern Pacific Steamship Co. has a tri-weekly service of steamers to China and Japan, while smaller lines of steamers run to various points on Puget Sound and up to Alaska.

Seattle.

This city is about 40 miles north of Tacoma, on the east side of Puget Sound, and a fierce rivalry exists between the two cities. Seattle had a population of 40,000 in 1890, and this is now probably between 50,000 and 60,000. The city is decidedly larger and more bustling than Tacoma, but it is smokier, and not so attractive to the traveler. As at the latter place, great terminal facilities and harbor accommodations are projected, to be built on made land in the shallow water, as the ground upon which the city is built rises steeply up from the water. In consequence of this the approach to the city by rail presents a most singular view. Great areas of open water are thickly dotted with piles, while here and there a roadway or a wharf extends over the piles, and in some cases houses have already been built on a pile substructure. At some distance behind the city are large fresh water lakes, and canals are proposed to connect these with the harbor, the purpose being to facilitate the extensive local marine traffic with places on the lakes and the sound, for Seattle is a great center for local navigation. The city has a considerable amount of brick paving on its streets, and, like all the places of which it is a type, it has a very complete and extensive rapid transit system, the cable and electric lines reaching all parts of the city and suburbs, and extending far into the country. Many of the lines have very steep grades and sharp curves, over and around which the cars are run at high speed, giving the passengers considerable exercise in sliding and swinging about. Some of the changes of grade are made with such sharp curves that fenders cannot be used, as in rising from the level street intersection to the grades the car plaform almost touches the pavement. A new water supply, from Cedar River, is now projected.

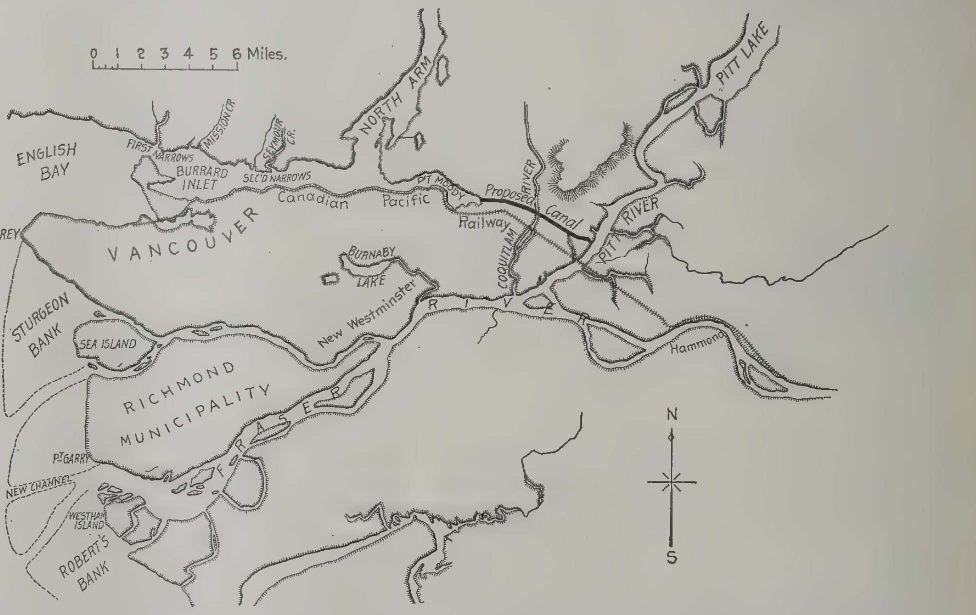


FIG. 2.—MAP OF PROPOSED RELIEF CANAL FOR FLOOD WATER IN THE FRASER RIVER; VANCOUVER, B. C.

The city is not on the Northern Pacific R. R. main line, but on a branch line, which has connections giving a through route to the Canadian Pacific Ry. at Mission, B. C., through trains being run between Portland and Vancouver. There is not a very good railway station, but the Northern Pacific R. R. proposes to purchase a block and erect a large modern station. In view of the large number of transportation interests centering here, and the disadvantages which would result from rivalry in establishing independent stations, yards, etc., the municipal authorities and the Chamber of Commerce have been endeavoring to promote the establishment of a terminal company to provide facilities and accommodations for the joint use of the various railway and steamship lines, thereby increasing the convenience for passengers and shippers and reducing the cost of handling passengers and freight. The railways, etc., would hold stock in proportion to the values of their respective properties in the city, and all details of operation, switching, etc., would be under the control of the terminal company. Another matter of commercial interest at the time of my visit was the proposed establishment of a new line of steamers to Japan, by a Japanese company, and a representative of that company was then on the coast, viewing the various harbors from Victoria and Vancouver, B. C., down to San Francisco and San Diego, Cal. Every coast city, therefore, was pointing out (through its papers and its citizens) its own supreme advantages as the port of such a line, and the adsurdity of the claims of all the other cities interested.

The proposed canals to connect Puget Sound with Lake Washington were described in Engineering News of March 15 and July 12, 1894, and Jan. 24, 1895. There are two of these projects, one of which is being carried on by the U. S. Government, the other by the Seattle & Lake Washington Waterway Co. No appropriation for actual construction of the Government Canal has yet been made. The other enterprise, which is as much a land reclamation project as a canal scheme, is in active progress. A summary of the work thus far done was recently furnished, as follows:

> The company has filled in at present a little less than 50 acres of tide lands immediately adjoining the town. In doing this it has moved over 1,000,000 cu. yds. of sand an average distance of about 4,000 ft., and have dredged the East Waterway for about 2,000 ft. to a depth of 26 ft. below low tide. There are at present two of the largest Bowers hydraulic dredgers at work, and the company proposes to build another in the spring, and also to start work on the hill section part of the canal. The terminal and dock facilities were planned by Mr. V. G. Bogue, M. Am. Soc. C. E., and are shown on the accompanying map (Fig. 1.) They were first considered in platting this part of the tide flats.

Mr. Edgar Ames, General Manager of the company, states that the railways are all to enter along the railway reserve and have their freight houses and yards along this strip. Then along Railway Ave. and Whatcom Ave. there will be tracks with spurs leading on to the docks, so that freight will be handled directly from steamer to car. The east and west waterways will be 1,000 ft. wide, but 448 ft. of this is allowed for lengthening of docks and wharves to accommodate large ocean steamers. The lock will be 400 × 50 ft., with 32 ft. of water on the upper sill and 16 or 32 ft. on the lower sill at low or high water. The excavation of the big cut will be done by hydraulic giants, the excavated material being conveyed in flumes to the tide flats. The bulkheads for the inner harbor lines have three rows of piles 6 ft. apart, with horizontal timbers, some of these timbers being 9-in. tree trunks, with branches extending back into the made ground. These three pile bents are 12 ft. apart, and a brush mattress filling is placed between the piles.

Seattle to Victoria and Vancouver.

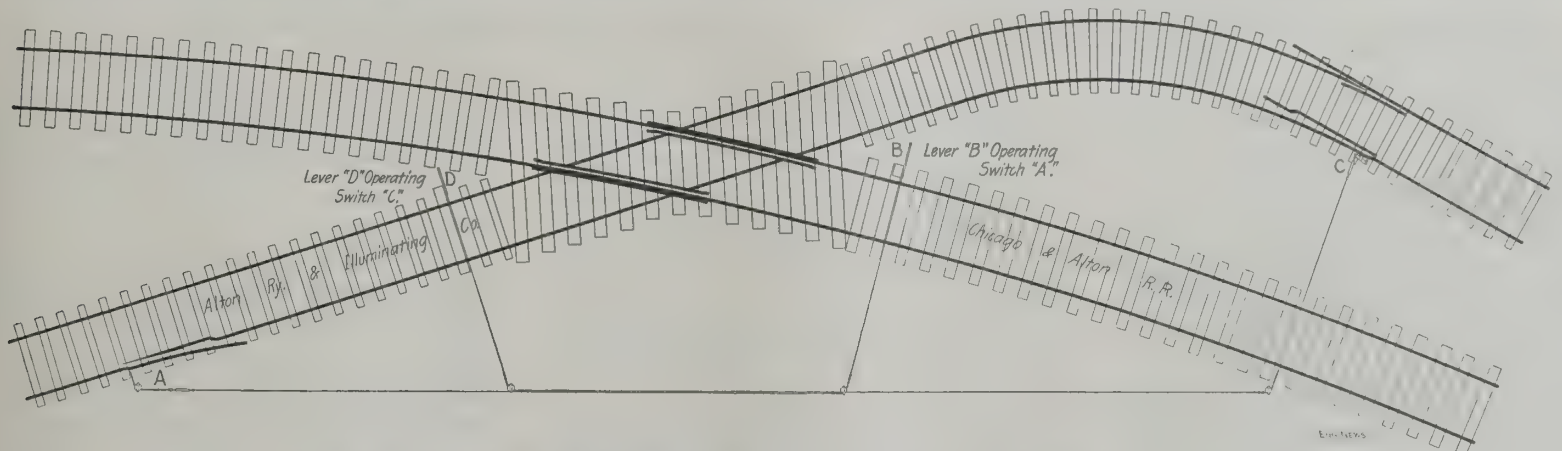
At 10:15 a. m., on July 26, I left Seattle on the steamer "City of Kingston" for Victoria, B. C., a trip of about 80 miles. The "City of Kingston" is a Hudson River steamer, which was purchased some years ago to run between Tacoma, Seattle and Victoria, and was successfully navigated around Cape Horn to its new service on the Pacific. The boat is a screw vessel, built by Harlan & Hollingsworth in 1884. Its trip is mainly in smooth water, but beyond Fort Townsend (crossing the Strait of Juan de Fuca, which connects the sound with the Pacific Ocean) there is something of a sea swell.

Victoria (or Vancouver Island), the capital city of British Columbia, is an attractive city, very pleasantly located, and has a population of about 20,000. The old government buildings are of wood of the Swiss chalet style of architecture, but a large and handsome stone building is now being erected to replace the several old wooden structures. The streets, etc., have a general air of neglect, due, apparently, to a careless and unsystematic administration of municipal affairs, an example of which was brought to light by the inquiry into the terrible disaster caused by the failure of the Point Ellice Bridge in May, as described in Engineering News June 18 and July 2. After the accident, a new steel bridge was proposed, but this was voted down by the council and a plan adopted to build a pile bridge, or trestle, alongside the old bridge, the cost of this to be $5,200. The citizens presented a petition for a steel bridge, to be paid for by the city, the government and the street railway company, but the trestle was adopted as being more rapidly built to re-open communication with Victoria West. As the accident occurred on May 26, and the trestle was still unfinished when I saw it in July (when only a very few men were at work upon it), neither the builders nor the council seem to have been in any hurry to reopen this communication, leaving persons bound for Esquimault to walk across a railway bridge and then walk 1½ miles along a dusty country road to the street car line on the opposite side of the wrecked bridge. So affected was the municipal mind by this disaster, that all bridges and trestles are now closed to street railway traffic, which is a brilliant precaution against accidents. The whole thing seems to have been a dreadful muddle. As to the street railway company, which shared the responsibility for the disaster, it has a most curious and inconvenient way of running its cars, the passengers being liable at almost any time, apparently, to be told that their car does not go any further, but that they must get out and walk on a block or so, where they will find another car. From Victoria, the Esquimault & Nanaimo Ry. extends to the coal mines of Nanaimo, 73 miles, and Wellington, 78 miles, while at Esquimault, two or three miles from Victoria, is the British naval station, with a great land-locked harbor and a masonry dry dock.

On reaching Canadian territory it is interesting to note the difference in appearance, style, dress and accent of the people, which makes it at once evident that this is a part of "Greater Britain," and this difference is accentuated by the scarlet and blue uniforms of the military which pervade the streets, and also by the appearance of the buildings. On the other hand, however, one sees that in all railway affairs American methods prevail, to the exclusion of English methods and practice.

After one day at Victoria, I left at 2 a. m., July 28, for Vancouver, on the steamer "Charmer," of the Canadian Pacific Navigation Co., a vessel built by the Union Iron Works, San Francisco, Cal., in 1887. This northeast trip of about 84 miles was considerably rougher than that from Seattle to Victoria. Vancouver was reached at 9 a. m. (one hour late), the steamer landing at the dock close to the S.S. "Empress of India," of the Canadian Pacific Ry. Co.'s line to Japan and China. The city is small, with a population of about 20,000, but has fine buildings and streets and a general air of prosperity and local pride, which are entirely wanting at Victoria. At the time of my visit it was unusually dull, the mining excitement in the province having drawn away a number of the people. The city was founded in 1886, and a steady commercial growth may be expected for it, as it is the terminal of a transcontinental railway and of two important transpacific steamship lines. The C. P. Ry. has shops and a fine hotel at this place, but in view of the class of passengers and the number of distinguished persons carried by this road, it is strange that a somewhat imposing terminal station has not as yet been built to replace the present small and commonplace wooden structure.

The Canadian Pacific Ry. has two lines of ocean steamers from this port. The fleet of its royal mail line to Japan and China consists of three fine large steamers, which leave every three weeks during the summer and every four weeks during the rest of the year. They are all built to the same plans, being 485 ft. long and 51 ft. beam, and having twin screws driven by triple expansion engines, giving the vessel a speed of over 19 knots. The interior arrangements are very handsome, and the hull is painted white, to aid in keeping the vessel cool in the hot Eastern climate. The other line of steamers runs to Australia (Sydney, New South Wales), stopping at the Hawaiian and Fijian Islands. This fleet consists of four vessels, sailing once a month.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Alton Ry. & Illuminating Co.
Chicago & Alton R.R.
Eng. News

DERAILING DEVICE FOR PROTECTING STREET AND STEAM RAILWAY CROSSING AT ALTON, ILL.
Paige Iron Works, Chicago, Ill., Builders.

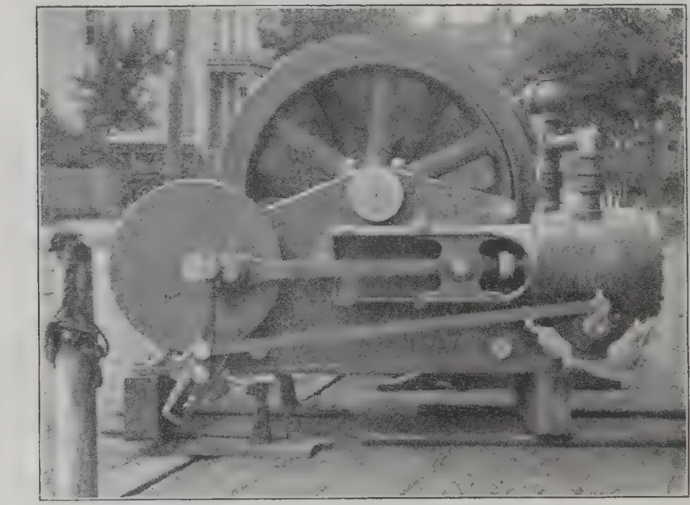
The flat meadow lands along the rivers for some miles east of Vancouver are very fertile, but are subject to inundation by the fierce floods in the Fraser River. To protect these lands a canal is proposed to carry off flood water from the Fraser River, and discharge it direct into an arm of the sea. The project to build a canal between the points indicated on the accompanying map, Fig. 2, is of an entirely private nature, although government assistance has been asked. It is not likely, however, that permission will be granted to construct it without locks, as the wash of gravel into Burrard Inlet would, in all probability, be very considerable and highly detrimental to that harbor. The Minister of Public Works of the Dominion, the Hon. J. Israel Tarte, has been recently in British Columbia studying the whole question of the control of the flood waters of the Fraser River, and it is his intention to send out government engineers to make a careful survey of the channel and to consider the feasibility of diking the banks in a satisfactory manner. Mr. Thomas H. Tracy, City Engineer of Vancouver, states that on the Pitt River, and also on the Fraser River, a great deal of very satisfactory diking has been done by private parties and by the various municipalities. The dikes on the Pitt River, built to reclaim the grazing lands, are from 40 to 54 ft. wide at the base, 12 to 15 ft. in height, and 6 ft. wide on top, and so far they have answered admirably. The British Columbia Drainage & Diking Co. owns about 14,000 acres of the Pitt meadow lands, under a diking concession from the Dominion Government, and has built dikes to protect its land from the flood water.

Mining in British Columbia.

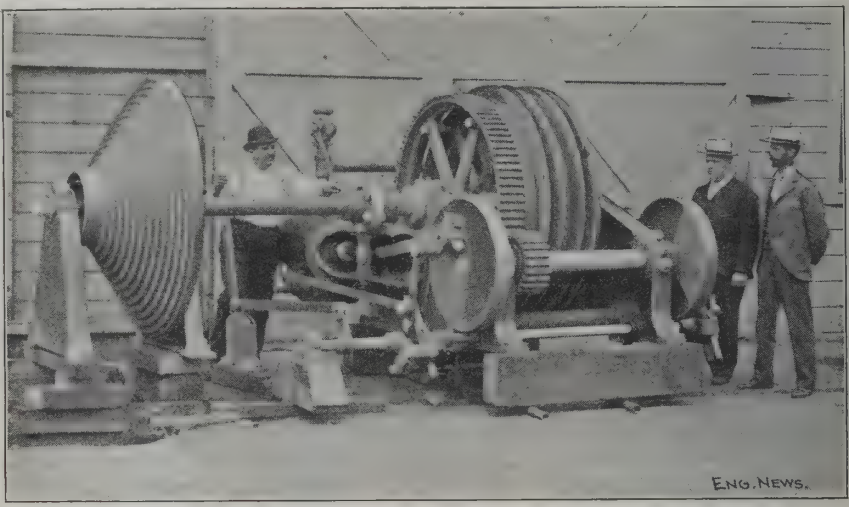
During the past summer there has been a great mining boom in this province, mainly in gold mining, and numerous very rich and valuable properties have been developed, although here, as in all other such cases, many wildcat schemes are founded by unscrupulous promoters. Mr. P. A. Peterson, M. Am. Soc. C. E., Chief Engineer of the Canadian Pacific Ry., and Prof. T. H. Egleston have reported very favorably upon the mineral resources of the province. The iron deposits on Vancouver Island are also being given some attention. Placer mining of gold bearing gravel is being commenced in some districts, and as the province has not yet had bitter experience enough to lead it to adopt legislation restricting the dumping of the debris into the rivers, the mining companies can work for the present with free hands. A less dangerous system is that of dredging the gravel from the river bottoms, and Beatty & Sons, of Welland, Ont., manufacturers of dredging and excavating machinery, have built a complete plant for this work on the Fraser River. The gravel will be raised by a dipper and dumped into a "grizzly," from which the finer material goes to the sluice-box to be treated by quicksilver, while the coarser material goes overboard to a dump scow. Better railway facilities are needed in most of the new districts, and locally there is great dissatisfaction expressed because the Canadians are so slow to provide these, while Americans have invested heavy amounts of capital in developing the resources of the new districts, and have already built lines which divert much of the traffic to points in the United States. The Canadian Pacific Ry. has now some small local connections and steamer lines, but a through line is much to be desired, and this could be afforded by the proposed Crow's Nest Pass line through the southern part of the province. This will not be built, however, unless the government gives the railway company a good subsidy. Mr. Collingwood Schreiber, Deputy Minister of Public Works, has recently visited British Columbia to investigate the actual requirement for such a line, and the desirability of granting a subsidy. The company has had careful investigations made by its mining expert, with very satisfactory results, and in consequence of this new smelting plants may be erected. The smelting has been done largely by the Kansas City Smelting Co., at Kansas City, Mo., 2,000 miles distant, but the company and the C. P. Ry. Co. will probably put up local smelters for their combined interests. One of the latest new lines is the Columbia & Western Ry. (narrow gage), which was completed from Trail to Rossland this past summer, the contractor being Mr. Henry Blackwood. A line from Vancouver to the celebrated Kootenai district is also projected, and the enterprise has been incorporated by McLean Bros., of Vancouver, as the Vancouver, Victoria & Eastern Ry. & Navigation Co. Another railway project heard of in this province is the British Pacific Ry., which is proposed to run north from Winnipeg, Man., and then westward, north of the Canadian Pacific Ry., touching the latter's branches at Prince Albert and Edmonton.

DERAILING DEVICE FOR PROTECTING STREET AND STEAM RAILWAY CROSSINGS.

We illustrate in the accompanying cut a derailing device designed to prevent collisions at the crossings of steam and electric railways, which was recently installed at Alton, Ill., at the crossing of the Chicago & Alton R. R. and the Alton Ry. & Illuminating Co.'s tracks. The device is manufactured by the Paige Iron Works, of Chicago, Ill., and as will be seen from the drawing consists simply of a hand operated derailing switch placed on each side of the steam railway tracks and about 50 ft. distant. Normally the switch is open—that is, it is set to derail the electric car, and to pass it the conductor must cross the steam railway track and raise a lever which throws the switch into line by means clearly indicated in the drawing. The lever B opens the switch A and the lever D opens the switch C, and each lever must be held up until the car passes the switch which it controls. After the car has cleared the switch the lever is dropped and the switch is returned to its original open position by means of a spring. The various structural features of the device are clearly shown by the illustration.



HOISTING ENGINE WITH HACKWORTH VALVE GEAR.
Manufactured by the C. W. Hunt Co., 45 Broadway, New York City.



FRONT VIEW OF HOISTING ENGINE, SHOWING WINDING DRUM WITH SPIRAL GROOVE.

A HOISTING ENGINE WITH A NOVEL VALVE GEAR.

We illustrate herewith a hoisting engine, built by the C. W. Hunt Co., 45 Broadway, New York city, which is noteworthy on account of its use of the Hackworth valve gear, which seems to be especially suitable to this class of engines. It has an overhung eccentric crank, and a rotary valve motion. There are only three moving parts in the valve gear, viz., the valve motion connecting rod, the sliding block and the valve rod. The valve gear is described as follows:

The eccentric is in the same radial line as the crank. The eccentric rod is supported at its lower end by a sliding block, of which the path may be given greater or less inclination, so that the crank end of the rod describes a circle concentric with the shaft, while the other is guided in a straight line by the sliding block. The valve rod is attached to the eccentric rod between the eccentric and the sliding block, and the point of attachment moves in an elliptical orbit, the major axis of the ellipse having the same direction as the path of the sliding block. The sliding block guide being set at a greater or less inclination, the travel of the valve is correspondingly varied, and its inclination being reversed with respect to the center line of the rod, the motion of the engine is reversed.

This device gives constant lead and a better motion of the valve than the link motion, especially at short cut-off. The strains are all in line; the bearing surfaces are all cylindrical or straight, ensuring good work and long service. The motion of the valve is benefited by the rocking of the valve arm, as the effective radius is shorter at the ends of the stroke, consequently the valve has a more rapid motion as its distance from the center line increases. The eccentric rod introduces an irregularity in the motion, and the connecting rod introduces an irregularity in the motion of the piston. The length of the connecting rod and of the valve rod and their relative positions are so chosen as to neutralize each other's irregularities.

CONTRACTION AND DEFORMATION OF IRON CASTINGS IN COOLING FROM THE FLUID TO THE SOLID STATE.*

By Francis Schumann, M. Am. Soc. M. E.**

Introduction.

One of the most serious and annoying difficulties to the iron founder is the tendency of castings to deformation, due to unequal cooling and consequent unequal contraction, excessive initial stresses, if not cracked castings, often resulting, no matter how carefully molded or with what care the iron is selected and manipulated. Our knowledge as to the causes has been but vague, notwithstanding the thought and attention given the subject.

The writer, impressed with the importance of the matter, and having opportunities for observation and experiment through his connection with foundries where great diversity in the form of product resulted, decided to investigate with a view of discovering what laws of physics applied, and in how far the cause and effect were determinable and controllable.

After some twelve years of observation and research the writer is enabled to submit the result of his labors, which it is hoped will prove of practical use to the engineer and foundryman.

General Laws Advanced.

Cast iron, as well as all other bodies, with but few exceptions, expands or contracts equally in all directions, with the increase or decrease of its temperature, respectively. Hence the proportion of a body, whether its temperature increases or decreases, remain alike. At moderate low temperatures, from 32° to 212° F., the change is directly as the temperature. At high temperatures the changes are greater than the changes in heat.

Contraction takes place just when incandescence disappears, or when the color changes from red to black, and continues until the temperature is that of the surrounding mediums.

Contraction and Deformation of Prisms Cast in Sand Molds.

A prism cast in a sand mold will maintain its alinement, after cooling in the mold, provided all parts around its center of gravity of cross section cool at the same rate as to time and temperature.

Deformation is due to unequal contraction of the elements of the cross section surrounding the center of gravity of the section. Unequal contraction is due to unequal cooling, causing, or tending to cause, initial stresses in the elements of the prism, resulting in deformation or rupture.

The rate of contraction between the fluid (heated) state and the solid (cold) decreases with the volume or mass of the casting, and inversely as the time of cooling. Rapid cooling tends to increase the density of the iron; the crystals are diminished in size, and the fracture denotes greater compactness, with more evenness of surface and less ruggedness. The color tends towards white, denoting a change of carbon into the combined state at the moment of solidification. The size of crystals decreases with an increase of combined carbon. Its resistance to impact is lessened, and the rate of contraction is increased.

Slow cooling develops larger crystals, less density, and increased ductility. The fracture is darker or more gray in color, the surface uneven and rugged, and the carbon is in a more free state. The contraction is lessened, and the casting has greater resistance to shock, although its resistance to a quiescent cross-breaking force may be less.

In any prism, variations in density may occur by reason of differences in the rate of cooling, the more rapidly cooling part being more dense, made so by the molecules drawn from the still fluid part of the casting, which, cooling later, will be less dense or with a diminished number of molecules. The molecules in adjusting themselves follow and flow in lines coinciding in direction with the waves of cooling, being from a high to a lower temperature, thus tending to create a void, and lessening the density of those parts which cool slower.

The rate of cooling, or dissipation, of heat, is uniform around the perimeter of the cross section. The total amount of heat to be dissipated per unit of perimeter of section may or may not be uniform or equal, depending upon the character of the cross section. The greater the amount of heat to be dissipated per unit of perimeter the slower the cooling.

A plane of neutral or mean action, relative to the total dissipation of heat, passes through the centre of gravity of the cross section. In symmetrical sections the action is alike on either side of the neutral plane, while in unsymmetrical sections it will, or may, vary.

The dissipation of heat through the perimeter of a section follows wave lines perpendicular, in direction, to the perimeter. The amount of heat to be dissipated per unit of perimeter varies in proportion to the volume or mass of the prism of which the respective unit forms the dissipating side. The relative amount of heat dissipated in a prism, per unit of time, varies in proportion to the dissipating surface of the perimeter divided by its respective volume of cross section.

The crystals that form in cast iron, when changing from the liquid to the solid state, have the tendency, when no disturbing causes interfere, to form themselves into regular octahedrons, or double four-sided pyramids, with their bases joined. Their size varies, the mean increasing with the slowness of cooling. The long axis of the crystals tends to adjust itself perpendicular to the plane of cooling surface of the casting. Thus, in a cylinder, the axis would coincide with the radial lines, while in a square prism, the axis of the crystals being perpendicular to the four sides, will tend to flow apart on a plane bisecting the angle of two sides; on this bisecting plane the casting will be less dense and of diminished cohesion.

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*Abstract of a paper presented at the New York meeting of the American Society of Mechanical Engineers.

**President Tacony Iron & Metal Co., Tacony, Pa.

A prism, unsymmetrical in section, in which the proportion of cooling surface to mass varies around the centre of gravity of the cross section will have the greatest proportion of smaller crystals in the parts cooling the quickest. Where the change in the rate of cooling is greatest will be the place of greatest interference to the natural adjustment of the crystals, as to size and position and hence the place of least cohesion. Contraction is in a direct relation to the rate of cooling, and size of crystals. The more rapid the cooling the smaller the crystals and the greater the contraction.

In any prism, unsymmetrical in section, composed of a smaller mass joined to a larger, the greatest longitudinal contraction will occur in the larger mass. This apparent contradiction to the general law, that contraction decreases with the mass and rate of cooling, is explained when we consider volumnar contraction. The larger mass will have its rate of contraction equal in all directions; the smaller mass is restricted in its contraction longitudinally by the larger mass at the point of juncture of the two masses, but maintains its greater rate of contraction transversely; were the transverse rate the same as that of the larger mass, its longitudinal contraction would be the same, but its transverse rate being greater, the excess in volume flows in direction of length, resulting in a greater length, after cooling, of the smaller mass.

When the rate of contraction in the elements of the cross section of a prism are known, the resulting change in alinement and initial stress, due to the differences in contraction, can be determined.

The line of mean contraction passes through the centre of gravity, or neutral plane, of the cross section. In unsymmetrical sections the centre of action of the maximum and minimum contraction coincides with the centre of gravity of the area elements that are separated by the neutral plane which passes through the centre of gravity of the whole section.

Modifying causes that affect the results obtained by the application of the preceding laws are: Imperfect alloying of two or more different irons having different rates of contraction; variations in the thickness of sand forming the mold, which is the medium for conducting the heat from the surface or perimeter of the cross section; when the prism is cast in a horizontal position, and thin layers of sand at top and bottom affect the dissipation of heat, which becomes unequal by reason of the difference in circulation of air between the upper and under external surfaces of the mold, the upper surface dissipating the greater amount of heat; the position and form of cores, which tend to resist the action of contraction, also the difference in the conducting power between moist sand and dry-baked cores; differences in the degree of moisture of the sand surrounding the prism, especially when small in mass; unequal exposure by the removal of the sand while yet in the act of contracting; flanges, ribs, or gussets that project from the side of the prism, of sufficient area to cause the sand to act as a buttress, and thus prevent the natural longitudinal adjustment due to contraction; in light castings of sufficient length the unyielding sand between the flanges, etc., may cause rupture.

Influence of the Principal Constituents of Iron Upon the Rate of Contraction.

Carbon is the most active element, when in the combined state, to increase the rate of contraction. As strength and hardness result from slight increase in the proportion of combined carbon to that in a free state, it follows that strong irons have a greater rate of contraction than those in which a lesser amount is present. When the combined carbon exceeds certain limits, hardness and contraction increase rapidly and the strength decreases. Increase in the proportion of free carbon has the opposite tendency.

Silicon, when present, not exceeding certain limits, tends to free the carbon, reduces the rate of contraction, and increases the ductility and softness of the iron. Increasing the silicon up to, say, 10%, causes the iron to become brittle, hard, and weak, and increases contraction.

Sulphur tends to change the carbon into the combined state, and hence increases the rate of contraction.

Phosphorus, while tending to harden the iron, has little, if any, influence upon the proportion of combined to free carbon. It lessens the rate of contraction, and diminishes the strength of the iron.

Manganese, as usually present in foundry irons, about 1%, has no appreciable effect. When, however, it reaches 1.5%, and the iron is low in silicon, it tends to hardness and increases contraction, although no alteration in the carbon is affected. In some hard irons the combined carbon is lessened, as also the contraction, by adding small quantities, not exceeding 0.15% of manganese to the molten iron in the ladles just before pouring in the mold. Increased strength also results.

Repeated remelting increases the rate of contraction; it tends to harden the iron, and increases its density. Originally soft mixtures become stronger and harder, while hard mixtures become harder; the proportion of free carbon decreases and the combined increases; the total carbon is slightly decreased. Silicon and manganese rapidly decrease, phosphorus to a less extent, while sulphur rapidly increases, due to the fuel.

Section of Test-Piece.

The cross-sectional area of test-pieces for determining the rate of contraction of a given mixture of iron should increase with the increase of combined carbon contained in the mixture when intended for large castings.

In the remainder of the paper Mr. Schumann develops a practical method of computing the contraction which will take place in any casting and also the initial stresses due to unequal contraction, illustrating the method by numerous examples of which the solution is given in detail. Lack of space compels us to omit this part of the paper, and any of our readers interested in the study of the subject can probably procure copies of the complete paper from Mr. Schumann or from the Secretary of the American Society of Mechanical Engineers. The conclusions with which the paper closes are as follows:

> The deformation of prisms due to unequal contraction can be overcome by providing counter deformation in the pattern, or by the addition of auxiliary parts that can be readily removed from the casting. Generally the section should be so subdivided or designed that the ratios of cooling surface to cross section of the piece are alike around the center of gravity of the section.
>
> In complex machinery castings the design should be so modified or chosen that there will result in the least differences in the rate of cooling of the different members. Sudden changes in form cause severe initial stresses, if not fracture, and should be rigidly avoided.
>
> Imperfectly proportioned flanges, ribs, or gussets added to the main body of a casting, either for the purpose of increasing the strength or connections, may be sources of weakness.
>
> Hollow cylindrical columns, although cast of even thickness and left in the mold until cold, may become crooked by reason of the unequal rate of cooling between the upper and lower halves, due to the currents of air passing through the column and clinging to the under side of the upper half after the core arbor is removed, which is usually done shortly after pouring and while the casting is still red hot. This deformation is avoided by stopping the ends with sand immediately after the withdrawal of the core.
>
> Greater attention to the laws of cooling and correct forms and proportions of castings will result in increased strength and economy, besides the avoidance of annoying crooked castings and mysterious breakdowns.

NOTES FROM THE ENGINEERING SCHOOLS.

Michigan Mining School.—The catalogue of the School for 1896-1898 has lately been issued, containing 238 pages. Besides the usual matter in work of this kind, it contains tables giving the classification of rocks and minerals for the use of students taking the course in Geology, Mineralogy and Petrography. The catalogue contains also statistics concerning the mineral production of the United States, and of Michigan in particular. Mention is made of the equipment and work of many of the most important copper and iron mines in the Upper Peninsula.

The storage battery plant which was donated to the school last year by Hon. J. M. Longyear is now being set up. On its completion, the laboratories will have all the supply of current necessary for use in the experiments made. In connection with this work, Mr. Edgar Kidwell, Professor of Mechanical and Electrical Engineering in the school, has developed an automatic circuit make and break switch, designed especially for use with storage battery plants.

Worcester Polytechnic Institute, Worcester, Mass.—The following changes in the faculty are reported: Profs. Geo. I. Alden, head of the department of mechanical engineering; Geo. E. Gladwin, professor of free-hand drawing, and M. P. Higgins, superintendent of the Washburn shop, have resigned. These gentlemen had been with the institute since its opening, 28 years ago, and its present high standing is largely due to their efforts. The first two named have gone into commercial life as manufacturers of direct plunger elevators, a business which has grown up under their direction in the Washburn shops, and which they purchased from the institute. Mr. Gladwin's department was reorganized as a section of the new department of drawing and machine design, now directed by Prof. W. L. Ames, formerly of the Rose Polytechnic Institute. A further resignation was that of Asst. Prof. W. W. Bird, of the mechanical engineering department, who was always a non-resident, and who now devotes all of his time to his iron foundry in Cambridge, Mass.

The new men are: Prof. J. J. Guest, from Cambridge, Eng., where he graduated with high honors and has since been instructor, who comes to take the head of the department of mechanical engineering from McGill University, Montreal; Prof. W. L. Ames, who was mentioned above; Prof. H. B. Smith, from Purdue University, to take the electrical engineering department; Dr. Fred. L. Dunlap, from the University of Michigan and Harvard, recently instructor in chemistry at Sheffield Scientific School, Yale University, occupying the new chair of industrial chemistry; Supt. C. A. Chandler, of the Washburn shops, a past graduate of this institute. New instructors have been appointed in mathematics and in the mechanical laboratory. Prof. Sidney A. Reeve has been appointed to the new chair of steam engineering and hydraulics. He took his degree and was instructor at the Sheffield Scientific School.

Columbia University, New York city.—Plans for the new gymnasium have been completed. It is to occupy about half of a building, to be known as the "University Building," the remainder being devoted to a power house and rooms for literary and other societies. The structure will be three stories high. In the basement will be a swimming pool,100 ft. in diameter and 10 ft. deep,and around the pool will be the shower, tub and needle baths. The principal gymnasium room will be 160x100 ft., 30 ft. high. The total cost of the gymnasium and swimming pool, it is estimated, will be $400,000, and that of the entire building, $800,000.

The Schools of Mines, Chemistry, Engineering and Architecture, of Columbia University, have issued a set of pamphlets, giving general information of the courses for 1896-97. Under the new arrangement of faculties, the Faculty of Applied Science has charge of the four professional Schools of Mines, Chemistry, Engineering and Architecture. In the School of Engineering four separate four-year courses are given, viz., civil engineering, sanitary engineering, electrical engineering and mechanical engineering. The last-named will be offered for the first time in 1897, or upon removal to the new site. Two four-year courses are given in the School of Mines, viz., mining engineering and metallurgy. Candidates intending to enter one of the four professional schools above-named, are advised first to take a four-year course in Columbia College, leading to the degree of Bachelor of Arts, at the same time preparing themselves to enter the third year of either of the professional schools, so that the technical degree may be taken two years later. We take pleasure in quoting the following extract from the pamphlet of General Information, showing how the idea that engineering students should obtain a liberal education before beginning the professional course is being favored by Columbia:

> As students may and do enter the college two years earlier than they enter the professional schools, students taking this combined course of study will be able to obtain the professional degree at the same age as though they entered the professional school in the first instance at the present average age of such students, with the added advantage that they will have had at the same time the elements of a liberal education before they enter upon a strictly professional course of study. This combined six-year course is strongly urged and recommended, for the reason that engineers, chemists, and architects, as professional men, need the liberal training offered by a collegiate course quite as much as do lawyers, physicians, or clergymen. Experience has shown that those who have taken a liberal course of study in the past, and who have enjoyed the advantages of such an education before beginning their technical studies, have taken a much higher standing in their profession, have exercised greater influence in the community, and have been much more useful men than those who have relied upon a purely scientific or professional course of study.
>
> Without sacrificing the necessary elements of a liberal education, the widest opportunity for elective work in science is offered in this new curriculum, which will permit the student to pursue almost any desired line of study and to specialize in it to almost any desired extent. A properly chosen course of study in the college will thus fit students for advanced work and original investigation, and is to be recommended to candidates for higher degrees under the Faculty of Applied Science, or the Faculty of Pure Science.

An alternative to the plan of taking a four-year collegiate, followed by a two-year professional course, is proposed in the announcement of the School of Mechanical Engineering, as follows:

> It is very desirable that every mechanical engineer should have had a course of liberal and literary studies.
>
> As the strictly professional course offers no time for these studies, students are warmly urged, for their own sakes, to take two preparatory years of such study in Columbia

College before entering the School of Engineering. Special facilities are offered for such a combination of courses. All the alternatives are of equal disciplinary value, so that while retaining the element of strength, the courses thus derive advantage from the flexibility which belongs to the university.

The School of Architecture issues, in pamphlet form, an admirable paper by Prof. William R. Ware, entitled "The Instruction in Architectural Drawing at Columbia University," profusely illustrated and describing his system in great detail. We strongly advise teachers of drawing and any others interested in architectural study to procure a copy of this paper. It was originally published in the "School of Mines Quarterly" for April and July, 1896.

Thayer School of Civil Engineering (Dartmouth College, Hanover, N. H.)—Prof. Robert Fletcher, director of this school, sends us a 12-page pamphlet giving a numbered list of engineering reference books and periodicals used in the schedules of the courses of instruction. In the schedules reference is made by number only. In the list the names of authors are given with the titles, and prices, and the names and addresses of publishers. Books of general value, considered indispensable as part of the equipment of any engineer, have their titles printed in small capitals, and other books of special value, for example, the best, or one of the best, in a particular branch or specialty of engineering, are indicated by an asterisk (*). Such a list as this should be of great value to students in any technical school, and we commend the plan to the attention of engineering teachers generally.

Cornell University.—The new hydraulic laboratory of the College of Civil Engineering has made use of the picturesque gorge and waterfall near the college to construct a rock cut canal 500 ft. long, 20 ft. wide and 10 ft. deep, with a steel stand-pipe 6 ft. diameter and 70 ft. high. This should afford excellent facilities for experimental work in hydraulics.

Ohio State University, Columbus, O.—The Department of Clayworking and Ceramics, which was authorized by an act of the legislature, in May, 1894, is now in the third year of its existence. We quote the following from a circular issued by the Department:

> It is the only school on American soil which has made a direct step toward placing the ceramic industries on the same plane as that occupied by the other branches of engineering science and chemical technology. At present the clay-working industries of America, while they enjoy a prosperity due partly to our unrivalled deposits of crude materials, and partly to the mechanical skill and business energy with which they are prosecuted, are feeling constantly the effects of foreign competition, and find themselves at some disadvantage in this contest on account of the wasteful and uneconomic methods used here, and also the very limited extent to which scientific training and chemical technology are employed in counteracting this waste.
>
> Clay industries are essentially chemical industries, and their problems are such as can be readily solved and controlled by the use of good chemical engineering. It is to create such a class of ceramic engineers, men who can apply to the clay industries of to-day the full fruits of the best knowledge of modern science, that this department has been organized and maintained; and it is confidently hoped that the clay industries will co-operate with it in its efforts to achieve present progress, and lead them to ultimate international supremacy.
>
> There are two courses offered: A long one of four years, leading to the degree of Engineer of Mines in Ceramics, and a Short or Industrial Course of two years' duration, which leads to no degree, but for which a certificate of work accomplished is issued.
>
> The four-year, or Engineers' Course, is designed to be complish the objects just set forth, and is therefore made the full equal, both in quantity and quality of the work done, of any engineering course offered by the University.
>
> The two-year or Industrial Course is designed to assist young men who have already been actively engaged in the ceramic industries, and who, on account of mature years, or lack of means, or lack of previous educational advantages, are unable to avail themselves of the full and complete course, and yet who wish to increase their earning power or chances of promotion by fitting themselves for other than routine labor.

Washington State University, Seattle, Wash.—President Harrington has asked the legislature for an appropriation to establish and maintain an engineering department in the University. He says:

> It is proposed to provide teachers and apparatus for beginning effective work in civil, mining, electrical and mechanical engineering. The desirability of these lines of professional training in this state need hardly be argued. In our opportunities for marine commerce, in our extensive mineral resources, in the many irrigation problems of the eastern two-thirds of the state, and in even the commonplace and universal problems of highways and bridges, there is more need in this state of all lines of engineering than in most other states of the Union. The estimates provide a very modest beginning for the four lines of engineering mentioned. The proposal is that the new teacher of civil engineering shall also teach mechanical drawing, and the teacher added for electrical engineering shall for a time have charge of the technical mechanical work.

THE BENEFICIAL EFFECT OF WATER METERS at Atlantic City, N. J., is shown by the annual report of Mr. W. C. Hawley, Assoc. M. Am. Soc. C. E., Superintendent of the water-works. On Aug. 1, 1895, there were about 350 meters in use. During the ensuing fiscal year 1,456 meters were added, making about 1,800 in all. The setting of the new meters began in February and was finished July 15. When the work was begun the total pumpage was over 250 gallons per capita per day. The per capita consumption later on is not given, and cannot be estimated by an outsider, Atlantic City being a summer resort. Comparison made be made with 1895, however. This is done in the following table, in which it will be noticed that during the first three months of 1896, or before or during the early part of the meter setting, the consumption was greater than in 1895, and during the succeeding four months of 1896 it was less than in 1895:

	Pumpage, gallons per day		
	1895.	1896.	Increase or decrease.
January	4,478,440	4,756,238	277,798 +
February	4,427,545	5,060,008	632,463 +
March	4,394,366	5,268,073	873,707 +
April	4,537,553	4,609,964	72,411 —
May	4,776,210	4,642,114	134,096 —
June	5,509,314	4,609,330	899,984 —
July	6,639,762	5,695,708	944,054 —

The cost of the 1,456 meters in place, including valves, fittings and labor, averaged $15.19, the meters ranging in size from 3 ins. to ⅝-in., as follows: 9 3-in.; 6 2-in.; 19 1½-in.; 47 1-in.; 378 ¾-in.; 997 ⅝-in.

THE EXCLUSION OF GROUND WATER FROM A sewer has been effected in a method described by Mr. Robert Godfrey, Assoc. Inst. C. E., in an advance publication of "Proceedings of the Institution of Civil Engineers." The sewer was of concrete, lined with 21-in. earthenware pipe. The defective portion was was 1,320 ft. long, laid in a tunnel through gravel and running sand, 10 ft. deep at one end and 54 ft. at the other, having a grade of 1 in 343. A shaft was sunk 968 ft. from the upper end, there being a manhole at the latter point. Wrought-iron pipe, 12 ins. in diameter and of ⅜-in. plates, was lowered in the shaft in lengths of 14½ ft. Each length of pipe had a special malleable iron collar, which served to connect the lengths by means of lead calking. Two runners were attached to the under sides of the collars to prevent injury to the pipe as the new pipe was drawn through. As one section after another was joined up the new pipe was pulled forward by means of a cable connected to a hand windlass operated by two men. The cable was attached to a bar laid across the end of the lower pipe, thus avoiding strains on the joints which would result from attaching it to the front end of the pipe. The total weight drawn forward after connecting the last length of pipe was about 14 long tons. The pipe was inserted in the 352 ft. of sewer below the shaft and pushed down the grade, as added on, by means of levers. After the new pipe was all in place the annular space between it and the old pipe, at the lower end, was packed with clay and concrete for a distance of 3 ft., thus holding the water back from the stretch of original pipe below. Gagings showed an infiltration of about 35,000 U. S. gallons of ground water in the 1,320 ft. of pipe treated as above, or about 140,000 gallons per mile.

THE NEW YORK STATE CANALS have been reported upon for the year 1896 by State Superintendent Aldridge. The total freight carried in the year amounted to 3,714,894 tons, divided as follows: Erie Canal, 2,742,438; Champlain, 802,510; Oswego, 57,245; Black River, 57,953; and the Cayuga and Seneca canal, 54,739. Of the total tonnage, 852,467 tons were products of the forest, 1,126,665 tons were agricultural products, 152,322 tons were manufactures, 270,603 tons were merchandise, and 1,032,837 tons of unclassified articles were carried. The gain in tonnage over the season of 1895 was 214,580 tons. The average price received by boatmen for the transport of wheat between Buffalo and New York was 3¾ cts. per bushel, the highest price in any year since 1890, except 1893. The report says that contracts for $3,500,000 have already been made out of the $9,000,000 especially appropriated for canal improvement, and work was commenced on Dec. 1. The Superintendent asks for $770,000 for the next fiscal year, for lock-tending and the ordinary repairs of the canal, which is the same amount that was appropriated for 1896.

THE 20-FOOT NAVIGABLE CHANNEL from Duluth to Buffalo, says Capt. Alexander McDougall, of Duluth, in the "Pioneer Press," is no nearer realization than it was in 1891, despite the work of the government in deepening the channels at St. Mary's River, the Lime Kiln Crossing, at the head of Lake Erie, and at other points. His contention is that since the government engineers ocmmenced these improvements, 10 years ago, the water has fallen 27 ins., as a direct result of cutting a deeper channel through the area of shallow water at the foot of Lake Huron and opposite the mouth of the St. Clair River. He says that, instead of having a deeper channel, we have simply succeeded in maintaining a depth previously utilized. Capt. McDougall is an advocate of the damming of the Niagara River as a means of raising the lake levels.

A NEW FLOATING DOCK FOR HAVANA, says a Madrid paper, has been ordered by the Spanish Government from Swan & Hunt, of Wallsend-on-Tyne, England. This dock is to be capable of lifting ironclads as well as ordinary vessels, and will be 450 ft. long, 82 ft. clear width, and will have 27½ ft. of water over the sill. Its lifting capacity is to be 10,000 tons, and the contract price is about $595,000, to be delivered in complete working order at Havana 11 months after signing the contract.

THE U. S. GUNBOAT ANNAPOLIS was launched at the Crescent shipyard, Elizabethport, N. J., on Dec. 23. It is one of six composite gunboats authorized by act of Congress, July 14, 1895. Three other vessels of this class, the Marietta, Vicksburg, and the Newport, have already been launched. The Annapolis measures 168 ft. on the water line, 200 ft. over all, 35 ft. beam; displacement, 1,000 tons. Babcock & Wilcox water-tube boilers, designed for a working pressure of 225 lbs., will be used. A single screw will be used, driven by a triple expansion engine with cylinders 15¼, 23½ and 36 ins. diameter and 30-in. stroke, developing 800 HP. at 150 revs. per minute. The boat will be barkentine rigged, carrying 11,500 sq. ft. of sail area. The hull of the vessel is built with a steel double bottom, planked with four inches of yellow pine planks to just above the water line. The planks are fastened by manganese bronze bolts, and are then covered by copper sheathing. The stem, sternpost, and rudder are all of bronze, so that no steel is exposed to the action of the sea water in contact with brass. She will thus be able to go on cruises of several years' duration on stations where there are no docks, as she will not have to be subject to frequent scraping of the bottom, as in the case of steel ships. Her large sail area and hull, shaped for easy handling under sail, will enable her to make most of her passages under sail, and to save coal, while her light draught will enable her to visit almost any port.

THE TORPEDO BOAT DESTROYER ENTRE RIOS, one of four boats recently built by Yarrow & Co., London, for the Argentine republic, has completed a voyage from London to Buenos Ayres, making a run of 3,700 miles from St. Vincent to Buenos Ayres without calling at any port. No other torpedo-boat destroyer has ever made a journey of this length without coaling.

A MILITARY TANDEM BICYCLE has been designed by an officer of our army and is illustrated and described in the "Journal of the U. S. Artillery" for November-December by Lieut. Wm. C. Davis, U. S. A. The chief feature of the device is the absence of sprocket and chain. The two riders sit directly over the front and rear wheels respectively, and the crank axles are geared up to the proper speed by a suitable mechanism in a gear-box on the axle. This is a simple epicycle gear, giving two revolutions of the wheel to one of the axle. The front or steering wheel is analogous to the "geared ordinary," and the two wheels are connected by a Humber frame. The gearing is in a dust-proof gear-box, and is oiled through the hollow axle; the frame may be hinged to make it more portable, and the weight of this bicycle need not exceed 40 lbs. for the roughest service. It is designed to carry two riders and 40 lbs. additional weight of equipment. The same article describes a number of bicycles designed for military use in the French and German armies; but all of these have chains.

LOW DUTIES IN THE TARIFF are favored by the Executive Committee of the National Association of Manufacturers. This body met in Philadelphia Dec. 18 and completed arrangements for the annual convention of the Association, which is to be held in Philadelphia Jan. 26, 27, and 28. The committee extends a cordial invitation to all manufacturers of the United States, whether members of the Association or not, to attend this convention; of course only members will be entitled to take part in the debate and the voting. The following resolution was adopted:

> "Resolved: That it is the sense of this Executive Committee that the tariff laws should be revised at the earliest possible moment, in order that uncertainty be removed, confidence restored, and business permitted to revive.
>
> "Rates of duties should be made as low as possible, consistent with the fair protection of our industries and the labor they employ."

WAGES AT THE CARNEGIE STEEL WORKS have been fixed to remain in force during 1897, the same as they were in 1895-6. The arrangement affects over 6,000 employes. The prices of pig iron and of finished products have fallen from 10 to 25% since the last scale was signed.

THE RENO INCLINED ELEVATOR has been put into experimental use at the New York end of the Brooklyn Bridge. It is only a small machine, intended to give a practical exhibition of its working, as the elevation attained is only 7 ft., so that passengers using it have still to walk up stairs the rest of the way

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PERSONALS.

Capt. John. A. Shannon has been elected City Engineer of Oskaloosa, Ia.

Mr. George V. Alsop has been elected City Engineer of Newport News, Va.

Mr. John P. Fiscus, President of the Dunlap Coal & Coke Co., died July 15.

Mr. F. A. Ruhe was recently elected a Water Commissioner of Allentown, Pa.

Mr. J. R. Sanford, civil engineer, of Cooperstown, Mich., died July 3, aged 91.

Mr. N. H. Brown, Train Master of the Texas Central R. R., has been appointed Superintendent of Transportation.

Mr. John N. Gamewell, the inventor of the Gamewell fire-alarm system, died in Hackensack, N. J., July 19, aged 74.

Col. F. S. Benson has been appointed Chief Engineer, and Mr. Thomas E. Byrne, Superintendent of Street Mains of the Brooklyn Union Gas Co., Brooklyn, N. Y.

Mr. J. P. Head, Foreman in Bridge and Building Department of the Texas Central R. R., has been appointed Road Master.

Mr. Thomas J. Cree, civil engineer on the Boston & Maine R. R., was married to Miss Etta B. Stebbins, of St. Johnsbury, Vt., on July 8.

Mr. Aurin Wood, an inventor and for many years head of the ironworking tool firm of Wood, Light & Co., died in Worcester, Mass., July 19, aged 84.

Mr. Hiram P. Randall, civil engineer, of Indianapolis, Ind., died July 14, aged 80. He was born in Boston, Mass., and for many years was Assessor of Indianapolis.

Mr. J. D. Higgins, Superintendent of the Rome Gas Light Co., Rome, N. Y., has resigned, and Mr. Stephen Parrish, of New York city, has been elected to succeed him.

Mr. Joseph McWilliams, Engineer and Superintendent of the Texas Central R. R., has resigned to accept service with another company, and the office has been abolished.

Mr. W. T. Gould, Resident Engineer of the Texas Central R. R., has been placed in charge of all engineering and construction, under the direction of the General Manager.

Mr. W. F. R. Mills has been appointed General Superintendent of the Denver, Lakewood & Golden R. R. to succeed Mr. J. B. McCormic, with headquarters at Denver, Colo.

Mr. L. D. Badger, Roadmaster of the Fitchburg R. R., with headquarters at Mechanicsville, N. Y., has resigned. Mr. Thos. Casey, of Waltham, Mass., is filling the position temporarily.

Mr. Bascom Sykes was elected City Surveyor of Portsmouth, Va., instead of City Engineer of Norfolk, Va., as stated in our issue of July 9. Mr. W. T. Brooke continues to be City Engineer of Norfolk.

Mr. W. F. Holloway has resigned his position as a member of the Board of Water-Works and Electric Light Trustees of Columbiana, O., and Mr. John E. Allen has been appointed to succeed him.

Mr. W. S. Frisbey, surveyor and civil engineer, representing Messrs. Geo. A. Ogle & Co., of Chicago, Ill., atlas publishers, was drowned while bathing in the Chippewa River, near Durand, Wis., July 14.

Mr. Joseph Downey, Commissioner of Buildings, of Chicago, Ill., has been appointed Commissioner of Public Works to succeed Mr. William D. Kent, whose resignation was noted in our issue of May 21.

Mr. J. W. Lovett, Superintendent of Bridges and Buildings of the Fifth Division of the Southern Ry., has been appointed to a similar position on the Georgia Midland & Gulf R. R., to succeed Mr. J. B. Glover.

Mr. J. S. Lemond, Roadmaster of the Fifth Division of the Southern Ry., has been appointed to succeed Mr. J. B. Glover as Roadmaster of the Georgia Midland & Gulf R. R., with headquarters at Columbus, Ga.

Mr. H. L. White, of the firm of White & Wetherbee, civil engineers of Brockton and Braintree, Mass., was married July 16 to Miss Grace W. Emery, of Wollaston, Mass. Mr. White is a member of the Boston Society of Civil Engineers.

Mr. H. M. Warren has been elected President and Treasurer, Mr. A. E. Jenks, Vice-President, and Mr. T. C. McNeely, Secretary and General Agent of the new Hendersonville & Brevard Ry., with headquarters at Hendersonville, N. C.

Mr. James M. Barr, General Superintendent of the Great Northern R. R., with headquarters at St. Paul, Minn., has been ordered to perform the duties of General Manager in place of Mr. Charles H. Warren. Mr. Barr will retain, however, his present title.

Mr. John Vanderslice, who has filled the position of Shop Superintendent of the Pottsville Bridge Co., Pottsville, Pa., for the past 5½ years, has accepted a similar position with the Carnegie Steel Co. and will have charge of the Keystone Bridge Shops.

Mr. Charles R. Barnes, City Electrician of Rochester, N. Y., having charge of the fire-alarm telegraph system and the electric lighting of the city, has been appointed Consulting Electrical Engineer and Electrical Expert to the Railroad Commission of New York State.

M. Jules Guichard, one of the associates of M. Ferdinand de Lesseps in the Suez Canal project, died recently aged 70. He was a member of the French Senate and after the resignation of Count de Lesseps was elected a Vice-President of the Suez Canal Co.

Mr. Clarence R. Neher, formerly Division Engineer of the New York & Pennsylvania R. R., has been appointed Resident Engineer of the Erie Canal at Rochester, N. Y., to succeed Mr. Alfred T. Jones, whose resignation was noted in our issue of July 2.

Capt. Smith S. Leach, Corps of Engineers, U. S. Army, has been relieved from duty at Burlington, Vt., where he has been in charge of the river and harbor improvements, and has been placed in charge of similar work at New London, Conn. Maj. William S. Stanton will succeed him at the former place.

Mr. Nehemiah S. Bean, the inventor and builder of the first steam fire engine ever constructed in New England, died at Manchester, N. H., July 20, aged 78. He was an ex-Chief Engineer of the Manchester fire department, and at one time was in charge of the locomotive works of the Essex Mfg. Co., of Lawrence, Mass.

Mr. John Brunner has resigned his position as Assistant to Chief Engineer of the Carnegie Steel Co., Pittsburg, Pa., and has been appointed by Mr. E. M. Bigelow, Director of Public Works of that city, to examine the suspension bridge across the Monongahela River and to prepare plans and specifications for the reconstruction of the same.

Mr. Ernest G. Barrow, Assistant City Engineer of Hamilton, Ont., has been appointed City Engineer to succeed Mr. William Haskins, whose death was announced in our last issue. Mr. Barrow, although only appointed Assistant City Engineer six years ago, has assisted Mr. Haskins for the past 20 years. He is a native of England and a member of the Canadian Society of Civil Engineers.

Mr. Oscar Lowinson, Jun. Am. Soc. C. E., 39 Cortlandt St., N. Y., is engaged on a series of tests on the transverse crushing strength of full-sized specimens of timber taken from buildings which are being strengthened. The object is to obtain such values as might be considered safe in determining the safety of existing structures, such as bridges and buildings where a question frequently arises as to the life of the same and the advisability of reconstructing.

Mr. Albert Stanwood, at one time a member of the Board of Water Commissioners of Boston, Mass., died at Waterford, Me., July 20, aged 72. His connection with the water department began more than 40 years ago. In 1856 he resigned as the Superintendent of the Eastern Division and became the Superintendent of the Western Division of the Department, resigning the latter position in 1873. From 1883 he served continuously as a member of the board.

Mr. Andrew Rinker, formerly City Engineer of Minneapolis, Minn., has accepted and entered upon the duties of Engineer and General Agent of the Great Falls Water-Power & Townsite Co., of Great Falls, Mont. This company owns the water-power created by the Missouri River for a distance of about 10 miles below the city of Great Falls, in which distance the river has a total fall of over 400 ft. and includes Black Eagle, Rainbow and Great Falls. (For a complete account of this plant see Eng. News for July 19, 1894.)

Mr. Henry I. Bliss, M. Am. Soc. C. E., of La Crosse, Wis., died recently aged 65. He was born in Hartford, Conn., and graduated frim Yale College in 1853 as a civil engineer. He assisted in surveying the New York & Boston Air Line R. R. and, after going west, was engaged in the survey of the Milwaukee & Fond du Lac R. R., the La Crosse & Prairie du Chien R. R., Southern Minnesota R. R. and several other preliminary and trial lines. In 1858 he located at La Crosse and formed a partnership with Mr. George Gregory and later with Mr. Wallace M. Spear. From 1860 to 1884 Mr. Bliss was City Engineer of La Crosse and was instrumental in having many valuable improvements made in the varions public works of the city.

Hon. Arthur Sewall, the Democratic nominee for Vice-President of the United States, is a prominent resident of Bath, Me., where he was born in 1835. He was trained as a carpenter's apprentice in his father's ship-yard, and in 1858 became associated with his brother, Mr. Edward Sewall, under the firm name of E. & A. Sewall, as successors to their father as shipbuilders. Upon the death of Mr. Edward Sewall, about 20 years later, the firm name was changed to A. Sewall & Co., the members being the sons and nephew of the senior partner. This firm has built several of the largest wooden ships afloat, one being the "Roanoke," a leader in tonnage of that class of the merchant marine. Three years ago, at great expense, the firm changed their wooden shipbuilding plant to one for steel shipbuilding, and soon after built the "Dirigo," the only steel merchant sailing vessel built in the United States. Mr. Sewall was the President of the Maine Central R. R. and a Director of the Boston & Maine R. R. for a number of years. He is President of the Maine Water Co., a concern that controls water plants in seven large towns and cities of Maine, and he is also a member of the Bath Board of Trade.

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ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Aug. 20. Kimball House, Atlanta, Ga.
SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.
Aug. 20 to 22. Annual meeting at Buffalo, N. Y.
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
Aug. 24. The annual meeting will be held in Buffalo, N. Y. Secy., Prof. F. W. Putnam, Cambridge, Mass.
AMERICAN MATHEMATICAL SOCIETY.
Aug. 31 to Sept. 1. Annual meeting at Buffalo N. Y.
ROADMASTERS' ASSOCIATION OF AMERICA.
Sept. 8. Annual meeting to be held at Niagara Falls, N. Y.
RAILWAY SIGNALLING CLUB.
Sept. 8. Secy., Geo. M. Bashford, The Rookery Bldg., Chicago.
AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 24 and 25. Annual convention will be held in St. Louis.

CIVIL ENGINEERS' CLUB OF CLEVELAND, O.—At the regular meeting held Tuesday evening, July 14, a paper was read by Mr. H. F. J. Porter, of Chicago. It was illustrated by lantern slides of photos and drawings and gave a description of the plant of the Bethlehem Iron Co., at South Bethlehem, Pa., and the company's processes in the production of large forgings.

F. A. Coburn, Secy.

WESTERN FOUNDRYMEN'S ASSOCIATION. — The regular meeting of the association was held at the Great Northern Hotel, Chicago, Ill., July 15, and a paper on "The Practical Value of the Various Metalloids in Cast Iron" was read by Maj. Malcolm McDowell. The author called attention to the lack of definite knowledge on this subject and proposed a series of careful tests and experiments to determine definitely if possible the action of metalloids in various proportions and combinations. After some discussion the association voted that a special committee be appointed to carry out a series of experiments of the character suggested by the paper. This committee consists of Mr. A. Sorge, Jr., Maj. Malcolm McDowell and Mr. John K. Mackenzie. It was announced that there would be no meeting of the association in August and that the September meeting would be held at Cleveland, O.

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CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work. Place.	See Eng. News.
July 23.	Asphalt paving, St. Paul, Minn.	July 16
July 23.	Steel bridges (2), Nashville, Tenn.	July 16
July 23.	Laying water mains (25 Sts.), Chicago	July 16
July 23.	Steel bridges (2), Worthington, Minn.	July 16
July 23.	Asphalt paving, New York, N. Y.	July 16
July 23.	Macadam road, Cromwell, Conn.	July 16
July 23.	Sewers, Brooklyn, N. Y.	July 16
July 23.	Laying 20-in. water main, Buffalo, N.Y.	July 16
July 23.	Light station, Portland, Ore.	July 2
July 23.	Township house, East St. Louis, Ill.	May 28
July 23.	Plans for bridge, Brooklyn, N. Y. Advertised, Eng. News, July 2 to 16.	July 2
July 24.	Repairs to breakwater, Burlington, Vt. Advertised, Eng. News, June 25 to July 16.	June 25
July 24.	Addition to mission, San Luis Obispo, Cal.	July 9
July 24.	Brick paving, Grand Forks, N. Dak.	July 16
July 24.	Asphalt and brick paving, Saginaw, Mich.	July 16
July 24.	Hire of dredging plant, Cincinnati, O.	July 16
July 24.	Asphalt paving, Bridgeport, Conn. Advertised, Eng. News, July 16 and 23.	July 16
July 24.	Laying water mains, Rochester, N. Y.	July 23
July 24.	Brick paving, etc., Boston, Mass.	July 23
July 24.	Cement sidewalks, etc., Rochester, N. Y.	July 23
July 25.	Steel chimney, Wasington, D. C.	July 23
July 25.	Pipe sewers, La Crosse, Wis.	July 23
July 25.	Water bonds ($8,000), Coraopolis, Pa.	July 23
July 25.	Pig lead (15 tons), Baltimore, Md.	July 23
July 25.	School building, Pittsburg, Pa.	July 16
July 25.	Bridges (2), Clearlake, S. Dak.	July 16
July 25.	Brick paving and grading, Des Moines, Ia.	July 16
July 25.	Iron and steel bridge, Cumming, Ga. Advertised, Engineering News, June 18.	June 18
July 25.	Brick paving, Racine, Wis. Advertised, Engineering News, July 2.	July 2
July 27.	Garbage disposal plant, Halifax, N. S. Advertised, Eng. News, July 2 to 23.	July 2
July 27.	Hall and chapel, Cleveland, O.	July 9
July 27.	Brick paving, Toledo, O.	July 16
July 27.	Brick sewers, Toledo, O.	July 16
July 27.	Building bonds, New York, N. Y.	July 23
July 27.	School building, etc., New York, N. Y.	July 23
July 27.	Granite block paving, Brooklyn, N. Y.	July 23
July 27.	Granite paving and park work, New York	July 23
July 27.	Paving, Bradford, Pa. Advertised, Engineering News, July 23.	July 23
July 27.	Pipe sewers, Des Moines, Ia.	July 23
July 27.	Laying water main, La Crosse, Wis.	July 23
July 27.	Laying water mains (24 streets), Chicago	July 23
July 27.	School building, etc., St. Louis, Mo.	July 23
July 27.	Macadam paving, Depew, N. Y.	July 23
July 27.	Paving, St. Paul, Minn.	July 23

July 27. Pipe sewers, Boston, Mass. .... July 23
July 28. Laying water pipes, 1 yr., Jersey City.... July 23
July 28. Electric light poles, Chicago, Ill......... July 23
July 28. Addition to vault, Brooklyn, N. Y......... July 23
July 28. Cement (3,500 bbls.), Brooklyn, N. Y....... July 23
July 28. Curbing, Chicago, Ill. .... July 23
July 28. Paving, etc., Annapolis, Md. .... July 23
July 28. Sewers, Troy, N. Y. .... July 23
July 28. Water bonds ($150,000), Tarrytown, N. Y.. July 23
July 28. Pumping engines, Pittsburg, Pa. .... July 23
July 28. Water bonds, Fosston, Minn. .... July 23
July 28. Granite monument, Clarion, Pa. .... July 16
July 28. Sewer system, Champaign, Ill. .... July 16
July 28. Hook and ladder truck, Brooklyn, N. Y... July 16
July 28. Macadam paving, Winnetka, Ill. .... July 16
Advertised, Eng. News, July 16 and 23.
July 28. Sewage disposal system, Mansfield, O. ... July 16
July 28. Railway track scale, Mansfield, O. .... July 16
July 28. Laying 48-in. water mains, Boston, Mass. July 9
Advertised, Eng. News, July 9 and 16.
July 28. Asphalt paving, New York, N. Y.......... July 9
July 29. County jail, Philipsburg, Mont. .... July 9
July 29. Sewer, Montreal, Que. .... July 16
July 29. Electric lighting, Peterboro, Ont. .... July 23
July 29. Concrete coping, East Marion, N. Y....... July 23
July 30. Plumbing, Barnstable, Mass. .... July 23
July 30. Macadam road (9 miles), Jamaica, N. Y... July 23
Advertised, Eng. News, July 16 and 23.
July 29. School building, Baltimore, Md........... July 23
July 29. Electric light plant, Cincinnati, O........ July 23
July 30. Pig lead (100 tons), Buffalo, N. Y......... July 23
July 30. Heating, plumbing, etc., Palmer, Mass. .. July 23
July 30. Levee work, Memphis, Tenn. .... July 23
July 30. Steam fire engines (5), Chicago, Ill. ...... July 23
July 30. Pumping engines, Petrolea, Ont. .... July 16
Advertised, Eng. News, July 16 and 23.
July 30. Electric light franchise, Goldsboro, N. C... July 16
Advertised, Eng. News, July 16 and 23.
July 30. Plans for city hall, Mt. Vernon, N. Y... July 16
July 30. Levee work, Memphis, Tenn. .... July 16
July 30. Light station at Smith Point, Va......... July 16
July 30. Freight elevator, Washington, D. C....... July 16
July 30. Street bonds ($13,135), Wellston, O....... July 16
July 30. Bridge substructures (3), Reading, Pa..... July 9
July 30. Mill building, Stonington, Conn. .... July 9
July 30. Brick paving, Fort Dodge, Ia............. June 25
July 31. St. ry franchise, Kingston, Jamaica, W. I. May 28
July 31. Public lighting, Utica, N. Y. .... July 2
July 31. Lake tunnels, Cleveland, O............... July 2
Advertised, Eng. News, July 2 to 23.
July 31. Bridge superstructures (3), Reading, Pa. .July 9
July 31. Brick or asphalt paving, Richmond, Ind... July 16
July 31. Paving, Athens, O. .... July 16
July 31. Police station, New York, N. Y........... July 23
July 31. Cribs (7), Detroit, Mich.................. July 23
Advertised, Eng. News, July 23 and 30.
July 31. Paving, grading, etc., Pittsburg, Pa....... July 23
July 31. Brick and pipe sewers, Pittsburg, Pa. .... July 23
July 31. Disinfecting plant, Pittsburg, Pa......... July 23
July 31. School building, Chicago, Ill. .... July 23
July 31. Granite block paving, Troy, N. Y. .... July 23
Aug. 1. Steam engine lathe, drill, Baltimore, Md... July 23
Aug. 1. Asphalt paving, etc., New York, N. Y. .... July 23
Aug. 1. Plans for school bldg., Hartford, Conn.... July 23
Aug. 1. Water-works, Silver Creek, N. Y......... July 23
Advertised, Eng. News, July 23 and 30.
Aug. 1. Reservoir, Tyrone, Pa. .... July 23
Advertised, Engineering News, July 23.
Aug. 1. Boiler, Ironton, O. .... July 23
Aug. 1. Sewers, Washington, D. C. .... July 16
Advertised, Engineering News, July 16.
Aug. 1. Interior of capitol building, Denver, Colo. July 16
Aug. 1. Water bonds, Painesville, O. .... July 9
Aug. 1. Telford paving, etc., Elizabeth, N. J..... July 9
Aug. 1. Plans for city hall, Binghamton, N. Y.... June 4
Aug. 1. County jail work, Minneapolis, Minn..... June 18
Aug. 3. Water bonds, Salmon, Idaho .... July 9
Aug. 3. Mortars, steel forgings, etc., Washington.. July 9
Aug. 3. Garbage franchise, Oakland, Cal. .... July 16
Aug. 3. Brick paving, etc., Crawfordsville, Ind.. July 16
Aug. 3. Brick paving, Toledo, O. .... July 16
Aug. 3. Paving bonds ($12,000), Archbold, O. ..... July 16
Aug. 3. Gun forgings, Washington, D. C.......... July 16
Aug. 3. Court house, Lexington, Tenn............ July 23
Aug. 3. Hospital buildings, etc. (3), New York.... July 23
Aug. 3. Brick paving, Galesburg, Ill. .... July 23
Aug. 3. Brick sewers (3,500 ft.), Providence, R.I... July 23
Advertised, Eng. News, July 23 and 30.
Aug. 3. Water-works, Doon, Ia. .... July 23
Advertised, Engineering News, July 23.
Aug. 3. Fire hose, Baltimore, Md. .... July 23
Aug. 3. Iron bridges (3), Buffalo, N. Y........... July 23
Aug. 3. Bridge bonds ($60,000), Paterson, N. J... July 23
Aug. 3. Bridge, San Jose, Cal. .... July 23
Aug. 3. Grading, Kansas City, Mo. .... July 23
Aug. 3. Street work, Delford, N. J. .... July 23
Advertised, Engineering News, July 23.
Aug. 4. Hospital buildings, Collins, N. Y......... July 23
Advertised, Engineering News, July 23.
Aug. 4. Sewers, Brooklyn, N. Y.................... July 23
Aug. 4. Pipe sewers (3,700 ft.), Monticello, Ill. .... July 23
Advertised, Engineering News, July 23.
Aug. 4. Water-works, Edwardsville, Ill. .... July 23
Aug. 4. Post office building, Madison, Wis. ...... July 16
Advertised, Eng. News, July 16 and 23.
Aug. 4. Sewer system, Champaign, Ill. .... July 16
Advertised, Eng. News, July 16 and 23.
Aug. 4. Steward's quarters, Fort Myer, Va. ..... July 9
Aug. 5. Wire fence, Washington, D. C. .... July 23
Aug. 5. Sewers, Cleveland, O. .... July 23
Aug. 5. Drainage system, Youngstown, N. Y...... July 23
Aug. 5. Macadam road, Washington, D. C. ...... July 23
Aug. 5. Observation towers, Washington, D. C. ... July 23
Aug. 6. Enlarging town hall, Hudson, O.......... July 23
Aug. 6. Bridge, Shelton, Wash. .... July 23
Aug. 6. Electric wiring, etc., Poughkeepsie, N.Y.. July 23
Aug. 6. Macadam road (2 miles,) Jamaica, N. Y.. July 23
Advertised, Eng. News, July 16 and 23.
Aug. 7. Postoffice building, Meridian, Miss. ...... July 23
Aug. 7. Addition school bldg., W. Liberty, W. Va. July 23
Aug. 7. Brick paving, Beloit, Wis................ July 23
Advertised, Eng. News, July 23 and 30.
Aug. 7. Macadam paving, Beloit, Wis............ July 23
Advertised, Eng. News, July 23 and 30.
Aug. 7. Water-works, Three Oaks, Mich. .... July 23
July 7. Stone and brush jetty, Sandusky, O. ..... July 23
Aug. 7. Brick paving, etc.. Fortress Monroe, Va... July 23
Aug. 8. Building bonds, Oregon City, Ore....... July 23
Aug. 8. Brick paving, Evanston, O. .... July 23
Aug. 10. Heating and power plant, Cincinnati, O. .. July 23
Aug. 10. Macadam road (5 m.), Long Branch, N.J. July 23
Advertised, Eng. News, July 23 and 30.
Aug. 10. Water supply, Missoula, Mont. .... July 23
Aug. 10. Pumping engine, Binghamton, N. Y. ..... July 16
Advertised, Eng. News, July 16 to Aug. 6.
Aug. 10. Macadam road, Long Branch, N. J. ...... July 16
Aug. 10. Rubber hose (5,000 ft.), Jeffersonville, Ind. July 16
Aug. 10. Police station, Carbondale, Pa........... July 23
Advertised, Eng. News, July 23 and 30.
Aug. 10. Electric light plant, Dawson, Ga. .... July 23
Aug. 10. Wire fence (18,000 ft.), Wakefield, Va... July 23
Advertised, Engineering News, July 30.
Aug. 11. Pipe sewers, Frankfort, Ind. .... July 23
Aug. 11. Pipe sewer, Frankfort, Ind. .... July 23
Aug. 11. Brick paving, etc., Cincinnati, O. .... July 16
Aug. 11. Passenger elevator, Newark, N. J. ...... July 16
Advertised, Eng. News, July 16 and 23.
Aug. 11. Sewers, Cincinnati, O. .... July 16
Aug. 12. Heat'g and vent'l'g, Fergus Falls, Minn. July 23
Aug. 12. College building, Cincinnati, O.......... July 23
Aug. 12. Timber bridge, Cleveland, O. .... July 23
Aug. 12. Asphalt paving, Cleveland, O............ July 23
Aug. 13. Stand-pipe, Bangor, Me. .... July 23
Advertised, Eng. News, July 16 to Aug. 6.
Aug. 13. Cement, sand and stone, Boston, Mass... July 16
Advertised, Eng. News, July 16 to 30.
Aug. 14. Brick paving, Arcola, Ill. .... July 16
Aug. 14. Store house, Willet's Point, N. Y........ July 23
Aug. 14. Smokestack foundat'n, etc., Cleveland, O.. July 23
Aug. 15. Ferryboat, Dartmouth, N. S. .... June 25
Aug. 15. Heating and plumbing, Plattsburg, N. Y. July 23
Aug. 15. Dike work in Hudson River, ... July 23
Advertised, Eng. News, July 23 to Aug. 6.
Aug. 17. Street railway franchise, Los Angeles, Cal. July 23
Aug. 17. Trent Canal work (14 m.), Ottawa, Ont... June 25
Aug. 17. Sewers, siphons, etc., Woonsocket, R. I... July 23
Advertised, Eng. News, July 23 and 30.
Aug. 20. Removing wrecks, St. Augustine, Fla.... July 23
Advertised, Eng. News, July 23 to Aug. 13.
Aug. 20. Dam, pier, etc., Cincinnati, O. .... July 16
Advertised, Eng. News, July 16 to Aug. 6.
Aug. 21. Postoffice building, Racine, Wis.......... July 23
Advertised, Eng. News, July 23 and 30.
Aug. 22. Engine house, Allegheny, Pa. .... July 23
Aug. 24. Sewer bonds ($11,000), Yeadon, Pa. ...... July 23
Sept. 2. Bridges (2), Chicago, Ill. .... July 16
Sept. 3. Plans for school bldg., Lancaster, Pa... July 23
Sept. 4. Pumping engines, St. Louis, Mo. .... May 14
Sept. 7. Wooden bridge, White Sulphur Spgs., Mont. July 23
Sept. 14. Battleships (3), Washington, D. C....... July 16
Sept. 18. Torpedo boats, Washington, D. C....... June 25
No date. Water-works, Walkerton, Ind. .... July 23
Advertised, Engineering News, July 23.
" Artesian well, Greenwood, S. Dak. ...... July 23
" Steel bridge, Urbana, Ill. .... July 23

RAILWAYS.

East of Chicago.

CHESTER & BECKET.—This company is being organized to construct a standard gage railway from the main line of the Boston & Albany, just east of the village of Chester, Mass., to the quarries of the Hudson & Chester Granite Co., in the town of Becket, a distance of 5¼ miles. The capital stock has all been subscribed. The directors include several of the directors of the Boston & Albany R. R. Co. The surveys are completed and construction will probably be begun in August. J. B. Haviland is the chief engineer, with offices in room 19 of the B. & A. depot at Boston, Mass. Frederick J. Collier, of Hudson, N. Y., is clerk of the company.

Southern.

ALABAMA & LITTLE RIVER.—This company has been incorporated to build a railway through Monroe and Baldwin counties, Ala. The capital stock is $50,000; the incorporators are J. T. McKervy, Edwin Lashbrook and Jos. S. Greenwood.

BEATTY LUMBER.—The officers of this company, Crow, W. Va., are quoted as saying that eleven miles of a tram road are now completed. The company expects to complete the entire railway by Oct. 1, 1896. The equipment has been purchased.

PRIVATE.—A. Knabb & Co., of Krug, Md., are said to be building a railway five miles in length.

SEBASTIAN & CINCINNATUS FARMS.—Gen. Mgr., W. W. Russell, Sebastian, Fla., writes us that the projected length is 10 miles, to connect Sebastian and "The Cincinnatus Farms." The work is all finished except laying the track; this will be done by Aug. 1. A. O. Russell, Cincinniati, O., is the owner.

Northwest.

ALLOWEZ BAY.—Press reports from Superior, Wis., state that Winston Bros. & Dear have been awarded the contract for building this railway. The entire distance to be constructed is said to be 100 miles.

CHICAGO & NORTHWESTERN.—Press dispatches state that 25 miles of the extension north of Gillett, Wis., have been graded and that 700 men are now at work. Ch. Engr., John E. Blunt, Chicago, Ill.

CAVALIER & WALHALLA.—The surveys for a railway between Cavalier and Walhalla, N. Dak., are stated to have been completed. The distance is 21 miles. The grading is to be commenced at once and it is expected to have it finished in two months.

Southwest.

DENVER, OKLAHOMA & GULF.—It is stated that negotiations are pending to build this railway from Henrietta, Tex., by way of Breckenridge, Brownwood and Fredericksburg, to connect with the San Antonio & Aransas Ry. at Comfort, Tex.

MEXICAN INDUSTRIAL.—This company is said to have been organized to build a railway around the city of Mexico for transfer purposes. It will connect the Mexican Central, the Inter-Oceanic and the Mexico, Cuernavaca & Pacific. Three miles have already been constructed, and to complete the road it is proposed to issue bonds.

MISSISSIPPI & LA FOURCHE.—It is reported that work has begun on this railway at Lauderdale, near Donaldsonville, La. It is expected to complete the road from Lauderdale to a point on the Bayou La Fourche, near Klatzville, La., a distance of 7½ miles. Rails have been purchased for the first miles. Pres., R. W. Edwards; Treas., C. Kline. The road will be a feeder of the Southern Pacific system.

MISSOURI CENTRAL.—A press dispatch from Chicago states that a company has been organized in that city for the purpose of building a line of railway in Missouri from Versailles to Lebanon, a distance of 60 miles, passing through several county seats and the great Ha-Ha Tonka Park and Springs. This road, it is stated, will open up the richest mining section of the state, which is rich with coal, lead and zinc ore. Farming and fruit lands are also located along the line of the proposed route.

SOUTHWESTERN, ARKANSAS & INDIAN TERRITRY.—Geo. R. Brown, Little Rock, Ark., is quoted as saying that contracts have been awarded to R. W. Dodson for extending this line from Antoine, Ark., to a new town to be known as Pike City, 15 miles distant. The road has been in operation between Smithton and Antoine for several years, and is now 20 miles in length. It is expected to reach the terminus about Sept. 1.

TEXAS CENTRAL.—Wm. F. Gould, Resident Engr., Waco, Tex., writes us that preliminary surveys have been completed from Albany, Tex., westward 35 miles. Nothing further will be done until fall. Pres., H. K. McHaig.

WHITE RIVER VALLEY & WESTERN.—This company has been incorporated to build a railway 250 miles in length, from Stilwell, Ind. Ter., to Bald Knob, Ark. The incorporators are: George A. Hagerty, of Fayetteville, Ark.; G. H. Candel, Lowell, Mass.; Elgar Gurnsey, and eGorge P. Bassett, of Cincinnati, O. The route lies through the Arkansas fruit belt.

Rocky Mountain and Pacific.

ASTORIA & COLUMBIA RIVER.—Press reports state that the contract for building this railway from Astoria to Goble, Ore., has been awarded to Honeyman, De Hart & Co., of Portland, Ore., at about $500,000, and bonds for the performance of the work, in the sum of $100,000, have been furnished. This work will probably furnish employment for from 700 to 1,000 men for a year.

GULF, RIO GRANDE & PACIFIC.—This company has been incorporated at Santa Fe, N. Mex., to aquire contracts and concessions from the Mexican government for the construction, equipment and management of railway and telegraph lines in Mexico. The incorporators are. H. L. Warren, Albuquerque, New Mex.; William Hutchison, B. Y. McKeyes, Deming, New Mex.

SILVERTON NORTHERN.—It is stated that this railway has recently been completed for six miles north of Silverton, Colo., through the mountains of San Juan county. The present terminus is at Eureka, but it is proposed to extend the road to Mineral Point, five miles further. The line has been built by Otto Mears and reaches a gold producing district. It is expected that it will be finished to Mineral Point by October. The estimated cost of the road is placed at $600,000. Pres., Fred Walson, Denver, Colo.

STREET AND ELECTRIC RAILWAYS.

RUTLAND, VT.—It is reported that the Rutland St. Ry. Co. will soon extend its lines. Pres., J. W. Cramton; Treas., N. V. Chaffee; Supt., M. McKeogh..

SPRINGFIELD, VT. —Press reports state that work has begun on the Springfield Electric Ry. It will be built from Springfield to Charleston, N. H., a distance of eight miles. W. H. Slack, G. F. Leland and E. B. Flinn are interested.

PROVIDENCE, R. I.—The Union Ry. Co. has been granted permission to extend its lines. The company has 90 miles of railway in operation. Gen. Man., A. T. Potter; Ch. Engr., G. C. Tingley.

BRENTWOOD, N. Y.—It is reported that the state will build an electric railway to connect the asylums at Kings Park and Central Islip.

SYRACUSE, N. Y.—The Onondaga Lake R. R. Co. has been incorporated to construct a double-track street surface electric railway about seven miles in length, from Clinton square to the resort known as Long Branch, Onondaga Lake; capital stock, $250,000; directors, John S. Kaufmann, W. R. Smith, Bruce S. Aldrich, Edward A. Powell, Jas. M. Belden, P. R. Quinlan, W. H. Gallup.

LANGHORNE, PA.—Engineers have completed the survey for an electric railway between Langhorne and Frankford. The line is intended to accommodate passengers to Neshaminy.

PITTSBURG, PA.—It is said that the West End Street Car Co. will build an electric railway from the West End in Pittsburg, to Monongahela. It has purchased the franchise of the Little Saw Mill Run R.R. Co., and has secured the right of way through nearly all of the property along the route. A force of 200 men is at work grading the road at West Liberty. The road will be known as the West Side Belt Line R. R., and will extend from the Pittsburg terminals of the Little Saw Mill Run R.R., up the Saw Mill Run valley through Shalersville, West Liberty, Fairhaven, Castle Shannon, Curry Station, Finleyville and thence up the river to Monongahela. A branch will be built from Curry to Duquesne, a distance of ten miles. The length of the main line is 27 miles.

CHARLESTON, S. C.—Therrell & Co. are quoted as saying that they will make a proposition to the owners of the Charleston St. Ry. to adopt electricity. In case the proposition is accepted, work will begin at once upon the reconstruction of the Charleston system.

CINCINNATI, O.—It is reported that the Consolidated St. Ry. Co. is distributing rails for extensive improvements and that bids will soon be asked for doing the work.

CLEVELAND, O.—The Cleveland "News" states that the Cleveland Electric Ry. Co. has made application for permission to extend its track to Cedar Glens and Euclid Heights. Right of way has already been obtained. Pres., H. E. Andrews; Supt., H. J. Davies.

PORTSMOUTH, O.—The Portsmouth St. Ry. & Light Co. is reported to have made appropriations for extensions and new machinery to cost $12,000 to $15,000. Pres., F. L. Smith; Supt., S. P. Baird.

ZANESVILLE, O.—A press report states that the Zanesville St. Ry. Co. has doubled its capital stock, making it $500,000. The line will be extended and new equipment added. Pres., A. L. Conger; Supt., A. H. Johnson.

ST. JOSEPH, MICH.—W. Worth Bean, Pres., writes us that the St. Joseph & Benton Harbor St. Ry. Co. is projecting an electric railway, two miles long, to be completed by July 1, 1897.

MADISON, WIS.—A press dispatch states that Wingra Park citizens have raised $4,000 of the $7,000 required to extend the Madison Electric St. Ry. from its terminus on University Ave. to Harrison St., while the University Heights citizens have pledges for $3,000 of the $4,500 needed to secure an extension to that suburb. Pres., W. Lamprecht.

RACINE, WIS.—It is stated that the Belle City St. Ry. Co. has accepted the additional franchise upon the streets of Racine. Pres., J. I. Case.

MASON CITY, IA.—O. E. Stanley, Asst. Cy. Engr., writes us that the city has granted a franchise for an electric railway to W. E. Brice and L. H. Ong, Tama City, Ia., and that a local company will be organized to push the project. The city of Clear Lake has also granted a franchise to the same parties and efforts will be made to build the road between this city and Clear Lake, a distance of about eight miles. It is hoped to complete it this summer.

BEATRICE, NEB.—A press dispatch states that the Beatrice Electric Co. will make some improvements in the way of straightening and relaying its tracks. The company now owns 7½ miles of track.

KANSAS CITY, MO.—It is said that the Missouri, Kansas & Texas Trust Co. is backing a scheme to connect Kansas City, Leavenworth, Kan., Atchison, Kan., and St. Joseph, Mo., by an electric road.

OGDEN, UTAH.—W. H. Rowe, as receiver, has sold the track, rights of way, franchises and other properties of the Ogden Street Ry. Co. to Daniel Van Dam, whose bid was in the name of Roland R. Conklin, of New York city. The amount paid was $350,000. It is expected that extensive improvements will be made. The tracks are 12 miles long.

UNIVERSITY PARK, ORE.—Isaac Leskard writes us that he is working on some improvements in the Barnes Heights Electric Ry., and that the Portland General Electric Co. may aid in the work of extending this line to Hillsboro, Ore., a distance of 18 miles, east of Portland.

WATERLOO, ORE.—An electric railway may be built from here to Lebanon, Ore. Dr. J. L. Hill, Albany, Ore., is interested.

LOS ANGELES, CAL.—A press dispatch states that the council will receive bids until 11 a. m. Aug. 17 for a franchise for the construction and operation of a street railway along certain streets. C. A. Luckenbach, Cy. Clk.

SAN FRANCISCO, CAL.—The Geary St. Park & Ocean Ry. Co., has applied for a franchise to build an electric railway upon certain streets.

SANTA ROSA, CAL.—An application is stated to have been made for a franchise for an electric railway between Sonora and Santa Rosa. From Santa Rosa the line will extend to Melitta, thence to Kenwood, thence to Glen Ellen, from there to Agua Caliente and from Agua Caliente to Sonora.

ELECTRIC LIGHT AND POWER.

HARDWICK, VT.—A committee has been appointed to make a contract with Mr. Almon to furnish this place with electricity. It was instructed to give $5.50 each for the street lights per year. The village will have 100 street lights thus making a cost for the street lighting $550 per year, $3.50 for 16-c. p. lights for house lights and $4 per year for store lights of 30 c. p. The power at George Smilie's mill will be utilized for the plant. The street lights will be ready for operation in October or November.

CHICOPEE, MASS.—The council has appropriated $6,000 for extending the electric light plant.

WESTERLY, R. I.—An election will probably be held to vote on the question of a municipal electric light plant.

BUFFALO, N. Y.—Wm. B. Rankine, Secy. Niagara Falls Power Co., this week made the statement that the contract for the transmission pole-line to this city will be let within a few days. The company will deliver 1,000 HP. in this city Nov. 1.

LITTLE FALLS, N. Y.—Jesse Peterson, Pres. Indurated Fibre Co., Lockport, N. Y., proposes to erect an electric light plant in this city.

WADDINGTON, N. Y.—An electric light plant is contemplated. R. S. Dalzell, Village Clk.

ASBURY PARK, N. J.—The Atlantic Coast Electric Co. proposes putting in a new plant to cost about $500,000. Isaac C. Kennedy, of Asbury Park, is the counsel.

STOCKTON, N. J.—Young & Bailey, of Philadelphia, Pa., are preparing plans for an electric light plant of 100-arc light capacity to be erected at North Cramer Hill.

WEST NEWTON, PA.—The construction of an electric light plant at this place is proposed.

MANCHESTER, VA.—The council has appointed a committee to investigate the advisability of erecting a city plant.

CONCORD, N. C.—The Concord Electric Light Co. finds it necessary to increase the capacity of its plant. New boilers, etc., will be added at once.

ANDERSON, S. C.—It is reported that arrangements are being made for the immediate construction of a power plant at Poilman Shoals, 10 miles from this place, for the Anderson Light & Power Co.; estimated cost, $200,000. W. C. Whitner, Gen. Mgr., Anderson.

DAWSON, GA.—Bids are asked until Aug. 10 for an electric light plant. Consult. Engr., Frank Lederle, 608 Gould Bldg., Atlanta, Ga.; Dr. J. G. Dean, Chn. Com.

LAFAYETTE, LA.—The council has awarded to James Ferguson, of New Orleans, the contract for constructing an electric light plant and water-works, for which $36,000 in bonds will be issued.

BLANCHESTER, O.—G. L. McKibben, Cy. Engr., of Van Wert, O., has been engaged to prepare plans and specifications for a water and electric light plant, and to superintend the erection.

CINCINNATI, O.—Bids are asked until July 29 for furnishing the House of Refuse with one 75-HP. engine, medium speed, to drive dynamo; one 45-K.-W. multipolar dynamo, 110-volt constant potential, slow speed; one set of accumulators, 300 ampere hones 110 volts, and one 10-HP. 110-volt constant potential motor, wire work and appliances. James Allison, Secy. Bd. Directors.

IONIA, MICH.—The county surveyor has completed surveys for a dam for the Ionia Electric Co.

PORTLAND, MICH.—The following bids were received July 7 for erecting an electric light plant; Engrs., H. H. Humphrey, 22 Bennett Bldg., Detroit, Mich.; R. W. Alton Pres. of Village:

Fort Wayne (Ind.) Electric Corporation. accepted	$6,495
General Electric Co, Chicago, Ill	6,620
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.	6,700

THREE OAKS, MICH.—F. B. Hinchman, Three Oaks, writes us that this place will soon vote on the question of putting in a plant. Plans and specifications have been prepared by Geo. C. Morgan, of Chicago.

CHICAGO, ILL.—Bids are asked until July 28 for furnishing 50 electric lamp poles for Garfield Park. Engr., Foree Bain, 1657 Monadnock Bldg.; Harvey T. Weeks, Pres.

DENVER, COLO.—Press reports state that the east side power house of the Denver Consolidated Electric Works was destroyed by fire July 12, causing the loss of 18 engines and 17 generators of the Westinghouse pattern, worth about $130,000.

GREAT FALLS, MONT.—The Great Falls Water-Power & Townsite Co., which is a large owner of lots and lands in this city, and plotted in the original townsite, is also the owner of the water power created by the Missouri River for a distance of about ten miles below the city, in which distance it has a total fall of over 400 ft., and includes the Black Eagle, Rainbow and Great Falls. The former of which is now developed to the extent of 40 ft. head, and capable of furnishing at the average flow of the river about 30,000 gross HP. A large portion of this power is now being used by the Boston & Montana Copper Smelting Co., the Street Ry. & Electric Light & Power Co., Royal Milling Co. and other industries. Andrew Rinker, Engr., and Gen. Agent, Great Falls; Samuel Hill, Pres.; Paris Gibson, Vice-Pres.; Wm. W. Conner, Secy. and Treas.

PETERBORO, ONT.—Bids are asked until July 29 for lighting the streets with 80 arc lights, according to reports. S. R. Armstrong, Town Clk.

NEW COMPANIES.—Dubinski Electric Co., San Antonio, Tex.; $10,000; Benjamin Dubinski.

Farmington Electric Light Co., Farmington, Me.; $10,000; Pres., E. S. Dingley, of Farmington; Treas., J. P. Flint, of Farmington.

Winn Water & Power Co., Bangor, Me,; $100,000; Pres., N. M. Jones; Treas., J. E. Clark; Clk., M. F. Scott, Contract Power Co., Hamilton, Ont.; $99,000; J. M. Gibson, James Dixon, John Moodie, John W. Sutherland, John Patterson, E. D. Patterson, all of Hamilton.

Consumers' Electric Light & Power Co., Newark, N. J.; $300,000, with $5,000 paid in; Benj. Atha, Albert O. Headley, Edward L. Conklin, of Newark, and Thos. C. Barr, of Orange, N. J.

Montezuma Electric Co., Illinois; $2,400, with all paid in; Arnold Beck, Sr., Arnold Beck, Jr., Ernest P. Olshausen, Henrietta Plate.

BRIDGES.

SOUTH PARIS, ME.—A committee has reported on plans and estimates for a new bridge at this place.

WOONSOCKET, R. I.—The council has decided to rebuild the wooden bridge over the Blackstone River by the erection of a steel structure.

TORRINGTON, CONN.—The construction of a bridge to cost about $5,000 is proposed at Main St., according to reports.

BINGHAMTON, N. Y.—At an election held July 14 the proposition to appropriate $60,000 for erecting a bridge at Ferry St. was defeated. S. E. Monroe, Cy. Engr.

BROOKLYN, N. Y.—The East River Bridge Commission has adopted the plans for the proposed bridge between this city and New York. Ch. Engr., L. L. Buck.

BUFFALO, N. Y.—Bids are asked until Aug. 3 for constructing three iron bridges on masonry substructures over Scajaquada Creek. R. G. Parsons, Secy. Dept. Pub. Wks.

NIAGARA FALLS, N. Y.—At a recent election it is reported that the citizens voted to build a bridge over the railway tracks at Pierce St.; estimated cost, $15,000. W. W. Read, Cy. Engr.

SLOANSVILLE, N. Y.—Chas. Wright, Central Bridge, N. Y., informs us that it is proposed to erect a one-span bridge 280 ft. long at a cost of $10,000. No contracts have yet been awarded.

PATERSON, N. J.—Bids are asked until Aug. 3 for the purchase of $60,000 of bridge bonds. Geo. F. Feuerstein, Chn.

EASTON, PA.—It is reported that A. J. Cooper, Easton, has been engaged to prepare plans for an iron bridge in Northampton county.

PHILADELPHIA, PA.—It is proposed to build a new bridge at Gray's Ferry to cost $550,000. Of this amount the Pennsylvania R. R. Co. will contribute $75,000, under the condition that the Union Traction Co. contributes a like sum.

PITTSBURG, PA.—John Brunner has been engaged to prepare plans for reconstructing the suspension bridge over the Monongahela River. E. M. Bigelow, Dir. Pub. Wks.——The Oakland bridge over Three Mile Run at Halket St. was recently destroyed by heavy rains, causing a loss of about $2,500.

GASTONIA, N. C.—The commissioners of Gaston county at the monthly meeting last week, decided to build an iron bridge across the South Fork of the Catawba River, near McAdensville, N. C. The bridge is to be 350 ft. long, with wooden approaches 100 ft. and 25 ft. Bids will be received for the next two weeks for building the same.

ROANOKE RAPIDS, N. C.—The new bridge across the Roanoke River at this town, recently built by the Roanoke Rapids Power Co., was washed away and totally destroyed last week by the rise in the Roanoke River, caused by the unusually heavy rains. It was 275 ft. long. It will be replaced at once by an iron and steel structure of the same size, but at a higher elevation. Address Roanoke Rapids Power Co., Roanoke Rapids, N. C. This is a new manufacturing town and is located five miles above Weldon, N. C.

NORTH CAROLINA.—Owing to the heavy rains and consequently swollen streams, many of them rising higher than has been known in 50 years, especially the Roanoke and Cape Fear and other rivers and streams in Eastern North Carolina, a number of bridges and trestles owned by the Carolina Central, Wilmington & Weldon and other railway companies were washed away, or so badly damaged as to make rebuilding necessary. Our correspondent writes that bridge companies could afford to send representatives to that section to ascertain at once the exact location of several which must be replaced.

CLEVELAND, O.—Bids are asked until Aug. 12 for constructing a timber Howe truss bridge over the railway tracks at Seneca St., and also to construct a 400-ft. inclined timber roadway. D. E. Wright, Dir. Pub. Wks.

COLUMBUS, O.—W. H. Halliday, County Audr., informs us that on account of a decision by the supreme court it was decided not to award the contract for building the proposed 144-ft. steel bridge over Big Walnut Creek, bids for which were asked until July 16.

TROY, O.—E. E. Pearson, County Audr., informs us that the following bids were received July 17 for constructing a 140-ft. iron bridge over Panther Creek, noted in our issue of July 2:

Variety Iron Works Co., Cleveland, O.	$3,800
Oregonia Bridge Co., Oregonia, O.	3,850
Canton Bridge Co., Canton, O.	3,875
H. H. Barker, Br. Conctr., Mount Vernon, O.	4,000
Bellefontaine Bridge & Iron Co., Bellefontaine, O.	3,821
Cincinnati Bridge Co., Cincinnati, O.	$3,995 and 4,230
Indiana Bridge Co., Muncie, Ind.	4,070
Groton Bridge & Mfg. Co., Groton, N. Y.	$3,875 and 3,995
Penn Bridge Co., Beaver Falls, Pa.	4,100 and 4,000
Brackett Bridge Co., Cincinnati, O.	$3,795 and 3,810
Toledo Bridge Co., Toledo, O.	3,962
Champion Bridge Co., Wilmington, O.	3,795
Youngstown Bridge Co., Youngstown, O.	$3,920 and 3,680
Iron Substructure Co., Columbus, O.	4,260
King Bridge Co., Cleveland, O.	3,860 and 3,890
Hamilton Construction & Tool Co., Hamilton, O.	3 926
*Massillon Bridge Co., Massillon, O.	3,000 to 3,575

*Awarded contract at $3,700.

JOLIET, ILL.—Press reports state that Troy, Ill., has petitioned the county commissioners for a new bridge over the Du Page River, about a mile north of the village, to cost $4,500, and that Jackson asks for a structure over Jackson Creek, to cost $2,500.

PROPHETSTOWN, ILL.—C. A. Wetherbee, of Sterling, Ill.; D. C. Waite, of Ustick, and Wm. Beswick, of Clyde, Ill., have been appointed a commission to investigate the advisability of building a bridge over Coon Creek, at this place, to cost $1,500. A. R. Hendricks, Chn. Comn., Morrison, Ill.

MILWAUKEE, WIS.—Bids will be asked this week for constructing two handsome steel arch bridges over two ravines at Lake Park, on the shore of Lake Michigan. Each bridge will have an 87-ft. span between abutments, and a roadway 26 ft. wide and two sidewalks, each 9 ft. wide; estimated cost, $40,000. For the present it is the intention of the park commissioners to start work with the masonry and put in the steel work later in the fall. Consult. Engr., Oscar Sanne, Room 69 Colby & Abbot Building, Milwaukee.

URBANA, ILL.—At the court house the commissioners of Crittenden township will let the contract for a 70-ft. steel highway bridge on masonry. Prof. Ira O. Baker, Champaign, Ill., Engr.

MENASHA, WIS.—W. W. Reed, Cy. Engr., is reported to have been directed to prepare plans for a pile bridge. S. S. Little, Cy. Clk.

WHITE SULPHUR SPRINGS, MONT.—Bids are asked until Sept. 7 for constructing a three-span wooden bridge in the Musselshell Valley, according to reports. C. W. Hall, County Clk.

SHELTON, WASH.—Bids are asked until Aug. 6 for constructing a bridge over the west branch of the Satsop River. Thos. McCarthy, County Audr., Shelton.

STEVENSON, WASH.—The following bids were received July 6 for an 80-ft. 2-span timber Howe truss bridge, with 60-ft. approaches, over Wind River. C. G. Green, Clk.:

The Rowe Lumber & Mfg. Co., Lyle, Wash.	$899
J. P. Gillette, Chenoweth, Wash.	800
Gordon Wilson, Carson, Wash.	650
R. G. Connor, Cascade Locks, Ore.	530

DALLAS, ORE.—The clerk has been directed to advertise for bids for constructing a bridge over the Yamhill River on the Lee Rowell Road, according to reports.

SALEM, ORE.—The county court has decided to ask for bids for constructing a pile bridge near Champolg. The structure will have a 70-ft. span and 270 ft. of approaches.

PLACERVILLE, CAL. — Messrs. Lachman and Porter have been appointed by the supervisors as a committee to meet the Sacramento supervisors and see what can be done in the matter of a bridge in the southern part of the county.

SACRAMENTO, CAL.—The county surveyor has recommended the construction of a 2-span steel bridge, 258 ft. long and the extension of a trestle from 596 ft. to 1,100 ft.

SAN JOSE, CAL.—Bids are asked until Aug. 3 for constructing a 60-ft. bridge over Stevens Creek, according to reports. H. A. Pfister, County Clk.

BUILDINGS

BARNSTABLE, MASS.—Bids are asked until July 30 for additions to the plumbing at the county buildings in this town. Engr., Ernest W. Bowditch, 60 Devonshire St., Boston.

WORCESTER, MASS.—Norwood & Morton, of Worcester, have been awarded the contract, at $27,745 for erecting an eight-room school building on Lamartine St., and Rankin & Woodside have the contract for a four-room school building to cost $19,795. Archs., Earle & Fisher, 592 Main St., Worcester.

PALMER, MASS.—Bids are asked until July 30 for the heating, plumbing, electric lighting, etc., for the Massachusetts Hospital for Epileptics. Archs., Rand & Taylor and Kendall & Stevens, 87 Milk St., Boston, Mass.; Wm. N. Bullard, Chn.

HARTFORD, CONN.—Plans are asked until Aug. 1 for a brick school building at Market and Morgan Sts. Address Chas. L. Ames, 661 Main St., or Geo. C. Bailey. Chn.

BROOKLYN, N. Y.—The heirs of E. B. R. King propose to erect a 17-story building at 205 to 213 Montague St.

BUFFALO, N. Y.—The board of public works has been directed by the council to prepare plans and specifications and advertise for bids for a 3-story brick fire-engine house at Lovejoy and Gold Sts.——Morris Grant Holmes has prepared plans for a handsome brick and stone church to be built for the Methodist congregation at Depew, N. Y. It will cost $55,000.——Carl Schmill, Morgan Bldg., has prepared plans for a brick and stone convent to be built for the Polish church at Cheektowaga; estimated cost, $40,000.

COLLINS, N. Y.—Bids are asked until Aug. 4 for constructing an administration building, etc., at the Collins State Homeopathic Hospital, as stated in our advertising columns. August C. Esenwein, Arch., 707 Mooney Bldg., Buffalo; Fred J. Blackmore, Treas., Ellicott Square, Buffalo.

NEW ROCHELLE, N. Y.—It is stated that an election will be held Aug. 4 to vote on the question of issuing $50,000 in bonds for erecting a new school building.

NEW YORK, N. Y.—Bids are asked until July 27 for making alterations and improvements to about 20 school buildings and also for erecting a structure at 91st St. and First Ave., J. J. Little, Chn., 146 Grand St.——Bids are asked by the comptroller until July 27 for the purchase of $400,000 of 3½% bonds for making improvements on school buildings and on the new city college.——Bids are asked until July 31 for erecting a new police station at 133 to 137 Charles St.; surety, $30,000. Wm. H. Kipp, Ch. Clk., 300 Mulberry St.——Bids are asked until Aug. 3 for erecting three buildings for the Manhattan state hospital, and also for the steam heating and ventilating apparatus for these buildings. Arch., I. G. Perry, Albany, and Binghamton, N. Y.; Dr. A. E. Macdonald, Gen. Supt.; John M'Anterney, Acting Pres. Bd. Mgrs., 1 Madison Ave.——John Jacob Astor proposes to erect a 12-story office building at Duane St. and Broadway, and an apartment house at 56th St. and Fifth Ave.——Contracts have been let for the construction of the new passenger station of the New York Central, between 124th and 126th Sts., in Fourth Ave., and work will begin at once under the direction of Col. Walter Katte, Chief Engr. Inasmuch as the plans provide for a station under the elevated structure, instead of at the side, it will be necessary to sink the grade of a section of the elevated structure about 8 ins. in order to give room for the platform. This part of the work will consume considerable time, thereby causing further delay in the running of trains over the new steel viaduct and the four-track drawbridge. The date of the completion of the station is indefinite.——Plans have been filed by the New York Savings Bank for a 4-story brick bank building at Eighth Ave. and 14th St., to cost $220,000.——Wm. A. Clark, Pres. United Verde Copper Co., 62 William St., New York, is reported as about to erect a mausoleum in Woodlawn Cemetery, at a cost of $100,000. Archs., Lord & Hewlett, 123 East 23d St.

PLATTSBURG, N. Y.—Bids are asked until Aug. 15 for the heating, plumbing, etc., for the barracks. Capt. Geo. E. Pond, Asst. Qr. M., Plattsburg.

POUGHKEEPSIE, N. Y.—Bids are asked until Aug. 6 for electric wiring, etc., for two wings of the Hudson River state hospital. I. G. Perry, State Arch., Albany and Binghamton, N. Y.; Amasa J. Parker, Pres. Bd. Trustees.

ROCHESTER, N. Y.—A. J. Warner, Powers Bldg., has completed plans for a new cathedral for St. Patrick's, on Vought St.; estimated cost, $60,000.

YONKERS, N. Y.—The plans for a new city hall, prepared by Edwin A. Forsyth, have been accepted by the council.

WILLET'S POINT, N. Y.—Bids are asked until Aug. 14 for constructing a storehouse. Lieut. E. W. Van C. Lucas, Q. M., Willet's Point.

ALLEGHENY, PA.—Bids are asked by the controller until Aug. 22 for erecting an engine house at Branch and Forest Sts., to cost about $30,000. Arch., Joseph Stilberg, 204 Fifth Ave., Pittsburg, Pa.

BEAVER FALLS, PA.—It is reported that S. E. Gallagher, of Beaver Falls, of the firm of Cooper & Gallagher, now in the liquor business, has secured an option on two corner lots on Seventh Ave. and 13th St. After the deal is consummated a fine hotel will be erected.

CARBONDALE, PA.—Bids are asked until Aug. 10 for furnishing the material and remodeling the city police station, as stated in our advertising columns. T. L. McMillan, Cy. Clk.

ERIE, PA.—The council has decided to compel owners of buildings over three stories high, excepting residences, to put up fire-escapes.

LANCASTER, PA.—Plans are asked by the school board until Sept. 3 for an 8-room school building at Mulberry St. and Marion Alley.

PITTSBURG, PA.—The Consolidated St. Ry. Co. proposes to build a new car barn to hold several hundred cars.——Plans have been completed for a residence, two large shelter houses and two other buildings for Schenley Park. E. M. Bigelow, Dir. Pub. Wks.; Wm. Falconer, Park Supt.——The Masons have appointed G. W. Morris, W. G. Foster, of Pittsburg, and Chas. H. Bronson, Audr. Pittsburg & Lake Erie R. R. Co., a committee to consider the advisability of constructing a masonic university.——S. T. McClarren, Westinghouse Bldg., has completed plans for a building for State Bank of Pittsburg.

SALEM, PA.—It is stated that the board of education has awarded the contract for erecting the new school buildings to W. C. Wilkins, of Pittsburg, Pa., at $55,000.

SISTERSVILLE, PA.—F. H. De Arment, 708 Penn Ave., Pittsburg, Pa., has prepared plans for a bank building.

MONONGAHELA CITY, PA.—A new school building will be built. Bartberge & East, Westinghouse Bldg., Pittsburg, Pa., are preparing plans.

BALTIMORE, MD.—Bids are asked until July 29 for erecting a school building at Carey and Chappell Sts. Benj. B. Owens, Inspector of Bldgs.

BALTIMORE, MD.—The following bids were received July 15 by B. B. Owens, Inspector of Bldgs., for erecting a school building at Linden Ave. and Koenig St: Walter Bros., $47,565; John Stack & Sons, $49,184; Morrow Bros., $47,234; Fred. Decker & Sons, $46,020; Thos. P. Johns, $47,400; John Hughes, Jr., $45,574.50; C. Sheehan & Sons, $48,215. New bids will be asked, as these were considered too high.

WASHINGTON, D. C.—Bids are asked until Aug. 5 for constructing a masonry observation tower on the Antietam battlefield, Va. Maj. Geo. W. Davis, Pres. Bd., War Records Office, Washington.

RICHMOND, VA.—A committee has been appointed to consider the question of a new city jail.

WEST LIBERTY, W. VA.—Bids are asked until Aug. 7 for erecting additions to the normal school building at this place. Archs., Frank E. and Henry B. Davis, 1 Fayette St., Baltimore, Md.; Virgil A. Lewis, Pres. Trustees, Charleston, W. Va.

WHEELING, W. VA.—It is reported that the Baltimore & Ohio R. R. Co. is considering plans for a new passenger station in this city. Ch. Engr., W. T. Manning, Baltimore, Md.

ASHEVILLE, N. C.—The county commissioners are about to select a site for a new county court house.

ATLANTA, GA.—Grant Wilkins, Atlanta, has about completed plans for a new county jail to have 225 cells and to cost $175,000.

BIRMINGHAM, ALA.—E. W. Walpoole, of Talladega, Ala., has had plans prepared by him accepted for a girls' industrial school; estimated cost, $50,000. T. S. Plowman, Chn. Com., of Talladega.

MERIDIAN, MISS.—Bids are asked until Aug. 7 for erecting a post office building in this city. Wm. Martin Aiken, Supervising Arch., Washington.

LEXINGTON, TENN.—Bids are asked until Aug. 3 for erecting a court house in this city. Arch., R. H. Hunt, Keystone Block, Chattanooga, Tenn.; E. J. Timberlake, Chn. Com.

CINCINNATI, O.—Bids are asked until Aug. 12 for furnishing engines, boilers, smoke connections, ventilating and heating apparatus, plumbing, etc., for the north wing of Hanna Hall. Archs., S. Hannaford & Sons, Hulbert Block; J. M. Robinson, Chn. Com., University of Cincinnati, Cincinnati.——Bids are asked until Aug. 10 for a steam heating and power plant for the house of refuge; bond, $6,000. Archs., Samuel Hannaford & Sons; James Allison, Secy.

CLEVELAND, O.—John F. Rust proposes to erect a 7-story office building on Euclid Ave. to cost about $90,000. Arch., Geo. H. Smith, 29 Euclid Ave.

CLEVELAND, O.—The Baltimore & Ohio R. R. Co. has decided to spend about $500,000 on reconstructing its passenger station at South Water St.

HUDSON, O.—Bids are asked until Aug. 6 for enlarging the town hall. E. E. Rogers, Township Clk.

DETROIT, MICH.—The following bids were received June 30 by Maj. M. P. Adams, U. S. Engr., for erecting buildings, etc., for the North Manitou Light Station, as advertised in Engineering News:

Joseph V. Gearing, Detroit, Mich., accepted	$10,642
McCurdy Bros., Houghton, Mich.	11,791
O'Sullivan & Jenks, Port Huron, Mich.	12,674
J. T. Moyhen, Detroit, Mich.	14,288
Robert Dunn & Co., Detroit, Mich.	15,187

CHICAGO, ILL.—The following bids were received by W. B. Wickersham, Secy. Bd. Directors, for furnishing electric elevators for the public library building; the first price being for 10 elevators and the second for 8:

Eaton & Prince Co., Chicago	$18,985	$15,300
Standard Elevator & Mfg. Co., Chicago	26,795	21,640
Smith-Hill Elevator Co., Quincy, Ill.	24,862	19,951
Crane Elevator Co., Chicago	18,820	15,294

——The Tower Co. has been incorporated with a capital stock of $800,000 to erect a tower 1,150 ft. high and 300 ft. at its base. The structure will have 14 elevators. Pres., D. R. Proctor.

CHICAGO, ILL.—Bids are asked until July 31 for constructing an 8-room and assembly hall school building at Ashland and Greenleaf Ave. Arch., Aug. Fiedler, Schiller Bldg.

RACINE, WIS.—Bids are asked until Aug. 21 for constructing the U. S. post-office building in this city, as stated in our advertising columns. Wm. Martin Aiken, Supervising Arch., Washington, D. C.

SIOUX CITY, IA.—Wm. M. Aiken, Supervising Arch., Washington, received the following bids July 14 for furnishing and placing a steam heating and ventilating apparatus in the court-house and post-office building in this city, as advertised in Engineering News:

		Time, days
Bayley Heating Co., Milwaukee, Wis.	$11,566	120
Sproul & McGurrin, Grand Rapids, Mich.	12,974	120
Optenberg & Sonneman, Sheboygan, Wis.	9,999	90
J. J. Hanighen, Omaha, Neb.	12,320	114
Chas. B. Kruse Heating Co., Milwaukee, Wis.	11,099	120
Thomas & Smith, Chicago	11,880	120
Davenport Steam Heating Co., Davenport, Ia.	10,979	120
Allen Black, St. Paul, Minn.	13,495	90
Samuel I. Pope Co., Chicago, (by telegraph)	10,870	

FERGUS FALLS, MINN.—Bids are asked until Aug. 12 for a heating and ventilating apparatus for the east wing of the state hospital. Arch., W. B. Dunnell, Bank of Commerce Bldg., Minneapolis, Minn.; T. H. Titus, Secy., Fergus Falls.

ANACONDA, MONT.—A. C. Schweinfurth, of New York, N. Y., is to prepare plans for the new Hearst library in this city, to be built by Mr. Hearst, of San Francisco, Cal. Fred Clark, Librarian, Anaconda.

HELENA, MONT.—An election will be held July 25 to vote on the question of issuing $61,000 in bonds for work on city buildings and for furnishing a heating and ventilating apparatus for the high school building. Arch., Clarence Johnson; Peter Winne, Chn. Com.

ST. LOUIS, MO.—Bids are asked until July 27 for erecting a new school building and for furnishing hot blast heating apparatus for six school buildings. John Kissner, Chn. Com.; C. L. Hammestein, Secy.

PUEBLO, COLO. — The following bids were received July 16 for erecting a post-office building in this city, as advertised in Engineering News. W. M. Aiken, Supervising Arch., Washington, D. C.:

		Time, mos.
L. L. Leach & Son, Chicago, Ill.	$187,774	18
Chas. A. Moses, Chicago, Ill.	208.300	18
Thos. H. O'Neil, Denver, Colo.	237,715	20
Fleming Bros., Denver, Colo.	288,657	20
Frank Anderson, Denver, Colo.	249,860	..
James A. McGonigle, Leavenworth, Kan.	249,600	20
G. W. Atkinson & Son, Colorado Springs.	216,763	19

OREGON CITY, ORE.—Bids are asked until Aug. 8 for the purchase of $6,000 of 6% school building bonds. Jacob Shade, County Treas.

SEATTLE, WASH.—The Northern Pacific Ry. Co. is reported as considering the question of building a passenger station in this city. Heretofore this company has used a station jointly with the Seattle, Lake Shore & Eastern R. R. Co.

SPOKANE, WASH.—It is reported that Spokane's new army post is to be begun at once. A. E. Johnson will have charge of the architectural department of the buildings and grounds. The plans were prepared in Washington, D. C., but may be changed, and the contracts will be let, as all work is to be done by contract.

SAN FRANCISCO, CAL.—Press reports state that the Regents of the State University have decided to petition the next legislature for a special appropriation of $500,000 for building purposes, and $500,000 more for the same purpose from the succeeding legislature, in order to have a building fund of $1,000,000 for the erection of suitable college buildings.——Col. A. S. Kimball has awarded to M. McGowan the contract, at $74,700, for constructing two barracks at the Presidio.

SAN FRANCISCO, CAL.—Press reports state that the governor has approved the plans for the Affiliated Colleges, and bids will be at once asked for the construction. The buildings will number four, grouped on Parnassus Ave., between First and Fourth Avs., north of the Park; will be on ground given by Adolph Sutro. Archs., J. E. Krafft and Martens & Coffey, Academy of Science Bldg.

SAN JOSE, CAL.—A resolution has been introduced directing the city clerk to advertise for plans for a high school building and also a public library building. The high school plans must be for a building which will not cost more than $75,000, and the library building is not to exceed $25,000.

AMHERSTBURG, ONT.—Alfred B. Wood is reported to have prepared plans for a $100.000 hotel for the L'Hotel Oriental Co. The building will be 274 × 118 ft.

WATER-WORKS.

BANGOR, ME.—Bids are asked until Aug. 13 for furnishing and erecting a stand-pipe, as stated in our advertising columns (postponement from July 30). A. B. Tower, Engr., Holyoke, Mass.; Walter L. Brown, Clk. Bd.

PHILLIPS, ME.—A press report states that the construction of the new water-works was expected to begin July 20.

ST. JOHNSBURY, VT.—The Deane Steam Pump Co. has the contract for a 1,000,000-gallon power pump for this village.

ASHLAND, MASS.—William F. Merritt, Town Clk., writes us that nothing has been done except to appoint a committee to investigate the question of introducing water-works.

HOLDEN, MASS.—We are informed that the construction of works will probably be commenced next year; supply by gravity from a pond in Rutland; estimated cost, $40,000. Z. W. Armington, Town Clk.

HOLYOKE, MASS.—The water commissioners are reported as considering plans for the proposed new dam in the Manhan River.

LAWRENCE, MASS.—The water board is reported to have ordered 500 meters from the National Meter Co. and to have voted to advertise for bids for the new high-service stand-pipe.

MEDWAY, MASS.—E. V. Mitchell, of Medfield, is interested in the Medway Water Co., which proposes to construct works at this place; no plans or definite action yet decided on.

MERRIMAC, MASS.—B. Jacques, Town Clk., writes us that a committee has been appointed to report at the next annual meeting in March in regard to water-works; nothing will be done before then.

SOUTH DEERFIELD, MASS.—The South Deerfield Water Co. will probably commence the construction of works this fall; water supply from a stream; estimated cost, $25,000. E. M. Roche is interested.

SUTTON, MASS.—Efforts are being made to secure an extension of the Manchaug Water Co.'s mains to this village for fire protection, at a cost of $1,000.

TAUNTON, MASS.—A new pumping engine will probably be needed next year; no steps yet taken. Geo. T. Chace, Supt.

SUFFIELD, CONN.—The contract for pipelaying has been awarded by the Village Water Co. to A. R. Leete, of Thompsonville; pipe purchased from the Chattanooga Pipe & Foundry Co.; foundation for the stand-pipe is now being laid.

ARGYLE, N. Y.—The village clerk writes us that the proposed works will probably cost $5,000 to $8,000; supply by gravity from a lake at an elevation of 410 ft. above the village; there is some talk of organizing a company to construct the plant.

BOLIVAR, N. Y.—J. B. Bradley, E. R. Kilbury and Louis Seibert have been appointed water commissioners. It is expected that a special election will soon be held and $12,000 in bonds voted for a gravity system.

BUFFALO, N. Y.—Bids are asked until July 30 for 100 tons of pig lead for the water department. R. G. Parsons, Secy. Dept. Pub. Wks.

CLAYTON, N. Y.—Plans for works have been prepared by Hinds & Bond, of Watertown, and are now in the hands of the state board of health; water supply will probably be pumped from the St. Lawrence River to a stand-pipe. H. W. Morse, Village Clk.

ELMIRA, N. Y.—J. M. Diven, Secy., is quoted as stating that the water company has adopted plans for a 6,000,000-gallon filter plant, and that bids for the construction will be asked as soon as the specifications are completed.

FLUSHING, N. Y.—The village trustees are reported to have decided to purchase an additional pump, as recommended by the water committee.

KINGSTON, N. Y.—O. C. Longyear, Supt., writes us that it is proposed to build a new impounding reservoir and pipe line, as recently noted in these columns; no contracts have yet been awarded; the present plant was recently purchased by the city and as soon as necessary financial and other matters are arranged bids will be advertised for.

LIVONIA, N. Y.—Owing to the opposition of taxpayers the water-works project has been abandoned for the present.

NORTH TANAWANDA, N. Y.—It is stated that specifications are nearly completed for the proposed extensions, for which bonds have been voted.

NEW YORK, N. Y.—The lowest bid received July 21 for furnishing and laying two 48-in. water mains in Fifth Ave., from 80th St. to Fourth St., was that of Wm. T. Baird, at $452,460. There were 10 bidders; itemized bids will probably be published next week. Chas. H. T. Collis, Comr. Pub. Wks.

RAVENA, N. Y.—John Longear, of Kingston, has prepared plans for works estimated to cost $75,000; supply from Lawsons Lake; plant will probably be completed next year. C. L. Diston, Town Clk.

RENSSELAERVILLE, N. Y.—J. Vaughn, of Stamford, has the contract and has commenced the construction of water-works at this place, to be owned by the Rensselaer Water Co.

ROCHESTER, N. Y.—Bids are asked until July 24 for trenching and laying water pipe in six groups of streets. Thos. J. Neville, Clk. Executive Board.

SILVER CREEK, N. Y.—Bids are asked until Aug. 1 for constructing works, as stated in our advertising colunms. J. F. Witmer, Engr., Buffalo; Frank L. Smith, Village Clk.

SKANEATELES, N. Y.—A press report states that the water company has not replied to the offer of the commissioners to purchase the plant for $24,000 and that bids will soon be asked for constructing new works, for which the Stanwix Engineering Co. has prepared plans.

TARRYTOWN, N. Y.—Bids are asked until July 28 for the purchase of $150,000 in 4% 30-year water bonds. John F. Schall, Secy.

WURTSBORO, N. Y.—William H. Cowan, of Montgomery, N. Y., and associates have petitioned for a franchise, which the village trustees are expected soon to take action upon; supply by gravity from springs about one mile distant; estimated cost, $10,000 to $15,000. G. F. Harding, Village Clk.

CHATHAM, N. J.—Works will probably be constructed next year; supply to be pumped from springs to a stand-pipe.

CLINTON, N. J.—We are informed that a good gravity supply could be obtained for water-works at this place and that the common council would probably grant a franchise. Chester Tomson, Cy. Clk.

JERSEY CITY, N. J.—Bids are asked until July 28 for laying water pipe in the public streets until May 1, 1897. Geo. T. Bouton, Clk. Comrs.

NEWARK, N. J.—The East Jersey Water Co. is said to have in contemplation important extensions of its system, in addition to the work now in progress.

VINCENTOWN, N. J.—The Vincentown Water Co. has commenced the construction of works to cost $9.000; plant will probably be completed this month. Edgar A. Alcott, Engr., Mount Holly, N. J. John A. Kinney is interested.

ALTOONA, PA.—S. C. Corson, of Altoona, has been engaged to prepare plans for water-works for Juniata borough, Blair county, Pa. It is probable that a temporary dam and about four miles of pipe line will be constructed.

AVONDALE, PA.—J. W. Ledoux, 1319 Filbert St., Philadelphia, is reported to have prepared plans for works at this place; supply from creek; probable cost, $10,000. J. L. Paiste, Chn. Water Com.

CHARLEROI, PA.—The water company is talking of building a reservoir.

CHESTER, PA.—A permanent injunction has been granted restraining the borough of Norwood from borrowing $30,000 for water-works, sewers, etc.

CORAOPOLIS, PA.—The construction of works will probably be commenced soon; water supply from the Ohio River; estimated cost, $25,000 to $30,000, for which bonds will be issued. E. H. Ferres, Clk.; J. W. Arras, Chn. Com.

CORAOPOLIS, PA.—Bids are asked until July 25 for the purchase of $8,000 in 4½% 5 to 30-year water bonds. E. H. Ferree, Clk. of Council.

DRIFTWOOD, PA.—The question of water-works will probably be revived at this place at an early date.

DUSHORE, PA.—B. S. Collins, Secy., writes us that capital has been partially secured for the construction of a $15,000 water-works plant by a private company.

GROVE CITY, PA.—The Grove City Water Co. secured a charter some time ago but has not yet been granted a franchise; probable cost of plant, $25,000; work must be commenced within 1½ years to retain charter. J. C. Van Orsdell, Cy. Clk.

HATBORO, PA.—No definite action has been taken by council in regard to water-works, although the question is being discussed; water supply will probably be pumped from an artesian well to a stand-pipe. Comly Walton, Clk. of Council.

JERMYN, PA.—Property owners have secured a temporary injunction restraining the borough authorities from issuing $16,000 in bonds for water-works.

LANCASTER, PA.—The Conoy Water & Power Co. was incorporated July 17 with a capital stock of $1,000. Treas. Edward R. Heitshue, Lancaster.

LEBANON, PA.—The council has passed a bill providing for an election July 25 to vote on an issue of $200,000 in bonds for a water supply from Hammer Creek, according to reports.

LIGONIER, PA.—An election will be held Aug. 7 to vote on a 2% tax for water-works. Bids for constructing a system were opened last month, as advertised in Engineering News. L. W. Fogg, Engr., Latrobe, Pa.

LINESVILLE, PA.—The Bunday Water Co. is constructing works at this place; supply from springs. S. W. Lowing, Clk. of Council.

LITTLETOWN, PA.—This borough is sinking a well and it is stated that $15,000 in bonds will be issued for works. E. M. Kenly, Engr., Baltimore, Md.; Abia Smucker, Secy.

MIFFLINBURG, PA.—Authority has been obtained from the legislature for the construction of works estimated to cost $30,000; supply by gravity from mountain stream. T. M. Getgen, Town Clk.

MILLHEIM, PA.—There has been some talk of organizing a water company at this place; supply by gravity from a mountain stream 1½ miles distant; estimated cost, $4,000. H. E. Duck, Clk.

NAZARETH, PA.—The Nazareth Water Co. has important extensions of its plant in contemplation. The town is negotiating for the purchase of the plant. Frank Kunkel, Treas.

PITTSBURG, PA.—Bids are asked until July 28 for furnishing and erecting at Garfield pumping station two compound condensing duplex pumping engines of 1,500,000 gallons capacity each. E. M. Bigelow, Dir. Pub. Wks.

TYRONE, PA.—Bids are asked until Aug. 1 by the Tyrone Gas & Water Co. for the construction of a reservoir, as stated in our advertising columns. T. J. Humphreys, Engr.; C. A. Morris, Secy.

WEST BROWNSVILLE, PA.—Geo. Jenkins, of Monongahela, has been engaged as engineer of the proposed works at this place, estimated to cost $8,000; water supply will be pumped from Monongahela River to reservoir. J. D. S. Pringle, Burgess.

YORK, PA.—William H. Griffith, of this city, is treasurer of the following three water companies, each incorporated July 20 with a capital stock of $1,000: Water Company of Manchester Township; Water Company of Spring Garden Township; Water Company of West Manchester Township.

ABERDEEN, MD.—The town commissioners are reported as soon to call an election to vote on an issue of bonds for water-works and other improvements.

BALTIMORE, MD.—Bids are asked until July 25 for 15 tons of Omaha pig lead for the water department. William L. Kenly, Ch. Engr.

HYATTSVILLE, MD.—A. Cass. Clk., writes us that no official action has been taken by corporation in regard to water-works.

OAKLAND, MD.—We are informed that the question of water-works has been abandoned for the present.

SNOW HILL, MD.—It was expected that the construction of works at this place would be commenced last week, plant to be completed by Jan. 1; water supply to be pumped from wells to stand-pipe; estimated cost, $18,000. E. S. Dashiell is interested.

TANEYTOWN, MD.—This city expected to commence the construction of works this month; water supply to be pumped from springs; estimated cost, $12,000. H. D. Mehring, Burgess; L. D. Reid, Clk.

TAKOMA, PARK, D. C.—Geo. A. Warren, Town Treas., writes us that the charter of this town provides for the construction of water-works and that the council has discussed the cost of same, but it is not probable that additional action will be taken this year; water supply would probably be pumped from deep wells or Sligo Creek to stand-pipe.

FALLS CHURCH, VA.—M. E. Church, who was granted a franchise some time ago, writes us that the necessary capital has not all been secured and it is not known when the construction will be commenced; water supply from springs or artesian wells; probable cost $25,000.

RIVERTON, VA.—It is reported that the Royal Water Co., of Front Royal, Va., contemplates extending its gravity system to this place, about two miles.

GASTONIA, N. C.—This city has talked some of constructing works to cost about $30,000, but no legislative authority has yet been secured or definite action taken. Edgar Love, Clk.

LOUISBURG, N. C.—Geo. S. Baker, Cy. Clk., writes us that the question of water-works has not yet assumed definite shape.

WILMINGTON, N. C.—The water company may possibly erect a filter plant; question not decided. W. F. Robertson, Supt.

CHARLESTON, S. C.—A local paper states that Capt. U. R. Brooks will organize a water company to furnish the city with a water supply from artesian wells.

CHESTER, S. C.—C. C. Edwards, Clk., writes us that Perry Andrews, of Atlanta, Ga., has been awarded the contract for an artesian well and work has commenced; nothing will be done about plans for water-works until the well is completed, which will be about Oct. 1; population, 4,100.

GAFFNEY CITY, S. C.—This town has been granted authority to construct works to cost $15,000, but no commissioners have been appointed or bonds issued; water supply from springs 1½ miles distant. L. Baker, Town Clk.

EAST ROME, GA.—This town is laying water mains; supply from the mains of the city of Rome. O. H. McWilliams, Mayor.

HAWKINSVILLE, GA.—S. A. Way, Mayor, writes us that the plans and specifications for proposed water-works, etc., have not yet been completed.

HOGANSVILLE, GA. — We are informed that no definite action has been taken in regard to water-works in this town, although there has been some talk of a gravity system.

LAKELAND, FLA.—C. D. Clough, Cy. Clk., writes us that the question of water-works is now under consideration.

MIAMI, FLA.—The construction of work has been commenced, plant to be finished by Jan. 1. A. L. Knowlton, Engr.

GENEVA, ALA.—Wm. J. Hall, City Clk., writes us that this city desires water-works but that no definite action has yet been taken.

GURLEY, ALA.— Giles, Vance & Co., of Maysville, Ala., are the contractors for works in this city, to cost about $1,000; plant to be completed in 60 days; water supply to be pumped from an artesian well to a tank. F. T. Walker, Engr., Gurley.

ABERDEEN, MISS.—R. P. Houston, Cy. Clk., writes us that this city will probably have works soon, but has not yet taken definite action. J. M. Acker, Mayor.

BAY ST. LOUIS, MISS.—R. Mendes, Cy. Clk., writes us that nothing is now being done in regard to the proposed water-works.

GREENWOOD, MISS.—An artesian well has been sunk, flowing 30 ft. above surface of ground, but nothing definite has been done in regard to water-works.

WEST POINT, MISS.—The city clerk writes us in regard to the proposed works that no definite system has yet been decided upon.

LAFAYETTE, LA.—A press report states that the contract for constructing water-works and an electric light plant has been awarded to James Ferguson, of New Orleans, at $36,000, for which amount bonds will be issued.

WASHINGTON, LA.—This place is reported to have been granted legisuative authority to issue bonds for a water-works and electric light plant.

CLARKSVILLE, TENN.—The contract for a 25 × 100-ft. stand-pipe has been awarded to Walsh & Weidner, of Chattanooga, at $5,434, exclusive of foundation; 125 tons of 12 and 10-in. pipe has been purchased of the South Pittsburg Pipe Works, at $22.50 a ton delivered; valves purchased of the Chapman Valve Co. J. N. Hazelhurst & Co., Consult. Engrs., Atlanta, Ga.; R. E. McCulloch, Supt.

DECHERD, TENN.—It is probable that works to cost $35,000 will be constructed to supply this place and Winchester. E. D. Sanford may be addressed.

MARTIN, TENN.—J. E. Kennedy, Mayor, writes us that the legislature will be petitioned in January for authority to issue $15,000 to $18,000 in bonds for works and the contracts awarded as soon thereafter as possible; water supply will probably be pumped from a deep well to a stand-pipe; no engineer has been engaged.

ROCKWOOD, TENN.—J. A. Shadden, Cy. Recdr., writes us that legislative authority was secured some time ago but that no election has been held or other steps taken toward the construction of works.

TULLAHOMA, TENN.—Geo. W. Davidson, Cy. Recdr., writes us that it is expected to secure authority and commence the construction of a $25,000 water-works plant next year.

SPRINGFIELD, KY.—H. R. Thompson, Clk., writes us that the construction of works will probably be commenced next month; plant will include a stand-pipe; probable cost, $2,200.

UNIONTOWN, KY.—The question of water-works is now being discussed but nothing definite has been decided; probable cost, $20,000.

WEST COVINGTON, KY.—It is stated that a company will construct works at this place if enough takers can be procured; water supply from the Covington reservior at Newport, Ky. Joseph Ryan, Cy. Clk.

BLANCHESTER, O.—G. L. McKibben, Cy. Engr., Van Wert, O., has been engaged to prepare plans and specifications and to superintend the construction of the proposed water-works and electric light plant at this place.

CLEVELAND, O.—Bids are asked until Aug. 14 for building foundations of a new smoke-stack, for a short aqueduct and other work at the Division St. pumping station. D. E. Wright, Dir. Pub. Wks.

COSHOCTON, O.—A large well and a new pumping engine are among the projected improvements. D. A. Raiff, Supt.

EAST CLEVELAND, O.—At a special election last week only 20 votes of the 196 were opposed to the issue of bonds to lay water pipes.

FOSTORIA, O.—A press report states that the trustees of the water-works have voted to require all consumers to put in meters.

GREENWICH, O.—B. J. Ashley, of Chicago, is reported to have prepared plans for works at this place; supply to be pumped from the wells to stand-pipe; probable cost, $14,000; no definite action yet taken. I. J. Brooks, Clk.

HIRAM, O.—Contract for constructing works to cost about $12,000 will probably soon be awarded. Edwin L. Hall, Clk.

IRONTON, O.—Bids are asked until Aug. 1 for furnishing and placing in position a 150-HP. boiler. Geo. A. Meyers, Pres. Trustees.

MANSFIELD, O.—S. C. Clark, Supt., writes us that the proposed extensions include 12,000 ft. of 6-in. main, with 25 hydrants and 18 6-in. valves; work to be done by the city; water mains, valves and hydrants to be furnished by the Barnes Mfg. Co., of Mansfield.

PIQUA, O.—The proposition to issue $20,000 in bonds for water-works improvements lacked 69 votes of the necessary two-thirds, at the recent election and the improvements will not be made at present.

WEST ALEXANDRIA, O.—W. H. Burbaker, Clk., writes us that the question of water-works is not yet settled; water supply could probably be pumped from wells to stand-pipe; probable cost, $17,000.

ZANESVILLE, O.—The water-works trustees are reported as planning several improvements, including a pumping engine to cost $10,000 or $12,000.

SULLIVAN, IND.—R. H. Hutchison writes us that the Howe Pump & Engine Co., of Indianapolis, has the contract for works, to be completed Nov. 1. John H. Haines-worth, Engr., Indianapolis.

WALKERTON, IND.—Bids are asked by the Walkerton Water-Works Co. for the erection of a tower, pumping station and equipping of a complete system of water-works, as stated in our advertising columns. Wm. Clem, Secy.

BENTON HARBOR, MICH.—A press report states that the 13 wells from which the city water supply is obtained are inadequate to supply the demands and that the supply is decreasing.

HIGHLAND PARK, MICH.—The injunction to prevent this village from constructing works has been dissolved and it is stated that the construction will now be pushed as rapidly as possible; the village is to lay 26,445 ft. of pipe beyond the Detroit city limits, at a cost of $23,000, and pay the city 3 cts. for each 1,000 gallons of water used.

THREE OAKS, MICH.—Bids are asked until Aug. 7 for constructing works. Geo. C. Morgan, Engr., Chicago; F. B. Hinehman, Clk.

ASSUMPTION, ILL.—The town council is reported to have appropriated $20,000 for a water supply.

CHICAGO, ILL.—Bids are asked by the department of public works until July 27 for laying water mains in 24 streets.

EDWARDSVILLE, ILL.—Bids are asked until Aug. 4 by the committee on water-works for the construction of works, for which plans have been prepared by F. W. Raeder, Equitable Bldg., St. Louis.

GALENA, ILL.—The city council is negotiating with the Galena Water Co. for the purchase of the works.

GENOA, ILL.—The construction of works to cost $8,000 will probably be commenced in February. Hill & Enricht, Engrs., Chicago; A. U. Schneider, Cy. Clk.

GREENUP, ILL.—It is probable that works to cost $10,000 will soon be constructed at this place. M. T. Monohon, Clk.

JOLIET, ILL.—An election will probably be held Aug. 25 to vote on an issue of $200,000 in bonds for a water supply from artesian wells.

OAKLAND, ILL.—It is stated that C. J. Taber will commence the construction of works at this place about Sept. 1; water supply to be pumped from river to stand-pipe; probable cost, $12,000. Andy Shaffer, Engr.; Col. F. Gruber, contractor, both of Oakland.

PLYMOUTH, ILL.—It is reported that an election was held last week to vote on an issue of $3,000 in bonds for water-works.

SHELDON, ILL.—The contract for constructing works will probably be awarded at an early date; probable cost, $20,000. Jacob A. Harman, Engr., Peoria; M. B. Wood, Clk.

TONICA, ILL.—J. W. Richardson, Clk., writes us that this village wants water-works, but does not feel able to construct a plant at present.

BANGOR, WIS.—It is probable that the construction of works will be commenced in September, although nothing definite has yet been decided. R. W. Davis, Town Clk.

LA CROSSE, WIS.—Bids are asked until July 27 for constructing a water main in 12th St., from Badger to La Crosse St. Jacob Hahn, Secy. Bd. Pub. Wks.

MANAWA, WIS.—We are informed that works will probably be constructed at this place next year.

MILWAUKEE, WIS.—The water main crossing the Milwaukee River at Michigan St. broke July 12 causing a loss of about 10,000,000 gallons of water, according to local papers.

OSHKOSH, WIS.—The city has opened bids for $20,000 in water bonds authorized for extensions of the water mains in the manufacturing districts.

PORTAGE, WIS.—Receiver Maxcy, of the water company, is quoted as stating that work on the new intake will not be begun until Aug. 15.

SHULLSBURG, WIS.—The council is reported to have voted to call a special election to vote an appropriation for a stand-pipe.

WAUPACA, WIS.—The council has selected a site for a reservoir at an elevation of 117 ft. above Main St.

WAUPACA, WIS.—F. S. Baldwin and A. M. Hansen are expected soon to commence work on a water-works system to cost $45,000, plant to be completed within one year; water supply to be pumped from river to stand-pipe. C. G. Burbank, Cy. Clk.

WAUWATOSA, WIS.—Myron Gilbert, ex-Village Clk., writes us that the decision of the Supreme Court two or three weeks ago was that the law under which villages have been incorporated in this state is unconstitutional and that nothing is therefore now being done to construct water-works in this village.

BEDFORD, IA.—There is talk of constructing works to cost $20,000. F. S. Sturtevant, Clk.

DOON, IA.—Bids are asked until Aug. 3 for constructing works, as stated in our advertising columns. L. F. Wakefield, Engr., Sioux City; A. N. Thompson, Town Clk.

ELGIN, IA.—It is probable that works to cost $6,000 will be constructed. L. Y. Ehrich, Chn. Com.

GRANVILLE, IA.—It is reported that bids were received July 21 for constructing works. F. E. Wade, Engr., Sheldon, Ia.; N. H. Graff, Cy. Recdr.

LOHRVILLE, IA.—Bids are now asked, according to reports, for constructing works for which $4,500 in bonds have been voted. Fairbanks, Morse & Co., Engrs., Chicago; W. J. Gillam, Cy. Recdr.

RUTHVEN, IA.—E. C. Rowell, Mayor, writes us that this city will not be in condition financially to construct works for a year or more.

SANBORN, IA.—It is probable that works will be constructed at a cost of about $5,000. F. B. Owen, Recdr.

FOSSTON, MINN.—Bids are asked until July 28 for the purchase of $10,000 in bonds, voted June 30, for water-works and electric lights. I. O. Brandt, Cy. Recdr.

ST. PAUL, MINN.—The contract for the pumping station at Centreville has been awarded to Hennessy & Cox, at $9,429.

ROCHESTER, MINN.—Burt W. Eaton has been appointed receiver of the water company at this place.

WATERVILLE, MINN.—A. W. Knaak, Recdr., writes us that this village expects to construct works, but that no definite information can now be given.

GREENWOOD, S. DAK.—Bids are asked for furnishing all material and putting down one or more artesian wells on the Yankton Indian reservation. James A. Smith, U. S. Indian Agent.

BIG TIMBER, MONT.—It is reported that this city is about to construct water-works.

BELT, MONT.—P. C. Kittle, Mgr. Castner Coal & Coke Co., writes us that the private works noted in our issue of July 2 is nearly completed.

MISSOULA, MONT.—Bids are asked until Aug. 10 for furnishing the city with water for 10 or 20 years, at least 30 hydrants to be contracted for. It is reported that improvements to cost $40,000 to $50,000 are needed in the present plant.

WHITE SULPHUR SPRINGS, MONT.—It is reported probable that bonds will be issued and works constructed at this place. Powell Black, Cy. Clk.

ALBANY, MO.—W. W. Millen, Clk., writes us that no action has been taken by the council except to offer a franchise to any good party who will put in a plant.

GLASGOW, MO.—The contract for a stand-pipe is reported to have been awarded to the Warren City Boiler Works, of Warren, O., at $1,198.

KANSAS CITY, MO.—The board of public works is examining pumping machinery with a view to buying a new pump for the Turkey Creek station.

RICHMOND, MO.—This city is reported to have voted in favor of works to cost $45,000.

ST. LOUIS, MO.—The estimates for the water department include $275,000 for pipe, $500,000 for extensions and new work and about $70,000 for miscellaneous work.

COTTON PLANT, ARK.—F. B. Robinson, Recdr., writes us that works to cost about $1,000 will probably be constructed this year.

HEMPSTEAD, TEX.—Bids are asked by the Hempstead Artesian Well Works Co. until July 20 for sinking an artesian well 1,200 ft. deep. M. Schwarz, Secy.

HICO, TEX.—It is probable that works to cost $7,000 will be constructed this winter; no definite action yet taken. G. W. Hail, Cy. Secy.

ROGERS, TEX.—We are informed that J. C. Thompson, of Waco, Tex., has been awarded the contract for an artesian well at this place.

SEABROOK, TEX.—An artesian water supply of 50,000 gallons daily has been obtained at a depth of 570 ft.

BUENA VISTA, COLO.—The town contemplates the construction of a reservoir with seepage supply. H. M. Kemble, Supt.

CASTLE ROCK, WASH.—H. Orchard & Co., of Kalama, Wash., will probably construct works at this place to cost about $5,000. A. J. Hicks, Clk.

ILWACO, WASH.—H. A. Cory, Clk., writes us that there has been some talk of water-works, but nothing definite has been done.

KALAMA, WASH.—H. Orchard, Pres. Orchard Water Co,. writes that works to cost $15,000 have just been completed at this place.

SEATTLE, WASH.—This city voted $1,200,000 at the general election for the construction of a gravity water supply of 25,000,000 gallons daily from Cedar River. Several surveys have been made and reports state that it has been decided to build a dam in Cedar River which will turn the water into Swan Lake, from which place a conduit will be built to the terminus of the present city mains at Lake Washington.

HARNEY, ORE.—There is some talk of constructing works. Address the clerk.

WARRENTON, ORE.—There is talk of constructing works to supply this place, Flavel and New Astoria, at a cost of $45,000.

AZUSA, CAL.—We are informed that the water-works project noted in our issue of July 2 has been defeated.

LAKEPORT, CAL.—This town will probably construet works to cost $15,000 within a year; nothing definite yet decided. H. V. Keeling, Town Clk.

SANTA ANA, CAL.—The water company has appointed a committee to investigate the feasibility and probable cost of a reservoir near Anaheim, for storage purposes in the summer months.

SUISUN, CAL.—O. B. Powers, Town Clk., writes us that at the election July 13 the proposed issue of $42,000 in bonds was authorized by a vote of 122 to 6. O. H. Buckman, Engr., Napa City, Cal.

KENDRICK, IDAHO.—It is probable that a gravity system will be constructed; probable cost, $11,000; bonds now for sale. W. R. Graham, Engr., Kendrick; Lewis Hunter, Clk.

DESERONTO, ONT.—It is reported that this place is likely to construct works at a cost of $35,000.

LISTOWELL, ONT.—An election will be held Aug. 21 to vote on an issue of $15,000 in bonds for water-works, a gas or electric light plant, etc.

LONDON, ONT.—Surveys and plans are being prepared for increasing the water supply. John M. Moon, Supt.; O. Ellwood, Secy.

OWEN SOUND, ONT.—T. I. Thomson, Chn., writes us that metering is the most important change contemplated at present. Isaac Markle, Supt.

STURGEON FALLS, ONT.—H. E. McKee, Town Clk., writes us that bids will probably be received in September for constructing works estimated to cost $17,500; soil is sandy and very level; water supply to be pumped from the Sturgeon River. Alan Macdougall, Engr., Toronto.

ST. JOHN, N. B.—The city proposes to improve the pressure on heights by installing a small pumping plant to be driven by water power. Wm. Murdock, Engr. and Supt.

IRRIGATION.

DENVER, COLO.—Colorado and New York capitalists are said to be considering plans for building a storage reservoir in the Platte canyon for irrigation and power purposes. This reservoir will hold the waters of the South Platte River and is estimated to cost about $1,800,000. Engrs., S. G. Rhodes, of Denver, and Mr. Cook, of Chicago. Sylvester Smith and Cyrus W. Fisher, of Denver, are interested.

CUERO, TEX.—Press reports state that the object of the Cuero Power & Irrigation Co., noted in our issue of last week as incorporated by Alex. Hamilton, V. Weldon, J. J. Sumners, F. A. Taylor and Sam C. Lackey, is the construction of a dam across the Guadalupe River in De Witt county at or near a place known as Hell Gate, for diverting a portion of the water of the stream into ditches for irrigating the adjacent lands. The corporation will also have the right to build a power house, for milling, manufacturing and irrigating, and to furnish water for water-works and sewers for Cuero, and to furnish power for electric lights.

NEW COMPANIES.—Rio-Grande Land & Irrigation Co., El Paso, Tex.; $5,000; Isaiah A. Barnes, William Bremme, James Longwell.

Calamus Valley Irrigation Canal Co., Taylor, Neb.; $3,500; R. Hesselgesser, J. J. Collopy, C. B. Hesselgesser, M. A. Hesselgesser.

SEWERAGE.

BOSTON, MASS.—Bids are asked until July 27 for constructing 1,500 ft. of 18 and 15-in. pipe sewers. The work will include 750 cu. yds. of solid and loose rock excavation. Benj. W. Wells, Supt. of Sts.

QUINCY, MASS.—We are informed that the council has appropriated $5,000 for surveys, maps, etc., for a sewer system. The system has been adopted and work will be begun early next year. C. F. Knowlton, Comr. Pub. Wks.; Albert F. Schenkelberger, Sewer Comr.

WORCESTER, MASS.—F. A. McClure, Cy. Engr., informs us that $100,000 has been appropriated by the council for a sludge disposal plant, for which plans are now being prepared. Local papers state that the city engineer was authorized by the council on July 13 to engage an engineer and also a chemist to consult with him on the plans for the sewage separation system.

PROVIDENCE, R. I.—Bids are asked until Aug. 3 for constructing about 3,500 ft. of 105 × 75 to 36-in. brick sewers, etc., as described in our advertising columns. Robt. E. Smith, Comr. Pub. Wks.

WOONSOCKET, R. I.—Bids are asked by the sewer commissioners until Aug. 17 for constructing sections 1, 2 and 3 of the sewer system, as described in our advertising columns. The work will consist of a river wall, about 4,350 ft. of 36 to 30-in. brick sewers, four siphons under the Blackstone River, etc. Consult. Engr., Rudolph Hering, New York, N. Y.; S. P. Cook, Cy. Treas.; Arthur R. Sweet, Supt. Sewer Dept.

BROOKLYN, N. Y.—Bids are asked until Aug. 4 for constructing sewers in three streets. Theo. B. Willis, Comr. Cy. Wks.; R. M. Whiting, Secy.

BUFFALO, N. Y.—The council has ordered the board of public works to prepare plans and specifications and advertise for bids for constructing pipe sewers in nine streets.

JAMESTOWN, N. Y.—B. T. Wheeler, of Boston, Mass., has recommended the construction of sewage filtration beds.

TROY, N. Y.—Bids are asked until July 28 for constructing sewers in five streets. E. Ogden Ross, Secy.

YOUNGSTOWN, N. Y.—Bids are asked until Aug. 5 for a system of surface drainage at Fort Niagara, N. Y. Lieut. P. C. Harris, Q. M., U. S. A.

IRVINGTON, N. J.—Merton B. Owen and W. C. Ward, Jr., have been appointed by Clinton township to confer with the sewer committee of this place on plans for a system.

MONTCLAIR, N. J.—The committee has reported in favor of about 10,000 ft. of sewer extensions in Park and Chestnut Sts., at a cost of about $30,000.

PITTSBURG, PA.—Bids are asked until July 31 for constructing 36-in. brick sewers in two streets, and 18 and 15-in. pipe sewers in 25 streets. E. M. Bigelow, Dir.

READING, PA.—The city engineer has been directed to prepare specifications for extending the storm sewer in Penn Ave., and for making house connections and other extensions in this avenue, as it is proposed to pave Penn Ave. at a cost of about $100,000.

SHARPSBURG, PA.—An election will soon be held to vote on the question of increasing the debt for constructing a system.

YEADON, PA.—Bids are asked until Aug. 24 for the purchase of $11,000 of sewer bonds. Albert Moore, Secy.

CHILLICOTHE, O.—J. P. Force, of Fostoria, O., has completed plans for a system to cost about $94,000. Edward Kern, Chn. Com.

CLEVELAND, O.—Bids are asked until Aug. 5 for constructing sewers in two streets. D. E. Wright, Dir. Pub. Wks.

MIDDLETOWN, O.—L. Martin, Secy., writes us that only preliminary steps have as yet been taken toward a sewer system. The committee was organized July 7.

FRANKFORT, IND.—Bids are asked until Aug. 11 for the construction of about 966 ft. of 10-in. pipe sewer, with 6-in. house connections, with two manholes and one flush tank. A. J. Hammond, Cy. Engr.; Jas. A. Price, Cy. Clk.

MONMOUTH, ILL.—John W. Matthews, J. A. Higgins and Geo. B. Denman have been appointed a committee to consider the advisability of building a sewer in South Second St.

MONTICELLO, ILL.—Bids are asked until Aug. 4 for constructing about 3,700 ft. of pipe sewers, etc., as described in our advertising coumns. D. E. Widdersheim, Cy. Clk.; Ray S. Carberry, Engr., Monticello.

LA CROSSE, WIS.—Bids are asked until July 25 for constructing 15 and 12-in. pipe sewers in Eighth St. S. F. Nice, Chn. Comr. Pub. Wks.; Pred Ring Comptroller.

DES MOINES, IA.—Bids are asked until July 27 for constructing a 12-in pipe sewer in 27th St. John Sherman, Geo. C. Sims, Bd. Pub. Wks.

MASON CITY, IA.—Plans are being prepared for over a mile of 22-in. pipe and about half a mile of 10-in. pipe sewers, which will probably be built in the fall. Chester T. Dike, Cy. Engr.

SAN FRANCISCO, CAL.—It is reported that a resolution has been adopted by the supervisors ordering the city engineer to prepare plans for a system of sewers petitioned for by the Potrero Land Improvement Co. J. A. Russell, Clk.

HAMILTON, ONT.—W. F. Grant & Co., of Toronto, Ont., have been awarded the contract for furnishing a supply of sewer pipe.

GARBAGE DISPOSAL—STREET CLEANING.

ALTOONA, PA.—A committee has been appointed by the councils to investigate certain plans for a garbage disposal plant, according to reports.

PITTSBURG, PA.—The American Reduction Co. has been directed by the court not to deposit garbage at its plant until certain projected improvements are made to destroy the unpleasant odors.

STREETS AND ROADS.

BOSTON, MASS.—The Metropolitan Park Commission is reported to be in favor of building the Charles River Boulevard, for which the last legislature passed a bill appropriating $1,000,000.

BOSTON, MASS.—Bids are asked until July 24 for 13,000 sq.yds. of brick sidewalks, 8,960 lin. ft. of edge stones, etc. Benj. W. Wells, Supt. of Streets.

LOWELL, MASS.—It is proposed to pave 2,000 sq. yds. of Moody St. with brick. Geo. Bowers, Cy. Engr.

WATERTOWN, MASS.—It is proposed to widen and improve Mount Vernon St. at a cost of $60,000, about $25,000 of which is for land damages.

PAWTUCKET, R. I.—The committee has been petitioned to pave 3,000 lin. ft. of Cottage St. with asphalt; estimated cost, $20,000.

PROVIDENCE, R. I.—Arrangements are being made by the state commissioner of roads for the construction of half-mile sample macadam roads in a number of towns, for which the general assembly over a year ago approved an appropriation of $60,000.

HARTFORD, CONN.—Press reports state that 87 towns have applied to the Connecticut highway commission for state aid in constructing improved highways. Each town which completes its work will receive about $950 as its share of the state appropriation. Last year each town received $980, but more towns applied this year than last. Following is a list of towns that will receive a share of the state appropriation this year; James H. McDonald, Chn., 25 and 27 Capitol, Hartford:

Hartford county—Hartford, Avon, Berlin, Bloomfield, Bristol, East Hartford, East Windsor, Enfield, Farmington, Glastonbury, Manchester, New Britain, Newington, Plainville, Rocky Hill, Southington, South Windsor, Suffield, West Hartford, Wethersfield, Windsor, Windsor Locks.

New Haven county—New Haven, Ansonia, Derby, Hamden, Meriden, Middlebury, North Branford, North Haven, Orange, Seymour, Wallingford and Woodbridge.

New London county—New London, Norwich, Bozrah, Griswold, Groton, Montville, Voluntown, Waterford.

Fairfield county—Darien, Easton, Fairfield, Greenwich, Huntington, New Caanan, Norwalk, Ridgefield, Stamford, Stratford, Trumbull, Westport, Wilton.

Windham county—Brooklyn, Eastford, Killingly, Plainfield, Pomfret, Putnam, Thompson, Windham.

Litchfield county—Litchfield, Bethlehem, New Milford, Plymouth, Thomaston, Torrington, Watertown.

Middlesex county—Middletown, Cromwell, Durham, East Haddam, Essex, Middlefield, Old Saybrook, Portland, Saybrook.

Tolland county—Tolland, Andover, Ellington, Mansfield, Somers, Stafford, Vernon.

PLYMOUTH, CONN.—Henry E. Hinman, First Selectman, Terryville, Conn., informs us that the following bids were received July 8 for constructing 2,650 lin. ft. of macadam road: Fred T. Ley & Co., Springfield, Mass., $1.40 per lin. ft. for road in Terryville, and $1.85 per lin. ft. for the Plymouth Hill section; W. H. Scott & Co., Pequabuck, Conn., $1.30 and $1.75; John H. Doolittle & Co., New Haven (awarded contract), $0.98 and $1,28.

BROOKLYN, N. Y.—Bids are asked until July 27 for granite block repaving in Main St. and Maspeth Ave. Theo. B. Willis, Comr. Cy. Wks.——It is proposed to repave portions of Driggs and Putnam Aves. with asphalt at a cost of $47,000; Cropsey Ave. with macadam, at a cost of $37,000, and Bath Ave. with Belgian blocks, at a cost of $24,000.——The park commissioner proposes to macadamize the Park Plaza at a cost of $50,000.——E. J. McKeever & Bros. were the lowest bidders on the granite block paving in Tompkins Ave., at $37,442.

DEPEW, N. Y.—Bids are asked until July 27 for about 3,600 lin. ft. of macadam paving. Anthony Hartung, Village Treas.; Patrick E. Scully, Clk.

FLUSHING, N. Y.—We are informed that the following bids were received July 9 for macadamizing 2¼ miles of Bell Ave., as advertised in Engineering News; G. A. Roullier, Engr., 20 Main St., Flushing:

Thomas F. Touhy, Flushing	$31,282
Smith & Burden, Long Island City, N. Y.	27,855
Thomas J. McKenna, 35 Broadway, New York	26,826
Harvey B. Peace, Flushing	24,802
Wm. F. McCabe, Mamaroneck, N. Y.	23,742
*Ridgeway & Chapman, 253 Broadway, New York	21,793

*Awarded contract.

JAMAICA, N. Y.—Bids are asked until July 30 for macadamizing a road nine miles long between Jamaica and Hempstead, and until Aug. 6 for macadamizing a road two miles long, from Newtown to Jamaica, as described in our advertising columns. Robt. Seabury, Clk.; John J. McLaughlin, County Engr., Bank Bldg., Jamaica.

LANSINGBURG, N. Y.—The question of paving Second Ave. at a cost of about $100,000 is being discussed.

NEW YORK, N. Y.—Bids are asked by the department of public parks, the Arsenal, Central Park, until July 27, for about 14,000 sq. yds. of granite block paving, 2,200 sq. yds. of gravel paving, 31,000 sq. ft. of concrete walk, etc., and for other work in constructing Riverside Park and Drive, from 120th to 129th St; surety, $70,000.

NEW YORK, N. Y.—Bids are asked until Aug. 1 for asphalt paving in Alexander Ave., and for sewers in two streets, etc. L. F. Haffen, Comr.

NORTH TONAWANDA, N. Y.—The board of trustees of the village has announced its intention to have several streets graded and some paving done. Bids will be invited for the work.

ROCHESTER, N. Y.—Bids are asked until July 24 for cement sidewalks in four streets. Thos. J. Neville, Clk. ——The city engineer is preparing plans for asphalt paving in Monroe St., from Oxford to Alexander St.

ROCHESTER, N. Y.—It is proposed to pave Allan St. with Medina stone at a cost of $32,000, and South St. Paul St. at a cost of $24,000, and make improvements in seven streets, at a cost of about $44,000. T. S. Pulver, Cy. Clk.

TROY, N. Y.—Bids are asked until July 31 for granite block paving in Vanderheyden St. E. Ogden Ross, Secy.

DELFORD, N. J.—Bids are asked until Aug. 3 for grading and macadamizing the streets of this borough, as stated in our advertising columns. R. W. Cooper, Mayor; Milton G. Demarest, Clk., address Oradell, N. J.

LONG BRANCH, N. J.—Bids are asked until Aug. 10 for constructing five miles of macadam road, with gravel wings, at Long Branch, as stated in our advertising columns. John Guire, Chn. Road Com.; W. H. De Nyse, Engr., Long Branch.

MAGNOLIA, N. J.—Gloucester county formally accepted the Swedesboro stone road on July 16 from the contractor, R. A. Montgomery, of Lambertville, N. J.; paying him the balance due. J. J. Albertson, Engr.

WOODBURY, N. J.—It is reported that at the meeting of the Gloucester county board of freeholders July 16 a committee of five was appointed to prepare plans and specifications for a stone road from Swedesboro to Paulsboro, which had been deferred for some time. The committee was also instructed to investigate the cost of shell roads. John S. Jessup, County Solicitor, gave an opinion that the cost of maintenance of stone roads would, after their acceptance, fall upon the county, and that no portion would be paid by the townships direct.

BLAIRSVILLE, PA.—It is stated that this place has voted to issue $10,000 in bonds for paving certain streets.

BRADFORD, PA.—Bids are asked until July 27 for paving portions of Jackson and Walker Aves., as stated in our advertising columns. James A Lindsey, Cy. Clk.

PITTSBURG, PA.—E. M. Bigelow, Dir. Pub. Wks., is making arrangements for constructing the Boulevard, bids for which will soon be asked.

PITTSBURG, PA.—Bids are asked until July 31 for grading, asphalt paving, curbing, macadamizing, etc., portions of 16 streets. Edward M. Bigelow, Dir. Pub. Wks.

READING, PA.—We are informed that a $100,000 appropriation ordinance is now pending to pave Penn St. with asphalt. John H. Keppelman, Member of Select Council; E. Chamberlain, Cy. Engr.

ANNAPOLIS, MD.—Bids are asked until July 28 for grading and paving in three streets. F. M. Ramsay, Ch. Bureau of Navigation, Washington, D. C.

WASHINGTON, D. C.—Bids are asked until Aug. 5 for constructing about 2,800 lin. ft. of a macadam road, 12 ft. wide. Maj. Geo. W. Davis, Pres. Antietam Battlefield Board, Washington.

FORTRESS MONROE, VA.—Bids are asked until Aug. 7 for constructing brick pavements and a concrete sea wall. J. W. Pullman, Asst. Q. M., U. S. A., Fortress Monroe.

WICKLIFFE, KY.—It is reported that J. B. Postlethwaite, of Paducah, Ky., has prepared plans for paving certain streets. W. T. White, W. O. Schelbourne and I. E. Conley are interested.

NASHVILLE, TENN.—The board of public works has decided to advertise for new bids for furnishing pipe, brick, clay and other street supplies.

CLEVELAND, O.—Bids are asked until Aug. 12 for asphalt paving in Princeton St., bond, $2,000. D. E. Wright, Dir. Pub. Wks.

EVANSTON, O.—Bids are asked until Aug. 8 for brick paving in two streets. Engr., Chas. A. Ewing, 36 Carlisle Bldg., Cincinnati, O.; Wm. H. Krapp, Clk.

SOUTH BEND, IND.—The city engineer has been directed to prepare specifications for paving three streets with brick.

BRAZIL, IND.—Kattman & Murphy, of Brazil, Ind., and Paris, Ill., have been awarded the contracts for macadamizing about 13¾ miles of road in Brazil and Posey townships, at $33,629. Thos. Phillips, County Audr.

GRAND RAPIDS, MICH.—We are informed that James McDermott has been awarded the contract at $38,317 for paving South Division St., from East Fulton St. to Fifth Ave., with cedar blocks on concrete, and that Gilner & Miller have the contract at $18,182 for cedar block paving in South Division St., from Fifth Ave. to Hall St.

PORT HURON, MICH.—Plans have been prepared for paving Stone St. with cedar blocks, laid on a pine board foundation, from Thomas St. to River St. It will require 14,230 sq. yds. of paving and 7,660 lin. ft. of curb stone; estimated cost, $14,402. F. F. Rogers, Cy. Engr.; Henry Raumeier, Supt. Pub. Wks.

CHICAGO, ILL.—Bids are asked until July 28 for about 2,000 lin. ft. of granite concrete combined curb and gutter in Garfield Park. Harvey T. Weeks, Pres.; Geo. F. Talty, Secy., West Chicago Park Comrs, Union Park.

GALESBURG, ILL.—Bids are asked until Aug. 3 for paving two streets with brick. M. J. Blanding, Cy. Engr.; A. W. Truedson, Cy. Clk.

BELOIT, WIS.—Bids are asked until Aug. 7 for about 8,000 sq. yds. of brick and macadam paving, as stated in our advertising columns. Edgar S. Greene, Pres. Bd. Pub. Wks.; E. F. Hansen, Secy.

KANSAS CITY, MO.—Bids are asked until Aug. 3 for grading the Atherton and the Barton roads. F. J. O'Flaherty, County Surv., Kansas City.

ST. PAUL, MINN.—Bids are asked until July 27 for improving and boulevarding Summit Ave., from Sixth St. to Rice St. R. L. Gorman, Pres.; John C. Mueller, Clk. Bd. Pub. Wks.

TACOMA, WASH.—The "Ledger" of July 7 says the county commissioners have decided to again reject all bids for the construction of the Puyallup Boulevard, and to readvertise for new ones.

PORTLAND, ORE.—It has been decided to pave Washington St. with asphalt, work on which will be begun in September.

MANUFACTURING PLANTS.

YARMOUTH, ME.—It is stated that the Forest Paper Co. proposes to erect a new paper mill which will be two stories high with basement 150 × 50 ft.

BROOKLYN, N. Y.—Fire has partly destroyed the plant of the Alberine Varnish Works. The loss is estimated at $50,000. H. J. Romburg, F. J. Emanuel and Julius Hannan are the owners.

GLOVERSVILLE, N. Y.—It is stated that the Excelsior Fur Sewing Machine Co. intends to build a factory for the manufacture of sewing machines and bicycles. The company has options on several building lots and a building will be erected as soon as arrangements can be made.

NEW YORK, N. Y.—The Gas Engine & Power Co. of Morris Heights has plans and specifications for a new two-story machine shop, 250 × 76 ft., to be constructed of steel.

PAINTED POST, N. Y.—The Weston Engine Co., whose plant was recently destroyed by fire, will rebuild at once.

CONNELLSVILLE, PA.—It is reported that the contract has been let for the new plant of the Sloymaker-Barry Co. The building will be of steel.

ELWOOD CITY, PA.—A press dispatch states that the Baker Forge & Iron Co. is doubling the size of its forge works.

GREENVILLE, PA.—A press report states that the Lozier Tube Co. is to erect a large tube works, in which it will install entirely new machinery.

NEW CASTLE, PA.—Press reports state that an open-hearth steel plant may be erected costing about $750,000. Phelps, Dodge & Co., of New York; Norton Bros., of Chicago, and the tin plate and tubing mills at New Castle, Pa., are said to be among those who are backing the enterprise. The product of the plant will be hollow steel billets suitable for the manufacture of all kinds of tubing, including pipe.

POTTSTOWN, PA.—It is stated that the Glasgow Iron Co. is to erect another rolling mill.

CHARLOTTE, N. C.—The Louise cotton mill is being erected and will soon be ready for equipment. H. S. Chadwick, Pres., Charlotte, N. C.

COLUMBIA, S. C.—The Columbia Cotton Mills Co. has increased its capital stock from $700,000 to $1,000,000 and will either build an additional mill or largely increase the size of the present plant.

ATLANTA, GA.—The Atlanta Textile Mfg. Co. and the Piedmont Cotton Mills Co. have combined their capital and will build a large mill, which with the equipment will cost $500,000 or more and will be built at once. R. U. Hardeman, Pres.; W. J. Willingham, Mgr., Atlanta, Ga.

DONALDSONVILLE, LA.—A dispatch states that the Souvenir Sugar Refinery, three miles from here, has been destroyed by fire. The loss is about $75,000. Mr. Goldehaux, New Orleans, La., is the owner.

BRISTOL, TENN.—It is reported that the Willey Boom & Lumber Co. is adding a planing mill to its plant.

CANTON, O.—The Berger Mfg. Co. is pushing to completion a new building, 20 × 60 ft. in size, in which will be manufactured steel tubing for bicycles.

YOUNGSTOWN, O.—Press reports state that an addition is being made to the lower mill of the Union Iron & Steel Co., and improvements are being made in other departments.

JOLIET, ILL.—It is stated that Humphrey & Sons are building a large addition to their foundry. It will contain six pneumatic cranes.

MILWAUKEE, WIS.—Press reports state that the Yeuder & Paeschke Mfg. Co. contemplates the erection of a 40 × 69-ft. three-story addition to its tinware factory.

SAN FRANCISCO, CAL.—The Royal Eagle Distillery Co. has obtained a permit to build a four-story brick building at Powell and Ellis Sts., to cost about $41,345.

MINING.

PITTSBURG, PA.—A local paper states that George Barrett, of this city, has purchased a large tract of land on the river bank between Industry and Cook's Ferry, and will put in railway switches and open one of the largest stone quarries in the western part of the state, at a cost of about $25,000.

CRIPPLE CREEK, COLO.—It is stated that the new Ida May shaft will be sunk an additional 100 ft. For 40 ft. the chute holds firm and at even value and it is now proposed to sink and get below the ore. The vein has been opened by surface workings for a length of 1,000 ft.

DENVER, COLO.—The "Republican" has published a map showing the proposed system of the Pikes' Peak Mining Tunnel Ry. The main tunnel is to start from near Manitou, east of Pike's Peak, cut through the front range and pass under Victor, where are the Portland, Independence, Strong and other mines, at a depth of 2,800 ft., ending at Middle Creek, 21 miles distant. The project contemplates branch tunnels, for which the situation of Cripple Creek is so favorable. The main tunnel will be 14 ft. high and 18 ft. wide.

BUTTE, MONT.—The "Miner" contains the following items: The Anaconda mine is preparing to sink deeper levels, and a depth of 3,000 ft. will probably be reached.——It is reported that a 300-ton concentrator will be put in the Merrill mine at Porphyry dike, 17 miles north of Basin. The Pauper's Dream, at the same place, is soon to have a 300-ton mill. Other properties along the dike are being rapidly improved.——Adam O'Donnell will soon leave to work on his claim in the St. Joe district. He has a tunnel 60 ft. and expects to push it much farther this season.——L. F. Williams and others have purchased the Sullivan group of mines in East Kootenay. They will probably put in a concentrator next season.

GREEN VALLEY, CAL.—It is stated that Fred Jones, of Green Valley, and a number of other capitalists have located a promising quartz claim in El Dorado county. Vigorous operations are now being carried on and the company intends to erect a mill. The property is known as the Omo mine.

YUMA, ARIZ.—Wm. Luce is reported as to put up a 20-ton cyanide plant on the Colorado River, at El Rio.

CONTRACT PRICES.

ASPHALT, BRICK AND GRANITE PAVING.—Minneapolis, Minn.—F. W. Cappelen, Cy. Engr., writes us that the following bids were received July 10 for 16,242 sq. yds. of brick, 2,117 sq. yds. of asphalt and 422 sq. yds. of granite paving:

	5,873 sq.yds.	9,947 sq.yds.	1,695 sq.yds.	422 sq.yds.
Iowa Brick Co. (vit. brick)..	$1.91	$1.89	....	$1.89
Des Moines Brick Mfg. Co.[1]..	1.92	1.92	....	....
Des Moines Brick Mfg. Co.[2]..	1.85	1.85	....	....
Columbia P. Co., Minneapolis[2]	1.99	1.96	....	1.82
E.M.Ayres (Utah Asp.)Zanesvl	....	....	$2.45	2.75
Warren-Scharf Asp. Pvg. Co.	....	....	2.49	2.83
Canney Bros., Minneapolis[3]...	....	....	....	2.00

[1]Repressed brick. [2]Vitrified brick. [3]Granite.

SEWERS.—Fulton, N. Y.—We have received the following detailed statement of the bids received July 10 for constructing a system of sewerage as advertised in Engineering News; T's, Y's, slants, bends, split pipe and specials double the price of straight pipe; engineer's estimate, $50,000; Reeves Smith, Engr.; Geo. E. True, Pres. Comrs.; Arvin Rice, Clk. Comrs.:

BIDS FOR THE CONSTRUCTION OF A SYSTEM OF SEWERAGE, FULTON, N. Y., JULY 10, 1896

Quantities.		G. W. Barlow & Co., Seneca Falls, N.Y.	Dodge & McGregor, Buffalo, N. Y.	Lauer & Hagaman, Rochester, N. Y.	Geo. S. Miller & Co., Ottawa, Ill.	Lucius D. Hulburt, Syracuse, N. Y.	Patrick F. Curran, New York.	Johnson & Dwyer, Utica, N. Y.	Walter Bradley & Co., Fulton, N. Y.	C. Alden Smith, Buffalo, N. Y.	J. W. Bustin, Syracuse, N. Y.	Johnson & Patrick, Fulton, N. Y.	Clement & Co., Niagara Falls, N. Y.	Beck & Bradley, Watertown, N. Y.	John Madigan, Yonkers, N. Y.	S. W. Frescoln, Reading, Pa.
20-in. vit. pipe furnished and laid..	3,000 ft.....	$0.57	$0.55	$0.54	$0.50	$0.50	$0.46	$0.50	$0.57	$0.60	$0.49	$0.50	$0.46	$0.67	$0.51	$0.68
18-in. " " " " " ..	100 "	.55	.44	.43	.40	.45	.36	.39	.47	.45	.43	.39	.35	.55	.42	.57
15-in. " " " " " ..	8,100 "	.35	.30	.33	.37	.32	.28	.30	.37	.35	.32	.30	.26	.41	.32	.48
12-in. " " " " " ..	3,400 "	.25	.22	.24	.33	.25	.22	.21	.27	.25	.22	.22	.18	.30	.24	.40
10-in. " " " " " ..	2,500 "	.17	.18	.19	.30	.22	.18	.17	.23	.20	.17	.18	.14	.22	.18	.17
8-in. " " " " " ..	57,400 "	.13	.12	.14	.22	.18	.12	.12	.15	.13½	.11	.14	.10	.16	.17	.13
6-in. " " " " " ..	2,900 "	.09	.09	.10	.14	.15	.11	.09	.13	.09	.10	.11	.07	.11	.10	.10
4-in. " " " " " ..	3,000 "	.07	.07	.07½	.12	.13	.09	.07	.11	.06	.07	.09	.05	.06	.08	.08
8-in. drain tile furnished and laid..	6,000 "	.04¾	.06	.06½	.09	.08	.12	.05	.07	.04½	.08½	.08	.20	.13	.08	.13
6-in. " " " " " ..	12,000 "	.04	.05	.05	.08	.06	.09	.04	.05	.04	.06	.08	.15	.09	.07	.11
4-in. " " " " " ..	12,000 "	.02¾	.04	.03½	.06	.04	.07	.03	.03	.04	.03	.06	.10	.06	.05	.08
3-in. " " " " " ..	20,000 "	.02¼	.03	.03½	.04	.04	.07	.02½	.01½	.03½	.02½	.06	.08	.05	.04	.075
Trenchg and backfillg, 2 to 6 ft..	22,500 "	.07½	.08	.10	.04	.13	.09	.15	.16	.13	.11	.11	.18	.20	.24	.13
" " " 6 " 8 " ..	33,300 "	.10½	.14	.14	.04½	.14	.19	.20	.23	.17	.22	.21	.25	.30	.35	.20
" " " 8 " 10 " ..	14,200 "	.21½	.19	.20	.10	.23	.27	.35	.35	.26	.31	.38	.32	.45	.47	.32
" " " 10 " 12 " ..	3,650 "	.37	.30	.32	.22	.33	.33	.75	.50	.35	.53	.80	.50	.54	.70	.48
" " " 12 " 14 " ..	1,150 "	.45	.45	.50	.50	.45	.49	1.00	.75	.60	.60	.90	.75	.65	1.08	.72
" " " 14 " 16 " ..	710 "	.90	.75	.67	.74	.55	.70	1.50	1.00	.85	.76	1.10	1.00	.85	1.36	.85
" " " 16 " 18 " ..	420 "	1.00	1.00	.78	.95	.75	.80	2.50	2.00	1.25	1.00	1.20	1.50	.95	1.70	1.35
" " " 18 " 20 " ..	150 "	1.00	1.25	.93	1.14	.75	1.00	3.00	3.00	1.50	1.23	1.25	2.00	1.10	2.20	2.10
" " " 20 " 22 " ..	120 "	1.50	2.00	1.20	1.45	.75	1.80	3.25	3.00	1.75	1.48	1.30	2.25	1.15	3.30	2.33
" " " 22 ft. and over	10 "	1.50	3.00	1.25	1.75	.75	2.00	3.25	4.00	2.50	1.66	1.40	3.00	1.20	3.89	3.00
Spruce timber in place	50 M. ft...	21.00	12.00	14.50	16.00	14.00	20.00	15.00	12.00	20.00	19.00	20.00	20.00	30.00	15.00	25.00
Steam R. R. crossing	100 ft......	1.00	1.00	1.00	.50	2.00	1.50	1.00	1.00	4.00	1.00	1.25	1.00	1.00	1.25	1.00
Rock excavation	2,500 cu. yds.	1.55	1.50	1.40	2.85	2.00	2.60	1.50	1.75	2.50	2.20	2.40	3.00	3.30	3.00	2.50
Cast-iron pipe in place	30 tons...	35.00	35.00	35.00	22.00	30.00	30.00	30.00	26.00	33.00	27.50	26.00	25.00	26.65	42.00	30.00
Iron and steel	5,000 lbs.....	.05	.03	.06	.06	.05	.10	.05	.04	.03	.10	.05	.05	.03½	.05	.05
Flushtanks: Van Vranken, single..	72 each...	43.00	.45.00	42.00	46.00	55.00	40.00	40.00	28.00	45.00	60.00	45.00	21.50	57.00	65.00	68.00
Van Vranken, double	3 " ...	55.00	60.00	60.00	65.00	55.00	60.00	70.00	28.00	70.00	95.00	45.00	44.00	75.00	90.00	125.00
Miller, single	72 " ...	.....	45.00	.....	.....	55.00	40.00	.....	28.00	45.00	60.00	55.00	21.50	62.00	68.00	.....
" double	3 " ...	.....	60.00	.....	.....	55.00	60.00	.....	28.00	70.00	95.00	55.00	44.00	80.00	90.00	.....
Others, single	72 " ...	.....	45.00	.....	46.00	.....	.....	.....	.....	.....	.....	45.00	45.00	.....	65.00	.....
" double	3 " ...	.....	60.00	.....	65.00	.....	.....	.....	.....	.....	.....	45.00	80.00	.....	90.00	.....
Manholes: No. 1, under 8 ft.	63 " ...	19.00	20.00	30.00	18.00	25.00	30.00	26.00	19.00	33.00	35.00	36.00	32.50	31.75	45.00	39.00
No. 1, over 8 ft.	30 " ...	25.00	25.00	40.00	22.00	35.00	40.00	30.00	19.00	38.00	45.00	43.00	35.00	46.75	40.00	50.00
No. 2, under 8 ft.	2 " ...	25.00	30.00	30.00	19.00	25.00	45.00	30.00	19.00	45.00	40.00	41.00	40.00	36.75	30.00	48.00
No. 2, over 8 ft.	10 " ...	29.00	35.00	43.00	24.00	35.00	50.00	35.00	19.00	50.00	[illegible]	44.00	50.00	65.00	50.00	60.00
Lampholes	28 " ...	2.50	3.00	3.00	4.00	5.00	8.00	8.00	7.00	5.00	4.50	4.00	5.00	3.00	9.50	7.00
Concrete: Nat. American	100 cu. yds.	4.00	4.00	4.00	3.00	4.50	5.00	4.00	2.00	3.00	4.75	4.00	4.00	4.95	4.50	6.00
Portland	200 " "	5.90	6.00	5.50	4.50	6.00	6.50	5.50	3.00	4.50	8.00	5.00	5.25	6.60	9.00	7.00
Rubble masonry, ...	20 " "	6.00	9.00	7.50	7.00	10.00	8.00	5.00	6.00	7.00	6.50	6.00	5.25	4.95	9.00	7.00
Embankment	1,000 " "	.40	.60	.40	.30	.60	.50	.25	.23	.75	.60	.40	.75	.33	.35	.75
Dredging	500 " "	.50	1.00	1.00	1.00	.80	.50	1.00	.75	1.50	1.00	.60	2.00	1.00	1.25	2.00
Bailing and draining		200.00	300.00	300.00	300.00	200.00	500.00	500.00	450.00	1000.00	350.00	500.00	1000.00	800.00	1100.00	3500.00
Total		$41,355	$41,658	$44,275	$46,372	$50,055	$50,796	$50,839	$50,882	$52,013	$52,724	$56,656	$57,325	$68,043	$73,084	$76,336

SEWER.—New York, N. Y.—The following bids were received by Louis F. Haffen, Comr., 2622 Third Ave., July 18 for constructing a sewer in Cromwell Ave., Jerome to Inwood Ave.:

Quantities.		J. C. Rodgers & Son.	Michael Dunn.	M. J. Leahy.	Bart. Dunn.
Sewers:					
Class I. ..	4,221 ft......	$18.00	$11.00	$17.45	$15.64
Class II. .	45 "	10.00	5.00	6.00	6.50
12-in. pipe	70 "	1.50	1.50	1.00	2.00
Spurs	1,160.........	.50	.50	1.00	.60
Manholes ..	25.........	70.00	50.00	55.00	60.00
Rec'g basins	3.........	150.00	150.00	150.00	1.70
Rock excav.	16,000 cu. yds.	.01	2.19	.20	2.50
Concrete ...	50 " "	6.00	4.00	4.00	3.00
Rubble mas.	250 " "	5.00	4.00	2.00	4.50
Brkn stone .	1,500 " "	2.50	2.00	.40	1.00
Piles	20,000 ft......	.25	.10	.19	.20
Lumber	200 M. ft...	20.00	20.00	30.00	15.00
18-in. pipe .	100 ft......	1.50	1.00	1.15	2.00
Days to complete work....		200	200	175	300
Total		$94,579	$95,181	$92,096	$120,330

MISCELLANEOUS CONTRACTS.

STEAM ROAD ROLLER.—Worcester, Mass.—The street commissioner has been directed to purchase a steam road roller to cost $3,000.

FIRE HOSE.—Baltimore, Md.—Bids are asked until Aug. 3 for furnishing about 9,000 ft. of 3 and 2½-in. fire hose. A. R. Cathcart, Pres. Comrs.

CEMENT.—Brooklyn, N. Y.—Bids are asked until July 28 for furnishing 3,000 to 3,500 bbls. of Portland cement at Wallabout Market lands. T. B. Willis, Comr. Cy. Wks.

STEEL CHIMNEY.—Washington, D. C.—Bids are asked until July 25 for erecting a steel smoke chimney at the government printing office. T. E. Benedict, Pub. Printer.

LEVEE WORK.—Memphis, Tenn.—Bids are asked until July 30 for the construction and repair of levees in Upper Yazoo levee district. Capt. Graham D. Fitch, U. S. Engrs.

DIKE WORK.—New York, N. Y.—Bids are asked until Aug. 15 for constructing and repairing dikes in Hudson River, as stated in our advertising columns. Col. G. L. Gillespie, U. S. Engrs.

WIRE FENCE. — Washington, D. C.—Bids are asked until Aug. 10 for furnishing materials and erecting 18,000 ft. of wire fence, with gates, at Wakefield, Va. Col. John M. Wilson, U. S. Engrs.

STONE AND BRUSH JETTY.—Cleveland, O.—Bids are asked until Aug. 7 for constructing a stone and brush jetty from Cedar Point, at Sandusky Harbor, O. Lt.-Col. Jared A. Smith, U. S. Engrs.

WIRE FENCE.—Washington, D. C.—Bids are asked unlti Aug. 5 for furnishing about 1,200 ft. of wire fencing for the battlefield of Antietam, Va. Maj. Geo. W. Davis, Pres. Bd., War Records Office.

CONCRETE COPING.—East Marion, N. Y.—Bids are asked until July 29 for a concrete coping on the sea wall between East Marion and Orient, Suffolk county. Geo. W. Aldridge, Supt. Pub. Wks., Albany.

REMOVAL OF WRECKS.—St. Augustine, Fla.—Bids are asked until Aug. 20 for the removal of certain wrecks from Key West Harbor, as stated in our advertising columns. Lt.-Col. W. H. H. Benyaurd, U. S. Engrs.

ADDITION TO VAULT.—Brooklyn, N. Y.—Bids are asked until July 28 for building an addition to a vault in the building occupied by the department of health, at 38 and 40 Clinton St. Theodore B. Willis, Comr. Cy. Wks.

CRIBS.—Detroit, Mich.—Bids are asked until July 31 for furnishing materials, constructing, sinking and filling seven cribs in Hay Lake Channel, as stated in our advertising columns. Maj. M. B. Adams, U. S. Engrs.

STEAM ENGINE, LATHE DRILL.—Baltimore, Md.—Bids are asked until Aug. 1 for furnishing the water department with one horizontal 50-HP. stationary steam engine, one 18-in. swing engine lathe, to turn 10 ft. between centers, and one No. 2 radial drill. Wm. L. Kenly, Ch. Engr.

DISINFECTING PLANT. — Pittsburg, Pa. — Bids are asked until July 31 for furnishing the bureau of health and erecting on municipal hospital grounds the following machinery, apparatus and appliances: One jacketed steam disinfecting chamber, having a capacity, in inside measurement, of not less than that represented by a chamber 4 ft. 4 ins. wide, 5 ft. 4 ins. high, and 9 ft. long, together with the necessary boiler, air exhausters, indicators, gages, thermometers, valves, pipes, cars, tracks, racks, cranes, magnesia covering and all such other appliances, apparatus and fixtures as may be necessary to the successful operation of a thorough and effective system of steam disinfection, under pressure. J. O. Brown, Dir. Dept. Pub. Safety.

FIRE ENGINES.—Chicago, Ill.—Bids are asked until July 30 for furnishing two second-class steam fire engines and three third-class combination steam fire engines (engine and hose wagon combined), said engines to be double pump, crane neck, with improved patent circulating coil boiler, made of homogeneous steel and of sufficient strength to bear double the greatest pressure ever required for fire service; to have brass, nickel-plated dome; pumps to be entirely of gun metal, with improved cone valves and relief valve, and engine to be supplied with improved equalizing platform spring rigging in front and half elliptical springs in rear. D. J .Swenie, Fire Marshal.

THIS OFTEN HAPPENS.

Pella, Ia., July 18, 1896.

Engineering News Publishing Co.,
New York city.

Gentlemen: I cannot do otherwise than consider the Engineering News an excellent medium through which to make known the wants of any and all parties desiring bids upon work pertaining to water service, as the small advertisement given two insertions in your publication brought us almost a deluge of inquiries from contractors, supply men, builders, etc., so much so that we did not have specifications enough for all, although we had prepared what we thought to be an ample supply.

Yours truly, D. S. Huber,
Chn. W. W. Com.

BUILDINGS, ETC.

Collins State Homeopathic Hospital, Collins. N. Y.

Sealed proposals will be received by the Board of Managers of the Collins State Homeopathic Hospital until 10 o'clock a. m., Aug. 4, 1896, for constructing an Administration Building and one hospital wing, including plumbing, heating, ventilating and electric work and appurtenances, at Collins, N. Y., aggregating in cost about eighty thousand dollars ($80,000) in accordance with plans and specifications on file with August C. Esenwein, Architect, 707 Mooney Building, Buffalo, N. Y.

Each proposal must be made on blanks provided by the architect, enclosed and addressed as provided in the specifications.

Each proposal must be accompanied by a bond as provided by the specifications.

Proposals will be received upon the whole or any part of said work.

Plans and specifications may be seen and bid blanks secured at the office of the architect.

The right to reject any or all bids is expressly reserved by the Board of Managers.

WILLIAM TOD HELMUTH, M. D.,
ASA STONE COUCH, M. D.,
FRED. J. BLACKMON,
Board of Managers.
AUGUST C. ESENWEIN, Architect. 30-1t

SEWERS.

Monticello, Ill.

Sealed proposals will be received at the office of the City Clerk of the City of Monticello, Illinois, up to 8 o'clock p. m., of August 4, 1896, for constructing sanitary sewers. The work will consist approximately of the following: 3,283 lineal ft. 6-in. pipe sewer, 383 lineal ft. 8-in. pipe sewer, 560 lineal ft. trenching and backfilling between 4 and 6 ft., 1,676 lineal ft. trenching and backfilling between 6 and 8 ft., 1,340 lineal ft. trenching and backfilling between 8 and 10 ft., 100 lineal ft. trenching and backfilling between 10 and 12 ft., 8 manholes, 4 flush tanks, together with lampholes.

Plans and specifications are on file at the office of the City Clerk, and blank forms for bids and requirements for bidding may be had on application to the City Clerk or City Engineer.

The City Council reserves the right to reject any and all bids for any reason they may deem sufficient.

D. E. WIDDERSHEIM,
RAY S. CARBERRY, City Clerk.
Civil Engineer.
Monticello, Ill., July 20, 1896. 30-1t

RESERVOIR.

Tyrone, Pa.

Bids will be received by the Tyrone Gas & Water Co. for the construction of a Reservoir, until noon, Aug. 1, 1896.

Plans and specifications may be seen at the office of the Engineer, Tyrone, Pa.

All bids must be indorsed "Bid for Reservoir," and addressed to

C. A. MORRIS, Secretary,
30-1t Tyrone Gas & Water Co.

U. S. ENGINEER OFFICE, Army Building, New York, N. Y., July 10, 1896.—Sealed proposals for constructing and repairing DIKES in Hudson River, N. Y., will be received here until 12 m., August 15, 1896, and then publicly opened. Information furnished on application. G. L. GILLESPIE, Col., Engrs. 30-3t

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PAVING.

Bradford, Pa.,

Sealed proposals will be received by the undersigned up to 5 o'clock p. m., Monday,

JULY 27, 1896,

for the paving of Jackson Ave., in the City of Bradford (except that portion thereof which the Bradford Electric Street Railroad Company is required by ordinance to pave). Also for the paving of Walker Ave. Both streets (or avenues) to be paved according to the plans and specifications of the City Engineer, now on file in my office. Each bid to be accompanied by a certified check in the sum of $300, to be forfeited to the city in case the successful bidder fails to enter into a contract for the construction of said pavement within ten (10) days from the date of the awarding of the same. Councils reserve the right to reject any and all bids.

JAS. A. LINDSEY, City Clerk,
Rosenberg & Michael Block.
Bradford, Pa. 30-1t

OFFICE OF LIGHT-HOUSE ENGINEER, 11th District, Detroit, Mich., July 10, 1896.—Sealed proposals, addressed to the undersigned, will be received at this office until 2 o'clock p. m., of July 31, 1896, and opened immediately thereafter, for furnishing 40,968 feet B. M. of white pine timber; 75,832 feet B. M. of hemlock or Norway pine timber; 15,232 feet B. M. of white oak plank; 460 cords of foundation and filling stone; 1,708 lbs. of screw and washer bolts; 6,125 lbs. of drift bolts and spikes; 1,450 lbs. of guy rods, strap fastenings and angle irons, and constructing, sinking and filling SEVEN CRIBS in Hay Lake Channel, St. Mary's River, Michigan. Specifications, forms for proposals and detailed information can be had on application. MAJOR M. B. ADAMS, Corps of Engineers, U. S. A., Light-House Engineer.

U. S. ENGINEER OFFICE, St. Augustine, Fla., July 20, 1896. To whom it may concern: Whereas, the navigation of the Man of War Harbor at Key West, Fla., is obstructed and endangered by certain wrecks, notice is hereby given to all persons interested in said wrecks, and property pertaining thereto, that if within 30 days from date of this advertisement, they shall not have signified their intention to me and taken preliminary steps to REMOVE SAID WRECKS, etc., as soon as practicable the same will be considered as abandoned and derelict and they will be removed by the United States under authority of law. The wrecks are as follows: Bark "Marcelo," Schooner "Adelaide Baker," Bark "Brandon," Schooner "Rosalie," Bark "Anto," Ship "Marie Frederika," Bark "Almora," Steamer "Cochran," and old "Dry Dock." Sealed proposals, in triplicate, for the removal of all these wrecks, etc., will be received here until 11 a. m., August 20, 1896, and publicly opened. Government reserves right to reject any or all bids, and to waive any informalities. For information apply here. By authority of the Secretary of War. W. H. H. BENYAURD, Lt. Col., Engrs. 30-4t

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TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., July 21, 1896.—Sealed proposals will be received at this office until 2 o'clock p. m., on the 21st day of August, 1896, and opened immediately thereafter, for all the labor and materials required for the erection and completion (except heating apparatus) of the U. S. CUSTOM HOUSE AND POST OFFICE BUILDING at Racine, Wisconsin, in accordance with the drawings and specifications, copies of which may be had at this office or the office of the Superintendent at Racine, Wisconsin. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any or all bids and to waive any defect or informality in any bid, should it be deemed in the interest of the Government to do so. All proposals received after the time stated for opening will be returned to the bidders. Proposals must be enclosed in envelopes, sealed and marked "Proposal for the Erection and Completion (except heating apparatus) of the U. S. Custom House and Post Office Building at Racine, Wisconsin, and addressed to WM. MARTIN AIKEN, Supervising Architect.

WATER-WORKS.

Silver Creek, N. Y., July 9, 1896.

Sealed proposals will be received by the Board of Water Commissioners of the Village of Silver Creek, N. Y., up to 7 o'clock p. m.,

AUGUST 1, 1896,

for furnishing the materials and constructing a gravity system of water-works for said village. There will be required approximately the following:

1,430 tons (about 13¼ miles) of cast-iron pipe.
73 fire hydrants.
87 grate valves and boxes.
Concrete lined reservoir.

Bids will be received for constructing the work independent of furnishing material, for furnishing any of the materials mentioned above and for constructing the works complete, including furnishing material. A certified check equal to 2% of the amount of the bid must accompany each bid.

Plans may be seen and specifications and blank forms of proposal procured at the office of the Secretary of the Board, Silver Creek, N. Y., or at the office of the engineer, J. F. Witmer, Rooms 65 and 66 Chapin Block, Buffalo, N. Y.

The right is reserved to reject any and all bids.

JOHN B. WEBSTER,
FRANK P. STEWART,
HUGO E. FENSKE,
CHAS. L. O'NEIL,
Board of Water Commissioners.
J. F. WITMER, Engineer,
Buffalo. 30-2t

WATER-WORKS.

Walkerton, Ind.

The Walkerton Water-Works Company, of Walkerton, Indiana, is now ready to receive bids for the erection of a tower, pumping station and for the equipping of a complete system of water-works, according to plans and specifications now on file in the office of the secretary of the Walkerton Water-Works Company.

A copy of the plans and specifications may be had by addressing

WILLIAM CLEM, Secretary.
Walkerton, Ind., July 17, 1896. 30-1t

PAVING.

Beloit, Wis.

Bids are asked until Aug. 7, 1896, at 12 o'clock noon for paving with macadam and brick about 8,000 sq. yds. in certain streets in the City of Beloit, Wisconsin. Address

BOARD OF PUBLIC WORKS,
30-2t Beloit, Wis.

POLICE STATION.

Carbondale, Pa.

Sealed proposals will be received by the City Clerk of Carbondale, Pa., until 8 p. m., Aug. 10, for the furnishing of material and labor for the remodeling of the City Police Station, according to plans and specifications on file in the City Engineer's Office.

Bidders will be required to enclose cash or certified check in the sum of $200 as a guarantee of good faith and that the successful bidder will enter into a contract within ten days if awarded the same.

The city reserves the right to reject any or all bids.

T. L. McMILLAN,
30-2t City Clerk.

MACADAM ROAD.

Long Branch, N. J.

Bids will be received until 12 o'clock m., Aug. 10, 1896, by the Board of Chosen Freeholders of Monmouth County, N. J., for the construction of five miles of macadam road with gravel wings, at Long Branch, N. J. For further information, specifications, etc., address JOHN GUIRE, Chairman of Road Committee, or W. H. DE NYSE, Engineer, Long Branch, N. J. 30-2t

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WATER-WORKS.

Doon, Iowa.

Notice is hereby given that A. N. Thompson, Town Clerk of the incorporated town of Doon, Lyon County, Iowa, will receive sealed bids for the construction of a system of water-works in said town of Doon (according to plans and specifications now on file in my office) up to six o'clock Monday evening, August 3, 1896. Each bid to be accompanied by a certified check in the sum of five hundred ($500) dollars conditioned that the bidder will enter into a written contract with said town for the amount specified in his bid should the town award to him the contract. Said contract to be awarded to the lowest responsible bidder. The town reserves the right to reject any or all bids. Plans and specifications may also be seen at the office of L. F. Wakefield, in Sioux City, Iowa.

A. N. THOMPSON,
Town Clerk.
Dated Doon, Iowa, July 7, 1896. 30-1t

SEWERS.

Woonsocket, R. I.

Sealed proposals will be received by the Board of Sewer Commissioners of the City of Woonsocket, R. I., at their office, Room 15 Longley Building, until 2 p. m., Monday, August 17, 1896, for constructing Sections Nos. 1, 2 and 3 of the sewerage system of said city.

Section 1. River wall, storage tanks, engine house foundations, grading, and a short piece of 36-in. brick sewer.

Section 2. 2,072 ft. 36-in. brick sewer and appurtenances; 148 ft. 32-in. brick sewer and appurtenances; 4 siphons under the Blackstone River and trench.

Section 3. 2,130 ft. 30-in. brick sewer and appurtenances.

Each section will be considered a separate contract.

Contractors may bid upon one or more sections.

Drawings and specifications may be seen and blank forms for proposals may be obtained at the office of the City Engineer, Room 20 Granite Block, Woonsocket, R. I.; also at office of Rudolph Hering, C. E., 277 Pearl St., New York.

Proposals must be made upon the blank forms furnished.

Each proposal for each section must be accompanied by a certified check for five hundred ($500) dollars, drawn to the order of Samuel P. Cook, City Treasurer of the City of Woonsocket, as surety that if the proposal is accepted a contract will be entered into.

The Board of Sewer Commissioners reserve the right to reject any and all bids.

FRANK E. HOLDEN,
GEORGE S. READ,
PHILIPPE BOUCHER,
Board of Sewer Commissioners.
July 14, 1896. 30-2t

Contract Work Should Always be Advertised in a Paper Read by Contractors.

Nearly Every Prominent Contractor and Manufacturer of Contractors' Supplies in North America Reads Engineering News.

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PERSONALS.

Mr. Rufus G. Russell, architect, of New Haven, Conn., died Aug. 2, aged 73.

Mr. John Evans has been appointed Superintendent of the Warrior Run (Pa.) Water Co.

Mr. A. J. Breidenbach, of Newark, N. J., has been appointed Superintendent of Sewers.

Mr. Hugh Campbell, an iron manufacturer of Ohio, died at Hanging Rock, O., July 30, aged 86.

Mr. William G. Audenried, President of the Philadelphia Milling Co., died July 28, aged 64.

Mr. H. Fegraus, of Duluth, Minn., has been appointed Chief Engineer of the Duluth & North Dakota R. R.

Mr. Walker W. Smith, Vice-President and Treasurer of the Stilwell-Bierce & Smith-Vaile Co., of Dayton, O., died July 30.

Mr. A. J. Cartter, Superintendent of Bridges and Buildings of the Chicago, Burlington & Quincy R. R., has resigned.

Mr. Edward L. Bartlett has been appointed a Sewer Commissioner of Baltimore, Md., to succeed Col. Henry T. Douglas, resigned.

Mr. F. P. Olcott has been elected President, and Mr. J. H. Hill General Manager, of the Galveston, Houston & Henderson R. R.

Mr. M. P. Myers has been appointed Superintendent of Bridges and Buildings of the Kansas City, St. Joseph & Council Bluffs R. R.

Mr. T. D. Hinchcliffe, General Manager of the Litchfield, Carrollton & Western Ry., with offices at Carlinville, Ill., has resigned.

Mr. William R. Carter, Master Bridge Foreman, of the New England R. R., with headquarters at Boston, Mass., died at Hyde Park, July 25.

Mr. P. T. Downs, Superintendent of Transportation of the Gulf, Colorado & Santa Fe Ry., has been appointed Acting Geoneral Superintendent.

Mr. B. E. McCall has been appointed General Manager of the Litchfield, Carrollton & Western Ry., to succeed Mr. T. D. Hinchcliffe, resigned.

Mr. John Sheridan, of West Virginia, has been appointed a government director of the Union Pacific Ry., to succeed Gen. Fitzhugh Lee, resigned.

Mr. James D. Andrews, Jr., has been appointed Assistant Engineer of the Bureau of Sewers of the Department of City Works, of Brooklyn, N. Y.

Mr. D. Morrice, Assistant Superintendent of the Central Division of the Grand Trunk Ry., with headquarters in Toronto, Ont., has been appointed Local Superintendent.

Mr. James Donohue, lately with the Kansas City, Pittsburg & Gulf R. R., has been appointed Vice-President and General Manager of the recently organized Missouri Central R. R.

Mr. Malcom Jackson, of Richmond, Va., has been elected President of the Parkersburg & Charleston R. R., a new line that will connect the Kanawha and Ohio rivers in West Virginia.

Mr. Thomas C. Woodbury, of Portland, Me., has been elected President of the new Omaha Water-Works Co., of Omaha, Neb., and Mr. Ellis L. Bierbower, of Omaha, has been elected General Manager.

Capt. William H. Hooker has been appointed Supervising Engineer of the Belleville and High Service pumping stations of the Jersey City (N. J.) water-works, to succeed Mr. William S. Miller, resigned.

Mr. W. L. Brubaker, of the firm of W. L. Brubaker & Bros., tap and die makers, of Millersburg, Pa., died July 25, aged 32. He was interested in the Millersburg Fifth Wheel Co., and was treasurer of the Home Water Co.

Mr. Alphonse Fteley, M. Am. Soc. C. E., Engineer of the Croton Aqueduct Commission, New York, has been appointed Chief Engineer, and Mr. Chas. E. A. Jacobsen, Consulting Engineer, of the Passaic River Pollution Commission.

The new Harbor Commission of Niagara Falls, N. Y., created by the last legislature, has been appointed by the mayor and consists of Messrs. John J. McIntyre, Thos. Gaskin, J. W. Caryl Ely, James Low and Albert H. Porter.

Mr. J. V. Patton, General Superintendent of the Pittsburg Division of the Baltimore & Ohio R. R., has resigned, but will retain his position as General Superintendent of the Pittsburg & Western Ry., with headquarters in Pittsburg.

Mr. L. J. Ferriter, Chief Dispatcher and Trainmaster of the Omaha & St. Louis Ry., has been appointed Assistant Superintendent of the Central Division of the Grand Trunk Ry., to succeed Mr. D. Morrice, promoted, with offices at Toronto, Ont.

Mr. F. P. Gridley has been appointed Superintendent of the Sweetwater Coal Mining Co., the Rock Springs Coal Co., the Van Dyke Coal & Mining Co., and the Wyoming Mercantile Co., at Rock Springs, Wyo., to succeed Mr. Charles R. Kelsey.

Mr. H. L. Page, Secretary of the Norfolk & Ocean View R. R., has been elected President, and Mr. C. E. Norton, Auditor of the same, has been elected Secretary and Treasurer of the new Norfolk, Willoughby Spit & Old Point R. R., with offices in Norfolk, Va.

Mr. Thomas Fletcher, of the firm of Broth & Co., leather dealers and shipowners, of New York city, died recently in Liverpool, England, where he was born in 1841. He followed the profession of a civil engineer for some time, being associated with his father.

Sir William Grove, of England, died Aug. 2, aged 85. He made several important discoveries in electricity and optics, and in 1842 announced the doctrine of "the mutual convertibility of the various natural forces and of their being all modes of motion or forms of persistent force.'

Mr. George Lowe, General Superintendent of the Pullman Iron & Steel Co., Pullman, Ill., has been appointed Superintendent of the Rolling Mill Department of the U. S. Car Co., to succeed Mr. Levi Bibbins, resigned, whose appointment to this office was noted in our issue of July 2.

Mr. J. M. Gruber, Division Superintendent of the Great Northern Ry., with headquarters at West Superior, Wis., has been transferred to Great Falls, Mont., as Superintendent of the Montana Central Ry., to succeed Mr. C. H. Jenks, who will resume his position of Division Superintendent at Grand Forks, N. D.

Mr. John J. Hogan, the inventor of the Hogan boiler, died on July 30. He was a native of Ireland and was apprenticed to the Reading Iron Works, near London, England. After coming to this country he resided for a time in New York city, and later in St. Louis, Mo. About two years ago he organized a company which undertook the construction of a water tube boiler of his invention and built works for that purpose at Middletown, N. Y.

Mr. John T. Areson, formerly General Superintendent of Repairs of the Long Island R. R., died at Jamaica (L. I.), N. Y., July 29, aged 86. He laid the first track of the Brooklyn & Jamaica R. R., in 1832, which was the beginning of the present Long Island R. R. system. After the completion of the road to Greenport, at the extreme eastern end of the island, he entered the service of the Pennsylvania R. R., and became General Superintendent of Repairs, resigning to return in a similar position to the former road. He held this office for 21 years.

Mr. De Witt Clinton Weeks, formerly of the firm of D. C. Weeks & Sons, builders, died in New York city, Aug. 3, aged 76. Among some of his most important works were the Charity Hospital, Blackwell's Island; Inebriate Asylum, Ward's Island; Children's Hospital, Randall's Island; St. Thomas' Church, 53d St. and 5th Ave.; Museum of Natural History, the high service tower at 93d St. and Columbus Ave., and the Columbia College Library building, all in New York city. The firm recently completed Mr. Geo. W. Vanderbilt's mansion at Biltmore, N. C.

Hon. Manuel G. Zamora, Mexican consul at New Orleans, died at Mandeville, La., July 24. He was born in Vera Cruz, Mex., Nov. 1, 1850, and was educated as a mining engineer in Berlin, Germany, following his profession afterwards in Freiberg, Saxony and Hanover. In 1871 he returned to Vera Cruz and was appointed to superintend the construction of the public library in that city, which is considered one of the handsomest buildings in the republic. In 1886 President Diaz appointed him Consul of Mexico at New Orleans, which position he has held continuously ever since.

Prof. Heinrich Ernst Beyrich, late Director of the Museum of Natural Science at Berlin, Germany, died July 5. He was born in Berlin, Aug. 31, 1816, and graduated from the University of Berlin with the degree of Doctor of Philosophy in 1837. He was appointed Assistant in the Museum of Mineralogy, and in 1857 obtained the supervision of the paleontological collection, and in 1875 was appointed the head of the museum. He was made Professor of Minerology in 1865. Since 1873 he had been the Associate Director of the government geological department and under his direction a complete geological map of Germany has been prepared.

Mr. Peter P. Parrott, iron manufacturer, died at Arden, N. Y., July 30. He was born in Portsmouth, N. H., June 18, 1811, and during his early life traveled extensively, once making a voyage around the world. He associated himself with his brother, the late Robert P. Parrott, in the manufacture of iron in Orange county, N. Y. Their furnaces for many years were among the most successful in the country and the one at Greenwood made most of the iron from which the celebrated Parrott guns and other ordnance were manufactured at the West Point foundry of Mr. Robert P. Parrott. At one time his property in Orange county contained over 10,000 acres and his employees and their families living on the property numbered over 1,500 persons. Mr. Parrott devoted himself to the improvement and development of his property for over 50 years, building roads and dams and working the numerous iron mines.

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ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Aug. 7. Secy., O. Von Geldern, 819 Market St., San Francisco, Cal.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Aug. 11. "Solar Work in Land Surveying and a New Mechanical Method for Doing It," by J. D. Varney. Secy., F. A. Colburn, Case Library Bldg.
NORTHWESTERN SOCIETY OF ENGINEERS.
Aug. 11. Secy., D. W. McMorris, 635 Burke Block, Seattle, Wash.
ENGINEERS' CLUB OF MINNEAPOLIS.
Aug. 17. Secy., E. Mexer, 1620 S. E. 4th St., Minneapolis, Minn.
WESTERN FOUNDRYMEN'S ASSOCIATION.
Aug. 19. Secy., S. T. Johnson, Monadnock Block, Chicago.
NEW ENGLAND ROADMASTERS' ASSOCIATION.
Aug. 19 and 20. Annual convention at Boston, Mass. Secy., F. C. Stowell, Ware, Mass.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Aug. 20. Kimball House, Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.
Aug. 20 to 22. Annual meeting at Buffalo, N. Y.
TACOMA SOCIETY OF CIVIL ENGINEERS AND ARCHITECTS.
Aug. 21. Secy., 201 Washington Bldg.
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
Aug. 24. Annual meeting at Buffalo, N. Y. Secy., F. W. Putnam, Cambridge, Mass.
AMERICAN MATHEMATICAL SOCIETY.
Aug. 31 to Sept. 1. Annual meeting at Buffalo N. Y.
ROADMASTERS' ASSOCIATION OF AMERICA.
Sept 8. Annual meeting at Niagara Falls, N. Y.
AMERICAN SOCIETY OF RAILROAD SUPERINTENDENTS.
Sept. 9 and 10. Annual meeting at Niagara Falls. Secy., C. A. Hammond, Asbury Park, N. J.
MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.
Sept. 9. Annual meeting in New York city.
AMERICAN INSTITUTE OF MINING ENGINEERS.
Sept. 21 to 30. Annual meeting at Denver, Colo. Secy., R. W. Raymond, 13 Burling Slip, New York city.
AMERICAN RAILWAY ASSOCIATION.
Oct. 7. Annual meeting in New York city. Secy., W. F. Allen, 24 Park Place, New York city.
ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.
Oct. 20. Annual meeting at Chicago. Secy., S. F. Patterson, Concord, N. H.
AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 24 and 25. Annual convention at St. Louis.

NATIONAL IRRIGATION CONGRESS.—The topics to be discussed at the annual meeting, to be held at Phoenix, Ariz., Dec. 15, 16 and 17 are: "Irrigation on Humid America," "Water Storage in Mountain States," "Climatology," and "Irrigation into Arid Regions."

NEW ENGLAND ROADMASTERS' ASSOCIATION.—At the fourteenth annual convention to be held at Revere House, Boston, Aug. 19 and 20, the following subjects will be discussed: "Track Tools," (Continued from last year); "Rail Joints," (Continued from last year); "Elevation of Curves;" "Preparation Necessary and Best Method of Repairing Washouts; Reminiscences of Same;" "How Can We Secure Better Rail in Line, Surface and Quality?" "Is an Automatic Switch Stand Desirable? How Can We Better Protect the Facing Switches?" "How Should a Spring Rail Frog be Constructed?" "How Should We Estimate and Settle Fire Claims?" Secy., pro tem., F. C. Stowell, Ware, Mass.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.—At the meeting to be held in Chicago, Oct. 20, the following subjects will be discussed: "How to Determine Size and Capacity of Openings for Waterways;" "Different Methods of Numbering Bridges. Should All Waterways be Numbered?" "Drawbridge Ends, Methods of Locking, including Locking of Turntables;" "Protection of Trestles from Fire, including Methods of Construction;" "Local Stations for Small Towns and Villages, giving Plans of Buildings and Platforms;" "Tanks, Size, Style, and Details of Construction, including Frost-proof protection to Tank and Pipes;" "Shearing of Rivets in Plate Girders and Cause Thereof;" "Best and Uniform System of Report Blanks for Bridge and Building Department;" "Protection of Railroad Structures and Buildings from Fire;" "Mechanical Action and Resultant Effects of Motive Power at High Speed on Bridges;" "Best and Most Economical Railway Track Pile Driver;" "Span Limits for Different Classes of Iron Bridges, and Comparative Merits of Plate Girders and Lattice Bridges for Spans from 50 to 110 ft.;" "Interlocking Signals." S. F. Patterson, Secy.

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NEW PUBLICATIONS.

LITERARY MAGAZINES.—We advise any of our readers who desire to broaden their minds by their reading to take one or more of the leading English reviews. The American magazines have for years surfeited their readers with notes of travel, generally too trivial to be worth reading; but in these English reviews we get some clear idea of the people of the far-off countries of Asia and Africa, and an understanding of the questions and problems that are agitating them. The series of papers on South Africa, by Olive Schreiner, now appearing in "The Fortnightly Review," must be ranked as the ablest and most searching discussion of the social questions that affect a nation's life that has appeared for a long time. The literary genius of the gifted author makes it even more interesting than Prof. Bryce's excellent essays on the same topic which have just been concluded in "The Century."

While it is aside from the topics commonly reviewed in this column, we are sure our readers will pardon us for taking space to reprint the following extract from Miss Schreiner's paper in the July "Fortnightly." She has been discussing the problem of the "Half-Castes" in South Africa, and setting forth in powerful language the fact that the "Half-Caste" is what he is in large degree because he is isolated from black and white races alike. She refers to "That almighty 'we,' the consciousness of which lies at the base of all organic virtue," and continues:

> We learn our first lesson in the consciousness of human solidarity, and, therefore, in the true school of virtue, as we lie infants against our mother's breast, white against white, black against black; and, looking to the face above, know dimly we are not alone. It is I and thou—we. Our knowledge widens when we stand betwixt our father's knees, and feel the great hands guarding us from harm—it is father, mother and I. It increases in our contact with the brethren of our blood, who eat of the same bread with us; it spreads wider when in the sports and studies of youth we are linked with certain of our fellows, and our personal interests are absorbed into those of our comrades and company. It takes a vast stride when as adults, beyond the limit of kinship and personal contact, we recognize our union with that vast body of human beings who share our speech and our historic past; and the final expansion takes place when, beyond the limits of the nation and even of the race, in the heart of the poet, the saint or the sage, the fully-developed human creature, that little "We," which for the infant means only "mother, breast, and I," and for the child, kindred; and for the youth, comradeship; and for the adult, nation and race—so widens itself that it enfolds, not merely kindred or nation, but all sentient life, and the final goal of morality is reached.
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> To the man who has attained this stage it would be as imposible to desire to inflict suffering on the feeblest creature beneath him, as to run a knife into the breast of his mother; he could as little wish to deal falsely with the feeblest alien folk, as to betray his own nation; and the blow struck at the meanest human creature is struck through himself; this man's consciousness is spread abroad like a god's across all life saying—"It is mine." Social action is for him no more the result of compulsion, but instinct. Altruism grafted into the old stock of egoism, draws its life from those very roots which once fed its opposite. He, and he only, is the organically, and therefore perfectly socialized man.

Two other papers in the "Fortnightly" deserve mention here. One is on "Light Railways," and is—we are astonished to find—by Ouida, the French novelist, and about as poor a piece of nonsense as we have run across in a good while. The other is on "Public Sentiment in America on the Silver Question," by F. H. Hardy. We fancy the editor has let this contribution lie pigeon-holed a considerable time, for Mr. Hardy declares at the outset:

> Two years ago the "Silver Sentiment" was dangerously overgrown. Few writing now with a full knowledge of the subject will deny that "silver sentiment has declined to a point where it has ceased to menace the financial stability of the Republic.

It is passing strange that the editor does not keep in better touch with American politics.

"The Contemporary Review" has a paper on "Girls' Technical Schools on the Continent," which everyone interested in educational work will do well to read. It will surprise many to learn that in the public schools of France, Germany, Belgium and Holland girls spend three hours a day over their books and an equal length of time in the study of housework, cooking, dressmaking, needlework, drawing, typewriting, telegraphy, etc. In an editorial on "Money and Investments," the editor says:

> Among the external events which have interested British investors during the past month, the St. Louis convention was by far the most important. Having sunk many millions of his savings in the development of the United States, and having already written off a considerable portion of these investments as a dead loss, John Bull regards with melancholy anxiety the vagaries of the politicians who pull the wires on the other side of the Atlantic. The spectacle is anything but reassuring. The Republican party is now dominant in the United States, and has been holding its convention at St. Louis to select a candidate for the Presidential election which takes place next "fall." It was feared for some time before the assembling of the convention that the silver faction stood a very good chance of capturing the party "machine," and pledging it to a policy of free coinage at a ratio of 16 to 1. This apprehension caused a mild flutter in the silver market in London, and made holders even of the best secured and most gilt-edged of the American railroad bonds feel uncomfortable as to the possibilities of the future.

In "The Contemporary Review," Dr. Lennox Browne writes on the "Anti-Toxine Treatment of Diphtheria," and presents a variety of statistics going to show that the value of anti-toxine as a therapeutic agent has been greatly overestimated. He acknowledges, however, that there is undoubtedly an increased resistance to the disease when the treatment is begun early, and suggests the possibility that the injection of pure sterilized blood serum would produce equally good results.

The August "McClure's" is a mid-summer fiction number, and we find nothing worthy of note here. The July number of the same magazine, however, contained an excellent review of the progress of motor carriages by Mr. Cleveland Moffett. The August "Harper's" is likewise a "hot weather" number. Charles Dudley Warner, in the "Editor's Study," pays a compliment to Col. Waring and refers to the organization and esprit de corps which has been created in the New York Street Cleaning Department as a "municipal triumph."

In the "North American Review," Robert P. Porter discusses the question "Is Japanese Competition a Myth?" He states that we buy of Japan about $54,000,000 worth of goods per annum, while we sell to her about $9,000,000 worth. England buys of Japan goods to the value of $7,000,000, and sells to her about $56,000,000. Other statistics show that whatever may be the future of Japan, its export trade is still in its infancy. In 1895 it exported of textiles of all kinds $22,000,000 worth. This with $3,000,000 worth of matting, $4,000,000 worth of matches, and $11,000,000 worth of porcelain, curios and sundries, comprise the bulk of her exports of manufactured articles. No doubt with the nation's rapid progress in civilization it will become an important competitor in certain lines of manufacture. The necessity of importing many of its raw materials, however, promises to limit the lines in which its competition is likely to prove serious.

In the "Popular Science Monthly," we find an extended account of scientific work at the University of Pennsylvania. No mention is made, however, of its work in the department of applied science. Prof. W. G. Sumner has an able paper on the proposed dual organization of mankind, in which he presents the Monroe Doctrine in a wholly new light. Some reminiscences of early meetings of the American Association for the Advancement of Science are given by Mr. W. H. Hale.

In "The Century" we note a most interesting description of the famous Chinese Viceroy, Li Hung Chang, from the pen of Hon. John W. Foster, which is of especial interest at this time, in view of the great statesman's visit to this country.

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CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work. Place.	See Eng News.
Aug. 6.	Asphalt paving, Brooklyn, N. Y.	July 30
Aug. 6.	Brick paving, Erie, Pa. Advertised, Engineering News, July 30.	July 30
Aug. 6.	Dams, wells, etc., Norwalk, O. Advertised, Engineering News, July 30.	July 30
Aug. 6.	Telford road, Greenwich, Conn.	July 30
Aug. 6.	Enlarging town hall, Hudson, O.	July 23
Aug. 6.	Bridge, Shelton, Wash.	July 23
Aug. 6.	Electric wiring, etc., Poughkeepsie, N.Y.	July 23
Aug. 6.	Macadam road (2 miles,) Jamaica, N. Y. Advertised, Eng. News, July 16 and 23.	July 23
Aug. 7.	Postoffice building, Meridian, Miss.	July 23
Aug. 7.	Addition school bldg., W. Liberty, W. Va.	July 23
Aug. 7.	Brick paving, Beloit, Wis. Advertised, Eng. News, July 23 and 30.	July 23
Aug. 7.	Macadam paving, Beloit, Wis. Advertised, Eng. News, July 23 and 30.	July 23
Aug. 7.	Water-works, Three Oaks, Mich.	July 23
July 7.	Stone and brush jetty, Sandusky, O.	July 23
Aug. 7.	Brick paving, etc., Fortress Monroe, Va.	July 23
Aug. 7.	Sewage disposal plant, Altoona, Pa.	July 30
Aug. 7.	Brick paving, Monmouth, Ill.	July 30
Aug. 8.	Roof, etc., court house at Lowell, Mass.	July 30
Aug. 8.	Power house, Ogden, Utah	July 30
Aug. 8.	Asphalt paving (2½ m.), New York.	July 30
Aug. 8.	Building bonds, Oregon City, Ore.	July 23
Aug. 8.	Brick paving, Evanston, O.	July 23
Aug. 6.	Brick paving, Evansville, Ind.	Aug. 6
Aug. 10.	Levee work, Tallulah, La.	Aug. 6
Aug. 10.	Coal conveyor, etc., Schenectady, N. Y. Advertised, Engineering News, Aug. 6.	Aug. 6
Aug. 10.	Sewer bonds, Norwood, O.	Aug. 6
Aug. 10.	Electric lighting, Kankakee, Ill.	Aug. 6
Aug. 10.	School house, Detroit, Mich.	Aug. 6
Aug. 10.	Erecting armory addition, Mohawk, N.Y.	Aug. 6
Aug. 10.	Heating and power plant, Cincinnati, O.	July 23
Aug. 10.	Macadam road (5 m.), Long Branch, N.J. Advertised, Eng. News, July 23 and 30.	July 23
Aug. 10.	Water supply, Missoula, Mont.	July 23
Aug. 10.	Pumping engine, Binghamton, N. Y. Advertised, Eng. News, July 16 to Aug. 6.	July 16
Aug. 10.	Rubber hose (5,000 ft.), Jeffersonville, Ind.	July 16
Aug. 10.	Police station, Carbondale, Pa. Advertised, Eng. News, July 23 and 30.	July 23
Aug. 10.	Electric light plant, Dawson, Ga.	July 23
Aug. 10.	Wire fence (18,000 ft.), Wakefield, Va. Advertised, Engineering News, July 30.	July 23
Aug. 10.	Electric light plant, Vicksburg, Mich.	July 30
Aug. 10.	Water-works, Vicksburg, Mich.	July 30
Aug. 10.	Filling trestle, L. R. & M. R. R.	Aug. 6
Aug. 11.	Bridge, Minneapolis, Minn.	Aug. 6
Aug. 11.	Water-works, Phelps, N. Y. Advertised, Engineering News, July 30.	July 30
Aug. 11.	Brick paving, etc., Cincinnati, O.	July 16
Aug. 11.	Passenger elevator, Newark, N. J. Advertised, Eng. News, July 16 and 23.	July 16
Aug. 11.	Sewers, Cincinnati, O.	July 16
Aug. 11.	Macadamizing, Bound Brook, N. J.	Aug. 6
Aug. 12.	Subway widening, Toronto, Ont. Advertised, Engineering News, July 30.	July 30
Aug. 12.	Artesian wells, Wauseon, O.	Aug. 6
Aug 12.	Powder magazine, etc., Philadelphia.	Aug. 6
Aug 12.	Paving (19 contracts), New York, N.Y.	Aug. 6
Aug. 12.	Paving, Philadelphia, Pa.	Aug. 6
Aug. 12.	Heat'g and vent'l'g, Fergus Falls, Minn.	July 23
Aug. 12.	College building, Cincinnati, O.	July 23
Aug. 12.	Timber bridge, Cleveland, O.	July 23
Aug. 12.	Asphalt paving, Cleveland, O.	July 23
Aug. 12.	Gun emplacement materials, Finns Pt., N.J. Advertised, Eng. News, July 30 and Aug. 6.	July 30
Aug. 12.	Street supplies, Charleston, N. C.	July 30
Aug. 12.	Macadam roads (12½ m.), Monticello, Ind.	July 30
Aug. 12.	Painting and repairing bridges, Phila.	Aug. 6
Aug. 12.	Sewers, Cleveland, O.	Aug. 6
Aug. 13.	Water main and boiler, Wells, Minn.	Aug. 6
Aug. 13.	Jail, Greenville, Ga.	July 30
Aug. 13.	Water-works, Skaneateles, N. Y. Advertised, Eng. News, July 30 and Aug. 6.	July 30
Aug. 13.	Stand-pipe, Bangor, Me. Advertised, Eng. News, July 16 to Aug. 6.	July 23
Aug. 13.	Cement, sand and stone, Boston, Mass. Advertised, Eng. News, July 16 to 30.	July 16
Aug. 13.	Street sweeping mach., San Diego, Cal. Advertised, Engineering News, Aug. 6.	Aug. 6
Aug. 13.	Sewers (2), Brooklyn, N. Y.	Aug. 6
Aug. 13.	Electric light plant, Brooklyn, N. Y.	Aug. 6
Aug. 14.	Enlarging chapel, Columbus, O.	Aug. 6
Aug. 14.	Brick paving, Arcola, Ill.	July 16
Aug. 14.	Store house, Willet's Point, N. Y.	July 23
Aug. 14.	Smokestack foundat'n, etc., Cleveland, O.	July 23
Aug. 14.	Brick and asphalt paving, New York.	July 30
Aug. 14.	Post office building, South Bend, Ind.	July 30
Aug. 14.	Bridge, Easton, Pa. Advertised, Engineering News, Aug. 6.	Aug. 6
Aug. 15.	Bridge, Cincinnati, O.	Aug. 6
Aug. 15.	Cement and sand, Portland, Me. Advetrised, Eng. News, Aug. 6 and 13.	Aug. 6
Aug. 15.	Sewer materials, Washington, D. C. Advertised, Engineering News, July 30.	July 30
Aug. 15.	Railway, Concord, N. H.	July 30
Aug. 15.	Water-works, Le Roy, N. Y. Advertised, Eng. News, July 30 and Aug. 13.	July 30
Aug. 15.	Ferryboat, Dartmouth, N. S.	June 25
Aug. 15.	Heating and plumbing, Plattsburg, N. Y.	July 23
Aug. 15.	Dike work in Hudson River, Advertised, Eng. News, July 23 to Aug. 6.	July 23
Aug. 15.	City Hall, Lancaster, O.	Aug. 6
Aug. 15.	Paving brick, Washington, D. C. Advertised, Engineering News, Aug. 6.	Aug. 6
Aug. 15.	Brick paving, East St. Louis, Ill.	Aug. 6
Aug. 17.	Brick paving, Lockport, N. Y.	Aug. 6
Aug. 17.	Paving, Oswego, N. Y. Advertised, Eng. News, Aug. 6 and 13.	Aug. 6
Aug. 17.	Plans for bridge, Santa Monica, Cal.	Aug. 6
Aug. 17.	Asphalt paving (54,000 sq. yds.), N. Y.	Aug. 6
Aug. 17.	Street railway franchise, Los Angeles, Cal.	July 23
Aug. 17.	Trent Canal work (14 m.), Ottawa, Ont.	June 25
Aug. 17.	Sewers, siphons, etc., Woonsocket, R. I. Advertised, Eng. News, July 23 and 30.	July 23
Aug. 17.	Water bonds, Gibsonburg, O.	July 30
Aug. 17.	Bridge at Port Hudson, La.	July 30
Aug. 18.	School bldgs, etc., in South Dakota	July 30
Aug. 18.	Building work, Grant's Pass, Ore.	July 30
Aug. 18.	Bridge, Minneapolis, Minn.	Aug. 6
Aug. 19.	Arch and bridge abutments, Lima, O.	Aug. 6
Aug. 19.	Bridge, Cincinnati, O.	Aug. 6
Aug. 20.	Water-works, Opelousas, La.	July 30
Aug. 20.	Removing wrecks, St. Augustine, Fla. Advertised, Eng. News, July 23 to Aug. 13.	July 23
Aug. 20.	Dam, pier, etc., Cincinnati, O. Advertised, Eng. News, July 16 to Aug. 6.	July 16
Aug. 20.	Electric light plant, Ocala, Fla.	July 30
Aug. 20.	Electric lighting, Eugene, Ore.	July 30
Aug. 20.	Ice machine, Columbus, O.	Aug. 6
Aug. 20.	Subway, Boston, Mass. Advertised, Eng. News, Aug. 6 and 13.	Aug. 6
Aug. 20.	Snagboat, Portland, Ore. Advertised, Eng. News, Aug. 6 and 13.	Aug. 6
Aug. 20.	Pipe sewer, Warren, O.	Aug. 6
Aug. 20.	Water mains, etc., Dunlap, Ia.	Aug. 6
Aug. 21.	Water-works, Dansville, N. Y. Advertised, Eng. News, Aug. 6 to 20.	Aug. 6
Aug. 21.	Dynamo and lights, Newark, O.	July 30
Aug. 21.	Postoffice building, Racine, Wis. Advertised, Eng. News, July 23 and 30.	July 23
Aug. 21.	College buildings, San Francisco, Cal.	July 30
Aug. 22.	Engine house, Allegheny, Pa.	July 23
Aug. 24.	Sewer bonds ($11,000), Yeadon, Pa.	July 23
Aug. 22.	Water-works, Gilman, Ill. Advertised, Engineering News, Aug. 6.	Aug. 6
Aug. 24.	Bridge, Merced, Cal.	Aug. 6
Aug. 24.	Dredging in Canarsie Bay, N. Y. Advertising, Eng. News, July 30 to Aug. 20.	July 30
Aug. 24.	Dredging in Shoal Harbor, N. J. Advertising, Eng. News, July 30 to Aug. 20.	July 30
Aug. 24.	Dredging and jetty, Patchogue River, N.Y. Advertising, Eng. News, July 30 to Aug. 20.	July 30
Aug. 24.	Stand-pipe, Columbus, O.	Aug. 6
Aug. 24.	Dredging, etc., Chicago, Ill. Advertised, Eng. News, Aug. 6 and 13.	Aug. 6
Aug. 24.	Dredging, Portland, Me. Advertised, Eng. News, Aug. 6 to 20.	Aug. 6
Aug. 25.	Paving, Buffalo, N. Y.	Aug. 6
Aug. 25.	Buildings at Jefferson Barracks, Mo.	July 30
Aug. 25.	Sewers, Buffalo, N. Y.	Aug. 6
Aug. 26.	School building, Buffalo, N. Y.	Aug. 6
Aug. 26.	Asphalt paving, Cleveland, O.	Aug. 6
Aug. 27.	Stone wall, Presidio, Cal.	Aug. 6
Aug. 27.	Riveted steel pipe, Redding, Cal. Advertised, Eng. News, Aug. 6 to 20.	Aug. 6
Aug. 27.	Interior building work, Taunton, Mass. Advertised, Eng. News, Aug. 6 and 13.	Aug. 6
Aug. 31.	Electric light franchise, Mexico, Mex.	July 30
Aug. 31.	Brick paving, Toledo, O.	Aug. 6
Sept. 1.	City Hall, etc., San Francisco, Cal.	Aug. 6
Sept. 2.	Bridges (2), Chicago, Ill.	July 16
Sept. 3.	Plans for school bldg., Lancaster, Pa.	July 23
Sept. 4.	Pumping engines, St. Louis, Mo.	May 14
Sept. 4.	Bridge, Nehalem, Ore.	Aug. 6
Sept. 7.	Wooden bridge, White Sulphur Spgs., Mont.	July 23
Sept. 7.	County jail, South Bend, Ind.	Aug. 6
Sept. 9.	Jail cages, Visalia, Cal.	Aug. 6
Sept. 10.	Designs for monument, Chickamauga, Ga.	July 30
Sept. 11.	Bridge, Redding, Cal.	July 30
Sept. 14.	Battleships (3), Washington, D. C.	July 16
Sept. 18.	Torpedo boats, Washington, D. C.	June 25
Sept. 22.	Court house, Auburn, Cal.	July 30
Oct. 6.	Hospital building, Cherokee, Ia.	July 30
Dec. 30.	Steel rails (150,000 tons), Sydney, N.S.W. Advertised, Eng. News, Aug. 6 and Sept. 3.	Aug. 6

RAILWAYS.

East of Chicago.

CANADIAN PACIFIC.—It is stated that this company contemplates the early extension of its Vondreuil & Rigaud line to the capital of the Dominion. Engr., Hugh D. Lumsden has been making preparations to build a portion of the Montreal & Ottawa line between Rigaud and a point near Alfred, a distance of 28½ miles. The new railway offers no serious engineering difficulties, and after leaving Rigaud will pass through St. Eugene, Vankleck Hill and Caledonia Springs into Alfred.

CONNELLSVILLE & PITTSBURG.—A press report from Baltimore, Md., states that Orland Smith, of Baltimore, Pres. Connellsville & Pittsburg Ry., has filed petition in the United States Circuit Court asking that the issue of receivers' certificates to the value of $650,000 be authorized, the proceeds of the sale of which would be used in making permanent improvements in the line of road. The proposition is to construct terminals at Pittsburg to the value of $340,700; to build 6½ miles of second and 7½ miles of third track, at a cost of $143,000; to construct a new yard at Connellsville at a cost of $72,000; to put in reservoirs at Layton, Griffin, Robbins and Glencoe at a cost of $12,500, and to construct the line from Foley's Siding to Fair Hope. This would cost $181,000.

CLEVELAND & PITTSBURG.—A press report states that the right of way has been secured for an extension up Beaverdam Valley. All preliminary work has been about completed for the extension and the road will be built as far as New Cumberland this fall. The survey has been made. The extension is to be made for the purpose of developing fields of coal. This is a branch of the Pennsylvania. Ch. Engr., Thos. Rodd, Pittsburg.

KANONA & PRATTSBURGH.—It is stated that plans are now being discussed for an extension of this road north from Kanona to Stanley or to Penn Yan, N. Y., and on the south to Hornellsville, N. Y. Several routes are proposed for the northern extension, the line to Stanley being 25 miles long, with light grades, and that to Penn Yan, two miles less in distance, but involving some heavy grades. The latter is the more important town, and would give connections with the Northern Central and a branch of the Fall Brook line. A good deal of right of way has already been promised. J. G. Baker, Engr., Prattsburg, N. Y.

McKEESPORT TERMINAL.—This company has been incorporated to build a connecting railway about one mile long at McKeesport, Pa.; capital stock, $100,000; commencing with $10,000; Pres., Richard M. Wood, Allegheny, Pa.

NEW YORK & GREENWOOD LAKE.—This railway has been leased to the Erie Ry. Co. It may be double-tracked and otherwise improved. Ch. Engr., C. H. Buckholz, New York city.

NORTHEASTERN.—This company has been incorporated at Columbus, O., with a capital stock of $100,000, by Frank L. Lyon, Chas. N. Sheldon, Wm. D. Bennet, Gustave Runge and Lafayette Kilball. The road is to run from a point in Euclid township, Cuyahoga county, through Cuyahoga, Lake and Summit counties to Hudson village in Summit county. It is said to be a connecting link for the C., A. & C. between Hudson and Cleveland.

PENNSYLVANIA.—Plans have been made for elevating a portion of the company's tracks at Philadelphia. Thirty street grade crossings and one steam crossing will be removed. The work is estimated to cost about $2,000,000, of which the company will pay one-half. Ch. Engr., W. H. Brown, Philadelphia.

WOODSTOCK & CENTREVILLE.—The contract for the construction of the Woodstock & Centreville Ry., from Woodstock, N. B., to Bridgewater, Me., has been let to Babcock, Lary & Co., of New York; construction to begin at once; length of road, 32 miles.

Southern.

CAROLINA, TENNESSEE & OHIO.—J. L. D. Queen, Supt. of Construction, Wilmington, N. C., writes us that the projected length is 30 miles from El Paso to Town Creek, N. C. The surveys have been made, capital secured and contract let to Frank H. Blodgett, Wellston, O. He will sub-let much of the work. Pres. J. E. Challenger, Philadelphia, Pa.; Ch. Engr., Walter MacRae, Wilmington, N. C.

CAROLINA MIDLAND.—Woolsey Finnell, Batesburg, S. C., writes us that tracklaying on the 18-mile extension from Seivern to Batesburg, S. C., will begin during the next ten days; work willl be finished by Sept. 15, including grading, trestles and tracklaying.

CAPE FEAR & YADKIN VALLEY.—H. L. Fry, Ch. Engr., Greensboro, N. C., writes us that the report that this company is extending its lines is incorrect. No new work is contemplated.

LITTLE ROCK & MEMPHIS.—Bids are asked until Aug. 10 for filling trestle No. 8 on line of this road, six miles west of Memphis. Plans and specifications on file at the superintendent's office, in Memphis, and at the treasurer's office, in Little Rock. Rudolph Fink, Recvr.

Northwest.

ALLOWEZ BAY.—Winston Bros., contractors, Minneapolis, Minn., writes us that this is only a short line and is now finished.

CHICAGO & EASTERN ILLINOIS.—It is stated that this company has purchased the Chicago, Paducah & Memphis Ry., a line extending from Altamont to Marian, Ill., 97 miles long. The company contemplates an extension of its own line from Shelbyville to Altamont, a distance of about 20 miles, to connect with its new acquisition.

SHELBYVILLE SOUTHERN.—This company has been incorporated to build a railway to connect the Chicago & Eastern Illinois R. R. with the Chicago, Paducah & Memphis Ry., at Altamont or St. Elmo, Ill. The incorporators are: Don R. Patterson, Henry J. Messing, J. P. Reeves, B. A. Smith and E. H. Seneff, of Chicago.

Southwest.

OMAHA, KANSAS CITY & EASTERN.—This company has been incorporated with a capital stock of $1,500,000, to build and operate a railway from Pattonsburg, in Daviess county, Mo., through the counties of Daviess and Harrison to Trenton, in Grundy county, a distance of 34 miles, and to buy and operate the Quincy, Omaha & St. Louis R. R., from Quincy, Ill., to Trenton, Mo., and the Omaha & St. Louis R. R., from Omaha, Neb., to Pattonsburg, Mo.; incorporators: John Lowber Welsh, Philadelphia, Pa.; Theodore Gilmer, Jr., Yonkers, N. Y., and A. E. Stillwell, E. L. Martin, J. J. Cairnes, J. T. Nolthenius and C. A. Braley, Kansas City, Mo.

SAND CREEK & SULPHUR SPRINGS.—This company has been incorporated with a capital stock of $20,000, by N. T. White, Pine Bluff, Ark.; Frank Kendall, M. F. Williams, George McLeod, of Kedron, Ark., and Ed. McGann, of Brooks, Ark. Proposed line will run from a point on the Mississippi & Malvern R. R., at its crossing of Sand Creek in Jefferson county, to Sulphur Springs in the same county. ,

SOUTHWESTERN ARKANSAS & INDIAN TERRITORY.—Geo. R. Brown, Little Rock, Ark., writes us that the projected length is 35 miles, to connect Smithton, Okalona, Antoine and Pike City, Ark. Track now finished 23 miles from Smithton; grade finished for the entire line. Track will all be laid by Sept. 1. H. T. Dodson, Wilton, Ark., is the contractor. Pres., J. H. Hutchinson, New York city; Ch. Engr., M. P. Jackson, Smithton, Ark.

Rocky Mountain and Pacific.

ASTORIA & COLUMBIA RIVER.—Work is in progress on this line, which is to afford railway communication between Astoria, Ore. (at the mouth of the Columbia River) and the city of Portland. The Southern Pacific Co. is said to be interested. Honeyman, de Hart & Co., of Portland, are the contractors. Engr., T. K. Jamieson, Astoria, Ore.

COLUMBIA & WESTERN.—Arthur P. Heinze, Secy., Butte, Mont., writes us that the projected length is 200 miles, connecting Sayward, Trail, Rossland, Robson, Boundary and Penticton. The road from Trail to Rossland is completed and in operation. The entire line has been surveyed; right of way can readily be secured as the country is unsettled. The contractors for the completed portion of the road were Bennett & King, Tacoma, Wash. Pres., F. Aug. Heinze, Butte, Mont.; Ch. Engr., F. P. Gutelins, Rossland, B. C.

OREGON CENTRAL & EASTERN.—This company has laid track for a few miles east of its eastern terminus, extending to a pass through the range, and there is talk of constructing the extension east to Boise City, Idaho, the right of way for which has already been secured.

VANCOUVER, VICTORIA & EASTERN.—This company has given notice that application will be made to the Parliament of Canada for a charter for a railway from Vancouver, B. C., thence in an easterly direction through Alberta, Assiniboia and Manitoba, all south of the line of the Canadian Pacific Ry., thence through Ontario to the Great Lakes, and through Quebec to some point on the Atlantic seaboard, with power to construct branch lines, also with power to acquire, own, maintain and navigate steamboats and other vessels between the cities of New Westminster, Vancouver, Nanaimo, Victoria and other points in the Province of British Columbia. Donald G. Macdonell, Vancouver, B. C.

Foreign.

OCCIDENTAL.—Press dispatches state that this railway, which runs from Champerico, on the Guatemala coast, to San Felipe, 41 miles inland, is to be extended 30 miles to Mazaltenango, and a feeder run from San Felipe to Mazaltenango, a distance of ten miles. The actual work of construction will commence within six weeks. It is thought the company's intention is to extend the road clear across the country.

NEW SOUTH WALES.—Bids are asked until Dec. 30 for a supply of 150,000 tons of steel rails, to be manufactured in the colony of New South Wales, as stated in our advertising columns. J .H. Young, Minister of Public Works, Sydney, N. S. W.

STREET AND ELECTRIC RAILWAYS.

DEERING, ME.—The Portland St. Ry. Co. has petitioned to extend its tracks. Pres., W. R. Wood; Secy. and Supt., E. A. Newman, 471 Congress St.

CAPE ELIZABETH, ME.—The Portland & Cape Elizabeth St. Ry. Co. has asked permission to make extensive additions to its tracks. Pres., J. S. Winslow; Gen. Mgr., H. R. MacLeod, 45 Exchange St.

MONTPELIER, VT.—The time for building the electric railway in this city and Barre has been extended for one year. J. J. Flynn and A. O. Humphrey, Burlington, Vt., are interested.

RUTLAND, VT.—The Rutland St. Ry. Co. informs us that no further extensions are projected for the present.

BROCKTON, MASS.—The Brockton, Bridgewater & Taunton St. Ry. Co. has received franchises for a railway to connect this city, Bridgewater and Taunton; franchise calls for the completion of the road within 18 months.

HUDSON, MASS.—The Hudson, Bolton & Lancaster Electric Ry. Co. may be formed with a capital of $100,000 to build a railway from Lancaster to Hudson, a distance of seven miles. The estimated cost is $200,000. Henry Tower, W. H. Moulton and Geo. A. Tripp are interested.

MIDDLEBORO, MASS.—A franchise has been granted to the incorporators of the Middleboro & Lakeville St. Ry.

SPRINGFIELD, MASS.—The Enfield & Longmeadow Electric Ry. Co. has been reorganized with a reported capital stock of $125,000 to build a line nine miles long, starting from connection with the Springfield St. Ry. at the state line, and proceeding through Thompsonville to Enfield, so that the southern terminus will be within three miles of the Windsor terminal of the Hartford, Conn., electric road. Contracts for its construction were to have been awarded this week. Work will be begun soon.——The Springfield Electric St. Ry. Co. is reported as making extensive additions. Pres., John Olmstead; Gen. Mgr., A. E. Smith, Main St.

WORCESTER, MASS.—Press reports state that a company has been organized to build an electric railway from Worcester to Clinton. The stock has been practically all taken. The route will be from Worcester from Adams square, through Lincoln to Old Boylston over the turnpike. From that village the line will follow one of the roads just east of the Metropolitan reservoir to Clinton, a total distance of 12 miles.

BRIDGEPORT, CONN.—It is reported that Frank E. Clark, Frank Miller, N. H. Heft and Geo. E. Somers are interested in obtaining a charter for a new electric railway.

BRISTOL, CONN.—The Bristol & Plainville Electric Ry. may be extended to Terryville.

HARTFORD, CONN.—It is stated that a survey is in progress for an extension of the Hartford, Manchester & Rockville Tramway from Talcottville to Rockville via Vernon Center.

MIDDLETOWN, CONN.—Press dispatches state that the Middletown St. Ry. Co. will extend its tracks to Portland, Conn., a distance of 2½ miles. Pres., I. A. Kelsey; Supt. E. W. Goss, 265 Main St.

ROCKVILLE, CONN.—The Rockville & Ellington St. Ry. Co. is reported as making surveys for a proposed electric railway from Rockville to Talcottville. Mr. Burritt is general manager.

STAMFORD, CONN.—It is stated that the New York. New Haven & Hartford R. R. Co. has awarded contracts for the construction of the electric road between Stamford and Norwalk. H. Gore & Sons, of Boston, will construct the extension, and the General Electric Co., Schenectady, N. Y., will furnish the equipment.

HAMBURG, N. Y.— The Buffalo, Orchard Heights & Hamburg Electric Ry. Co. has been organized to build an electric line from Buffalo to Hamburg; capital stock, $120,000; incorportors: M. W. Wheatley, New York city; A. W. Hickman, I. W. Allan, U. L. Upson, A. V. Brown, F. K. Wing, Buffalo; S. A. Abbott, E. E. Hepp, O. L. Aga, H. A. Pierce, Armour; C. G. Briggs, Orchard Park, N. Y.

BATAVIA, N. Y.—The Batavia St. Ry. Co. may build an electric railway to Horse-Shoe Lake. The line has already been surveyed. Ch. Engr., J. W. Holmes.

DUNKIRK, N. Y.—An electric railway may be built to connect Dunkirk and Chattanooga. H. L. Kent and W. L. Minton are interested.

NEW YORK, N. Y.—C. H. T. Collis, Comr. Pub. Wks., has notified the Metropolitan Traction Co. and all lines operating cars on First Ave., from 20th St. to 109th St., to raise their tracks in conformity with the new street levels, so that the paving of the avenue may be completed.

ELIZABETH, N. J.—The Elizabeth "Herald" states that the work of rebuilding the Elizabeth St. Ry. and changing its motive power from horse to electricity, will be begun at once, and pushed forward to completion. Pres., F. L. Heidritter; Supt., J. C. Husbands, foot of East Jersey St.

NEWARK, N. J.—The Passaic & Newark Electric Ry. Co. has been granted permission to extend its lines.

PLAINFIELD, N. J.—The Plainfield Electric St. Ry. Co. is reported as contemplating extensions to be completed by December, 1896. Supt., John H. Adelmann, 909 West 4th St.

STOCKTON, N. J.—The Camden & Suburban Ry. Co. has been granted permission to extend its lines.

NEW CASTLE, PA.—The New Castle & Mahoning St. Ry. Co. was incorporated Aug. 4 to build an electric railway. Pres., De Witt Dilworth.

DAYTON, O.—The county commissioners have granted a 30-year franchise to the Troy, Tippecanoe & Dayton Inter-Urban Electric Ry. Co. to operate an electric road over that portion of the Miami and Montgomery turnpike lying in Montgomery county and outside the corporate limits of Dayton. The company is to pay the county $20 per mile per year for the first five years, and thereafter $50 per mile per year. Construction is to commence on or before Dec. 1, 1896, and be completed on or before July 1, 1897.

MADISON, IND.—The Madison Light & St. Ry. Co. has been incorporated. The capital stock is $75,000, of which $72,800 is owned by John S. Ward, of Chicago. The directors of the new company are John S. Ward, John Sutherland, Lewis J. Highland, Charles Fifer and George Everrod.

HARVARD, ILL.—Charles T. Yerkes, of Chicago, is said to be interested in a proposed electric railway to connect this place with the Chicago, Milwaukee & St. Paul Ry. at Elkhorn, Wis.

JOLIET, ILL.—A press dispatch states that the Joliet Ry. Co. has been reincorporated, and the capital stock placed at $300,000. The following officers have been elected: Jacob A. Henry, Joliet, Ill., Pres.; George F. Duncan, Portland, Me., Vice-Pres.; Henry P. Cox, Portland, Me., Treas. The road will be extended and new cars put on several lines.

WAUKESHA, WIS.—The Milwaukee & Waukesha Electric Ry. Co. has received a franchise from Milwaukee and the officers are quoted as saying that the road will be built this summer.

EAST ST. LOUIS, ILL.—Surveys have been made by L. L. Harper, Engr. East St. Louis & Belleville Rapid Transit Co., for an electric railway from East St. Louis to Belleville, about 14 miles.——The Belleville Electric R. R. Co. has petitioned the East St. Louis city council for a franchise to lay tracks on Missouri Ave., from 3d St. to the eastern city limits. This company also proposes to construct a line from Belleville to East St. Louis.

TACOMA, WASH.—A franchise has been granted to Frank C. Ross for building and operating an electric street railway.

SALEM, ORE.—An electric railway is proposed to connect this city, Fruitland, Macleay, Annisville, Stayton and Mehama.

SAN DIEGO, CAL.—An ordinance has been passed granting a franchise to the San Diego Electric Ry. Co. to extend its lines.

SANTA BARBARA, CAL.—The Consolidated Electric Co. has been granted the privilege of extending its lines.

ELECTRIC LIGHT AND POWER.

FAIRFIELD, ME.—The Waterville & Fairfield Electric Light & Power Co. is planning to build an addition of 20 or 30 ft. to its power house and to install two or three Hercules water-wheels.

CLAREMONT, N. H.—The Claremont Electric Light Co. has increased its capital from $12,000 to $20,000 and applied it to improving its plant. Storage batteries to augment the incandescent system have been introduced and the arc light system will be increased.

HOPKINTON, N. H.—A public meeting will be held Aug. 13 to consider supplying the village with electric lights.

BROOKLYN, N. Y.—Bids are asked until Aug. 13 for furnishing and installing a complete electric incandescent light plant at the sewage purification works; security, $1,250. Theo. B. Willis, Comr. Cy. Wks.; R. M. Whiting, Secy.

KINGSTON, N. C.—This town will soon vote on the question of issuing bonds for an electric light plant. The proposition is reported to meet with general approval.

BRYAN, O.—At a special election Aug. 1, the citizens voted 408 to 56 to issue bonds for an electric light plant.

ST. CLAIRSVILLE, O.—At an election July 25 the question of issuing bonds for $5,000 to improve the electric light plant was voted on.

SAULT STE. MARIE, MICH.—The Lake Superior Power Co. has been granted a franchise and proposes to build a canal 250 ft. wide and 20 to 30 ft. deep, to cost $2,000,000, and to erect suitable machinery to develop 40,000 HP. Calcium carbide works will be built and run by power transmitted by cable from the Canadian power station.

KANKAKEE, ILL.—Bids are asked until Aug. 10 for supplying 100 2,000 c. p. arc lamps for five years. Henry Reuter, Chn. Com.

MINNEAPOLIS, MINN.—The county commissioners have decided to erect an electric lighting plant for the city hospital.

PINE CITY, WASH.—A press report states that it is probable that this village will soon be lighted by electricity.

TACOMA, WASH.—It is reported that bids will soon be asked for another 2,000 lamp incandescent dynamo.

SONORA, CAL.—T. H. Linn and Geo. Batten have petitioned for a 50-year franchise to construct and maintain an electric power system along the public highways of Tuolumne county.

GRAND FALLS, N. B.—C. Le B. Miles, of Andover, N. B., Rest. Engr. Grand Falls Water Power Co., writes us that he has made a survey and completed plans and profile for the proposed canal, noted in our issue of July 16; nothing definite yet decided.

TORONTO, ONT.—A permit has been granted to the Toronto Electric Light Co. to erect a large power house on the Esplanade, south of Scott St.; cost, $5,000.

BRIDGES.

RUTHERFORD, N. J.—The freeholders of Passaic and Bergen counties have awarded a contract for an iron bridge over the Passaic River at Union Ave., this city, to Dean & Westbrook, at $25,750.

CONNELLSVILLE, PA.—A storm July 27 destroyed seven bridges between this place and Uniontown on the Connellsville & Fairmont branch of the Baltimore & Ohio R. R.

PHILADELPHIA, PA.—Bids are asked until Aug. 12 for repairs to bridges and for painting one bridge. Thos. M. Thompson, Dir. Pub. Wks.

EASTON, PA.—Bids are asked until Aug. 14 for constructing a highway bridge, as stated in our advertising columns. A. J. Cooper, Engr.; H. F. Trumbore, Clk.

ROCKVILLE, MD.—The county commissioners have awarded the contract for a bridge 72 ft. long and 16 ft. wide over the Baltimore & Ohio tracks at Capitol View to the Charlestown Building Co., of Charlestown, W. Va., at $1,148, to be completed within 60 days.

LIMA, O.—Bids are asked until Aug. 19, according to reports, for constructing a stone arch and abutments for three bridges. Phillip Walther, County Audr.

CINCINNATI, O.—Bids are asked until Aug. 15 for the construction of a wrought-iron truss bridge over Taylor's Creek, on the Hines road, Green township, and until Aug. 19 for the superstructure of bridge over Little Miami River and Big Dey Run at Indian Hill, Anderson township.. Geo. C. Zimmermann, Clk. County Comrs.

MINNEAPOLIS, MINN.—Bids are asked until Aug. 18 for the construction and erection of the superstructure of the Seventh St. bridge over the tracks of the Minneapolis & St. Louis and Great Northern railways; also until Aug. 11 for furnishing the iron and steel for the superstructure of the Nicollet Ave. bridge over Minnehaha Creek. Specifications on file at the office of F. W. Cappelen, Cy. Engr.; Chas. F. Haney, Cy. Clk.

LITTLE ROCK, ARK.—The only bids considered at the opening of bids July 15 were those which provided for payments in county warrants at the rate of $25,000 a year, as stated in the advertisement in Engineering News, being as follows: Missouri Valley Bridge & Iron Works, of Leavenworth, Kan., and Pulaski Bridge Co., Little Rock, plan A, $350,000; B, $375,000; C, $390,000; Groton Bridge & Mfg. Co., Groton, N. Y., $353,022, $372,322, $393,400. Edwin Thacher, Ch. Engr., 33 Telephone Bldg., Detroit, Mich. There were 33 inquiries received in response to the advertisement.

GREEN BAY, WIS.—Bids will soon be asked for constructing a 180-ft. drawbridge; estimated cost, $10,000. E. L. Shaw, Engr., Marietta; Jos. F. Rothe, Chn. Com.

ELLENSBURG, WASH.—The county commissioners have awarded a contract to Geiger & Zabriskie, of Tacoma, for the construction of a 200-ft. single-span wood and steel bridge, with one 180-ft. approach, at this place.

DALLAS, ORE.—At a meeting of the county court the clerk was authorized to advertise for bids for the completion of the Rock Creek road, a distance of seven miles; and for the construction of a bridge across the Yamhill River on the Lee Rowell road

NEHALEM, ORE.—Bids are asked until Sept. 9 for constructing a yellow fir bridge, 220 ft. in length, with about 250 ft. of approaches. J. D. Edwards, County Clk.

MERCED, CAL.—Bids are asked by the clerk of the supervisors until Aug. 24 for a bridge across Deadman's Creek, about three miles southwest of Athlone.

SANTA MONICA, CAL.—Competitive plans are asked until Aug. 17 for the construction of a bridge across the canyon lying between Railroad Ave. and the grounds of the Arcadia Hotel, said bridge to be of concrete and iron, or iron or steel, the plans accepted by the board to be paid for at the price of $75, and shall become the property of the town of Santa Monica. Each plan must be accompanied by an estimte of the probable cost of the proposed bridge. C. S. Dales, Clk.

BUILDINGS

TAUNTON, MASS.—Bids are asked until August 27 for the interior finish, plumbing and gas piping for the U. S. post-office building in this city, as stated in our advertising columns. Wm. M. Aiken, Supervising Arch., Washington, D. C.

NEW YORK, N. Y.—Plans have been filed for three brick flats, on St. Nicholas Ave. ,near 117th St., to cost $72,000; Chas. H. Dahlanser, 849 First Ave., owner; Neville & Bagge, 217 West 125th St., architects.——Plans were filed July 28, for a 16-story brick and terra cotta office building, at Broadway and 26th St., cost, $1,500,000; Bruce Price, architect.——John B. Ireland, owner, 15 East 47th St., has filed plans for a brick building, to cost $125,000, at 570 and 572 West Broadway; Hill & Turner, 44 Broadway, architects.——Plans were filed July 30, for eight 5-story brick flats, to cost $180,000, on 7th Ave., between 146th and 147th Sts.; Burns & Regan, 292 Lenox Ave., owners.——Plans were filed July 31, for six 3-story brick dwellings, on 148th St., near Grand Boulevard; cost, $60,000; James T. Fitzpatrick, 630 East 138th St., owner.

BUFFALO, N. Y.—Bids are asked until Aug. 26, for the construction of a 17-room school building, on Seventh St., to cost about $50,000. R. G. Parsons, Secy. Bd. Pub. Wks. ——Lansing & Beierl have prepared plans for a 5-story brick, steel frame candy factory, to be built for Sibley & Holmwood, at 153 Swan St.; to cost about $40,000.——H. L. A. Jaeckel has prepared plans for a 4-story brick tenement house to be built for E. B. Shearer, at the southwest corner of Franklin and Edward Sts.; cost, $30,000.

MOHAWK, N. Y.—Bids are asked until Aug. 10, for furnishing material and labor and erecting an addition to the drill hall of the state armory building. I. G. Perry, Albany, State Arch.; Maj. Gen. Edw. A. McAlpin, Adj. Gen. S. N. Y.; Brig. Gen. Fredk. C. McLewee, Insp. Gen., S. N. Y.; Brig. Gen. Benj. Flagler, Ch. of Ordnance, S. N. Y., Comrs.

YONKERS, N. Y.—The Metropolitan Building Co. has engineers at work laying out lots near Waring Place, upon which it intends building at once 20 more new houses.

PHILADELPHIA, PA.—Bids are asked until Aug. 12, for the erection of a powder magazine, two shell houses, three dwellings, one stable and five cisterns, at the U. S. magazine, Fort Mifflin, near this city. W. T. Sampson, Ch. of Bureau of Ordnance, Navy Dept., Washington,

PITTSBURG, PA.—Henry Phipps, Jr., has been granted a permit for building a steel and iron store building, eight stories in height, at the corner of Penn Ave. and Cecil Alley. Estimated cost, $160,000.

READING, PA.—Plans for the Masonic Temple to be erected on North Fifth St., have been modified so as to reduce the cost from $150,000 to $125,000.

NORFOLK, VA.—Carpenter & Peebles, Archs., of Norfolk, have prepared plans for a $500,000 hotel to be built at this place; construction will probably be commenced within 60 days; no general contract will be let. Sylvanus Stokes, of Baltimore, is interested.

HALIFAX, N. C.—The county commissioners are building a fireproof jail in which will be placed steel and iron cages and cells.

ATLANTA, GA.—The Mutual Building Co. has petitioned the board of aldermen to be allowed to erect a 12-story building extending over the sidewalks at the junction of Peachtree and Broad Sts., which has been granted, and J. M. Holbrook and J. C. Peck have presented like petitions for buildings at the intersection of Forsyth and Whitehall and Peachtree and Pryor Sts., respectively.

COLUMBUS, O.—Bids are asked until Aug. 14 for furnishing the materials and labor necessary for the enlargement of the chapel of the Ohio State University. Yost & Packard, Archs.; Alexis Cope, Secy.

LANCASTER, O.—Bids are asked until Aug. 15 for tearing down the old city hall building, and for furnishing the materials and erecting a new city hall building in this city. H. T. Mechling, Cy. Clk.

TOLEDO, O.—Bacon & Huber, Archs., have prepared plans for a new car barn, 100 × 150 ft., to adjoin the present structure on Canton Avenue, and it is reported that the contract will soon be let.

INDIANAPOLIS, IND.—Work on the Stevenson building was to be commenced this week; it will be 12 stories in height and cost $750,000, according to local papers. Henry Ives Cobb, Arch., Chicago.

SOUTH BEND, IND.— Bids are asked until Sept. 7 for the construction of a county jail in this city. John D. Fulmer, Peter H. Reeves, John N. Lederer, Bd. County Comrs.

DETROIT, MICH.—Bids are asked until Aug. 10 for furnishing the materials and labor necessary for erecting a new 12-room school house on McGraw Ave., and a 4-room addition to the Johnston school on Waterloo St.: also for furnishing the materials, labor, machinery and appliances for a system of ventilating and steam heating apparatus for each. L. H. Chamberlin, Secy.

CLINTON, IA.—The supervisor of Clinton county let the contract July 31 for the completion of the new courthouse to C. A. Moses, of Chicago, at $57,000.

WICHITA, KAN.—Press reports from this city state that the St. Louis & San Francisco Ry. will build new freight and passenger stations in this city.

LIVINGSTON, MONT.—A press report states that all arrangements for the erection of a new city hall are complete and the work of construction will soon begin. Hancock Bros., Archs., Fargo, N. Dak.

ST. LOUIS, MO.—The following contracts have been awarded: For constructing a new building to replace engine house No. 7, Wm. Daman & Son, $8,996; painting pillars and other iron-work in new city hall, Flesh & Mook, $1,885; for structural iron-work in new city hall, Koken Iron Works Co., $27,990.

SAN JOSE, CAL.—An ordinance has been adopted by the common council calling an election for the immediate erection of a $75,000 high school building.

SAN FRANCISCO, CAL.—Bids are asked until Sept. 1 for the construction of a new roof on the new city hall. for wainscoting and paving in the rotunda and for furnishing 3,000 bbls. of Portland cement. A. Sutro, H. T. Creswell, W. Broderick, Bd. of Comrs., New City Hall; J. J. McCarthy, Secy.

VISALIA, CAL.—Bids are asked until Sept. 9 for the construction of four modern steel cages and the erection of them in the county jail. Address the city clerk.

GUAYMAS, MEX.—H. T. Richards has been awarded the contract for the erection of a new brick and stone custom house in this place. The plans include a substantial stone wharf. Cost will be about $80,000.——Dr. P. Figueroa, Acting Governor of the state of Sonora, is arranging to erect a state penitentiary here.

WATER-WORKS.

MADISON, ME.—At a special meeting, July 30, the village corporation voted to purchase all property and rights of the Madison Water Co., for $80,000.

BOSTON, MASS.—The contract for laying water-pipes, July 28, as advertised in Engineering News, has been awarded by the metropolitan water board, to Snyder & Williams, Dayton, O., at $42,582. The itemized bids will probably be published in our next issue.

BRAINTREE, MASS.—At a special town meeting, July 22, the subject of an additional water supply was discussed.

BILLERICA, MASS.—Percy M. Blake, of Hyde Park, has been engaged to investigate the subject of a water supply, noted last week. F. S. Clark, Chn. Comrs., North Billerica.

LANESBORO, MASS.—It is reported that a proposition to build works is being considered. J. K. Anthony, Adams, offers to construct a $20,000 hotel if a system is built. Estimated cost about $10,000.

MARIEVILLE, R. I.—The question of extending the Pawtucket water mains to this place is under discussion.

WESTERLY, R. I.—An injunction has been granted by the circuit court prohibiting this town from erecting water-works, for which the contracts were recently awarded.

WESTERLY, R. I.—The Westerly Water-Works Co. is reported to have contracted with the New York Filter Co. for three new gravity filters to be placed at the pumping station near White Rock.

NAUGATUCK ,CONN.—The water company has voted to build a new 12,000,000-gallon reservoir on Mulberry Hill; cost, from $20,000 to $22,000. Capital of company will be increased from $60,000 to $85,000, according to report.

ROWAYTON, CONN.—The new water-works system has been commenced. John Cotter is interested.

ALDEN, N. Y.—Bids are asked, according to report, for a new well or reservoir 10 ft. in diameter and sufficiently deep to insure water enough for fire protection. E. A. Millinan, Chas. Sanderson and Chas. Ellers are interested.

CLAYTON, N. Y.—It is reported that plans for water-works have been approved by the state board of health, and a special public meetnig to decide whether they shall be built will soon be held. H. W. Morse, Village Clk.

DANSVILLE, N. Y.—Bids are asked until Aug. 21 for constructing works, as described in our advertising columns. J. F. Witmer, Engr., Buffalo; Frank J. Blum, Secy. Comrs.

LOCKPORT, N. Y.—The water commissioners will lay about 2,000 ft. of 6-in. pipe; work will be done by the board. C. H. Cornes, Cy. Engr.

MIDDLETOWN, N. Y.—The taxpayers, by a vote of 286 to 153, have refused to authorize the issuing of bonds to extend the water-works.

MONTOUR FALLS, N. Y.—It is reported that a franchise for water-works and electric lights has been let to E. A. Dunham & Co., of this place. E. W. Hibbard, Clk.

SOUTH GLENS FALLS, N. Y.—The Franklin Iron Co., of Troy, has been awarded the contract for the boilers for the new water-works.

NEWARK, N. J.—The board of street and water commissioners has decided to introduce watermeters in all factories.

DUSHORE, PA.—A press report states that this borough is considering putting in a system of water-works. B. S. Collins, Borough Secy.

ELKLAND, PA.—A vote will be taken Aug. 18 on the issuing of bonds for $10,000 for the purpose of building works.

NEW CASTLE, PA.—The city council has voted to invite ten of the heaviest taxpayers to go over the figures and make a recommendation on the question of buying the water-works in this place now owned by a private company.

PITTSBURG, PA.—The Chester Valley Water Co. has been incorporated with capital stock of $3,000, to supply water to the district south and west of the Ohio and Allegheny rivers, outside the city of Pittsburg; Treas., Frank S. Brunt, Castle Shannon.

FREEDOM, PA.—It is reported that plans and specifications for complete sewerage and water-works systems have been accepted and that an election will be held next spring to vote on an issue of bonds for the construction.

J. P. Leaf, Engr., Rochester; E. J. Bischoffberger, Borough Secy.

HYATTSVILLE, MD.—W. S. Powell, of Annapolis Junction, is reported to have applied for a permit from the town commissioners to lay water pipes in the streets to supply the town with water.

SAVANNAH, GA.—The water supply is reported to be inadequate for fire protection.

STARKVILLE, MISS.—Water is said to have been struck at the depth of 1,080 ft., flowing at the rate of 30 gallons a minute.

CROWLEY, LA.—The city authorities are said to have decided to erect water-works at once. An electric light plant is also talked of.

CLEVELAND, O.—The lowest bids for the construction of the Lake tunnels received July 31, as advertised in Engineering News, were: East side tunnel—W. J. Gawrie, Cleveland, $524,190; tunnel extension and shafts—Chicago Star Construction & Dredging Co., Chicago, Ill., $306,062. Complete bids will probably be published next week.

COLUMBUS, O.—Bids are asked until Aug. 24 for the construction of a 14 × 100-ft. steel stand-pipe, enclosed in a tower of brick and stone, with the foundations for the same; and for pipes, castings, hydrants, valves, etc. Adress R. W. Bell, Steward, Ohio Institution for the Education of the Blind; H. P. Crouse, Pres.; Frank Snyder, Engr.

DELPHOS, O.—G. F. Almy, Secy., writes us that 56 bids were received in answer to the water-works advertisement published in Engineering News, the contract being awarded to the Shaw-Kendall Engineering Co., Toledo, at $62,600. R. H. Gamble, Engr., Lima, O.

QUINCY, O.—Work has been begun on the water-works in this place.

RIPLEY, O.—The following contracts have been awarded for constructing water-works: Addyston Pipe & Steel Co., Addyston, O., cast-iron pipe and specials, at $7,948; Wm. N. Air, Newport, Ky., pipe laying, $2,470; J. R. Poindexter, Cynthiana, Ky., building pump house, $1,066; Boyce & Heffron, Cincinnati, O., settling basins, $2,300; Ryan & Link, Reading, O., storage reservoir, $2,067; C. H. Barnes Co., Cincinnati, O., boiler and stack, $1,180; Hall Steam Pump Co., Allegheny, Pa., pump and air lift, $3,005. Hydrant and valve not decided on. Bonds were sold by council to Seasongood & Meyer, Cincinnati, O., for $23,828, being at a premium of $828. L. Vern Williams, Clk. Bd.

WAUSEON, O.—Bids are asked until Aug. 12 for furnishing labor and material to sink as many artesian wells as may be required to furnish 500,000 gallons per day. C. E. Guilford, Secy.

KENTLAND, IND.—This city expects to lay 4,000 or 5,000 ft. of additional mains next year. Chas Frankenberger, Pres. Bd.

PENDLETON, IND.—A system of water-works to cost $30,000 is proposed. Dr. L. E. Alexander is interested.

HOLLAND, MICH.—The following contracts were awarded July 25 for building the new water-works: For furnishing pipes—Lake Shore Foundry, Cleveland, O., $20.20 per ton delivered at Holland; for laying pipes—A. L. Holmes, Grand Rapids, 16 cts. per ft. Work will be commenced at once.

CERRO GORDO, ILL.—The date for the opening of bids for the construction of water-works as advertised in Engineering News has been postponed. Chas. F. Sturtevant, Consult. Engr., 320 South 3d St., St. Louis; E. A. Barnwell, Clk.

GILMAN, ILL.—Bids are asked until Aug. 22 for constructing works, as stated in our advertising columns. A. D. Thompson, Engr., Peoria.; Chas. Meyer, Chn. Com.

GREENUP, ILL.—The village board has decided to issue bonds for $4,000 for water-works. A plant to cost $10,000 will be erected and an assessment will be levied for the balance.

POLO, ILL.—A tax has been levied to raise money to lay more mains next summer. L. F. Thomas, Chn. Com.; J. H. More, Cy. Engr.

LINDEN, WIS.—It is reported that a system of water-works will be built.

NEENAH, WIS.—About two miles of extensions are projected. I. E. Johnson, Supt.

DUNLAP, IA.—Bids are asked until Aug. 20 for furnishing and laying about 2,000 ft. of 4-in. water main with fire hydrants and connections complete. H. Jennings, Mayor; I. L. Pease, Recdr.

FAIRFIELD, IA.—The contract for digging a trench for 2,700 ft. of new 12-in. water mains has been awarded to Jefferson Griffiths. The water committee of the city council has decided that the city can build the new dam cheaper than by contract. Estimated cost, $5,000.

SHELDON, IA.—A second boiler is now under construction and there is talk of another pump next year. J. O. Gates, Supt.

TOLEDO, IA.—The contract for building a 140,000-gallon reservoir has been awarded to Turbett & Vest at $1,200.

FOSSTON, MINN.—The water-works and electric light letting, advertised for Aug. 6, has been postponed until early next spring,owing to failure to sell bonds. Chas. F. Loweth, Engr., St. Paul.

WELLS, MINN.—Bids are asked until Aug. 13 for furnishing and laying 2,500 ft. of 4-in. cast-iron pipe, and for a 16-in. × 16-ft. steam boiler. C. F. Loweth, Engr., St. Paul; A. O. Oleson, Village Recdr.

PLATTSMOUTH, NEB.—The city council at its meeting, July 28, discussed the question of purchasing the gas and electric light plant and appointed a committee to investigate.

FORT BENTON, MONT.—At a meeting of the town council it was decided to construct a reservoir or filtering well at the pumping station.

ST. LOUIS, MO.—Contracts have been awarded as follows: Laying water pipe, R. J. McDonald & Co., $9,410, and P. O'Donnell, $8,210; for furnishing 2,700 tons of water pipe, Howard-Harrison Iron Co., $53,028; for furnishing 75 tons special castings, Howard-Harrison Iron Co., $2,505; for furnishing 127 stop-valves, George J. Fritz Foundry & Machine Co., $2,625; for furnishing 100 fire-plugs, George J. Fritz Foundry & Machine Co., $1,375.

GOLDFIELD, COLO.—A press report states that a proposition for a system of water-works has been received by the town council from J. E. Hurd, civil engineer, of that place, and will be acted upon at the next meeting of the board of trustees. C. E. Dersell, Town Cilk.

CASTLE ROCK, ORE.—According to a press report H. Orchard has been granted a 30-year franchise for the construction of water and sewer systems; source of water supply is a mountain stream about two miles distant; a reservoir will be built.

MYRTLE, ORE.—An electric light and water-works plant is proposed for this city; P. L. Nelson may be addressed.

SPOKANE, WASH.—It is reported that the council is again agitating the subject of a new reservoir.

ANAHEIM, CAL.—An election was held Aug. 1 to vote on an issue of $11,000 in bonds for extensions; the city expects to take up old riveted pipe and replace with cast-iron pipe, about 2½miles. Chas. S. Rogers, Cy. Engr.; M. Nebelung, Clk.

BOSTONIA, CAL.—J. Donald is reported to be building a 60,000-gallon reservoir near this place to supply the town with water.

NORTH ONTARIO, CAL.—The Mountain View Water Co. has been incorporated, with a capital stock of $13,875, for the purpose of supplying water for domestic and irrigation purposes. Geo. B. Ford, Ontario; J. N. Huehn, North Ontario; A. Thompson and D. R. Clay, Clermont; J. T. Brady, Pomona.

SANTA BARBARA, CAL.—All previous actions of the city council concerning water-works have been annulled and new plans and specifications have been prepared by J. K. Harrington, Cy. Engr. They contemplate a sea-water system with a pump with capacity of 300 gallons a minute; a 200,000-gallon reservoir and suitable connections for street sprinkling and fire protection. A pipe line costing $29,100, from the city tunnel, and a 1,000,000-gallon reservoir to cost $20,000 will be required for the city service.

OSBURN, IDAHO.—Money is in hand for one mile of extensions of the water mains. W. B. Heyburn owns the plant.

NORTH SYDNEY, N. S.—J. J. McInnis, of Port Morien, C. B., has the contract for constructing the works at this place; plant will cost about $50,000 and is to be completed in December. J. N. Armstrong, Town Clk.

DESESONTO, ONT.—The question of spending $58,000 for a water-works system will be submitted to a popular vote.

VANCOUVER, B. C.—The city engineer has advised the city council to construct another water main from the reservoir to Westminster Ave., in order to regulate the pressure. The matter has been referred to the water committee.

IRRIGATION.

WICHITA FALLS, TEX.—Press reports announce that a $600,000 irrigation project is being agitated by Chas. D. Keyes, J. A. Kemp, Maj. W. W. Ford and others of this city, and that the money for the enterprise is to be furnished by T. C. Pudry, of St. Louis, Gen. Mgr. Missouri, Kansas & Texas Ry., representing John D. Rockefeller and other eastern capitalists. A stone dam will be built in the Wichita River about 35 miles southwest of this city, and a reservoir covering 40,000 acres will be made, from which 200,000 acres of land will be irrigated. It is stated that several contracts have already been awarded and it is believed that active work will begin within 90 days.

PORTAGE LA PRAIRIE, MAN.—F. E. Simonds has work on hand which includes estimating the cost of building and irrigation flume.

NEW COMPANIES.—National Land & Irrigation Co., Omaha, Neb.; $350,000; Edgar C. Salisbury, H. G. Candee.

Polomas Canal Co., Polomas, Ariz.; $6,000; directors: E. F. Snider, J. B. Martin, S. H. Grumbles, H. E. Fairman and J. T. Snider.

SEWERAGE.

DEERING, ME.—At the meeting of the council Aug. 14 the question of sewage disposal into Back Bay will be considered; at present only one sewer from the city has its outlet into that bay. Elbridge Matthews, Chn. Com.

RUTLAND, VT.—Surveys have been made by Sidney Smith, Cy. Engr., for 13,000 ft. of 12 to 6-in. pipe sewers, to be built by day labor. The contract for the Moon Brook sewer, for which bids were received June 12, as advertised in Engineering News, has not yet been awarded, although the sewer may be built this season.

NEW BRITAIN, CONN.—The sewer commissioners have prepared plans and estimates for a trunk sewer to drain the southwestern section of the city; estimated cost,$300,000; average depth, 13 ft.; work will include considerable rock excavation.

ARVERNE, N. Y.—A meeting of the property owners was held last week to discuss the question of sewers and macadam roads and it was voted to issue $50,000 in bonds for this purpose. Wm. H. Amerman and Oscar Mussinan are interested.

BROOKLYN, N. Y.—Bids are asked until Aug. 13 for constructing sewers; sureties, $1,750 and $8,500. Theo. B. Willis, Comr. Cy. Wks.

BUFFALO, N. Y.—Bids are asked until Aug. 25 for constructing 15 to 10-in. tile sewers in three streets. R. G. Parsons, Secy. Dept. Pub. Wks.

SANDY HILL, N. Y.—The plans for a system of sewerage for this village (population about 4,000) has been prepared by John W. Burke, of New York city, and approved by the state board of health, and will soon be submitted to the taxpayers to vote upon. The plans contemplate over 20 miles of 24 to 6-in. sewers; estimated cost, $60,000. F. M. Van Wormer is a member of the committee.

TROY, N. Y.—The following bids were received July 31 for a sewer in Mill St.: Robert J. Gleason, $21,400; Frank Cavanaugh, $22,889; Casey & Kavanaugh, $25,510; Martin Murray, $30,414; James H. Morrissey, $33,500.

ELIZABETH, N. J.—Francis Collingwood has prepared plans for the purification of the Elizabeth River and has submitted estimates to the city council for an intercepting sewer three miles long to tide water; size, 2 ft. 6 ins. × 3 ft. 9 ins. to 66 ins.; pumping station half-mile from terminus; estimated cost, $112,000, and $5,000 a year for maintenance of pumping station.

MANOR STATION, PA.—The construction of sewers in the town of Manor will soon be commenced, according to reports.

PHILADELPHIA, PA.—Thos. M. Thompson, Dir. Pub. Wks., awarded contracts July 29 for constructing about 80 branch sewers, to cost about $75,000, the successful bidders being as follows:- William & J. B. McHugh, John Morrison, James J. Madden & Co., James H. Deehan, P. P. Stuart & Co., David McMahon, John McCann, L. A. Hubbs, Richard Bennis, Robert Higgins, David France, H. C. Eyre, R. B. McDaniels & Co., Joseph Perna & Co., Frank McCullough, Walter D. Stone, Michael O'Rourke, William Chambers, William Moss, Jones & Wallace, Richard P. Bennis, McCann & Wilkins, Patrick Monaghan, John D. Murphy, John Robinson, John Dotger, Delaplaine & West, John Kerrigan, Patrick Durkin, J. H, Loucheim and Donnelly & Scattergood.

SWARTHMORE, PA.—It is reported that $15,000 has been appropriated for sewers to tidewater, by a vote of 59 to 16.

HAGERSTOWN, MD.—The town council has voted to issue $7,000 in bonds for two drains in the west side, one of which will be 1,680 ft. in length.

DALTON, GA.—The city clerk writes us that the sewer proposition was defeated at the recent election.

CLEVELAND, O.—Bids are asked until Aug. 12 for constructing sewers in two streets; D. E. Wright, Dir. Pub. Wks.

CLYDE, O.—It is reported that this place will have a sewage disposal farm of ten acres.

NORWOOD, O.—Bids are asked until Aug. 10 for the purchase of $36,892 in village bonds to pay for sewers W. E. Wichgar, Clk., 317 Walnut St., Cincinnati.

WARREN, O.—Bids are asked until Aug. 20 for constructing about 1,700 ft. of 15 to 9-in. pipe sewer, average cut 8 to 11 ft. Homer C. White, Cy. Engr.; Albert E. Andrews, Cy. Clk.

FRANKFORT, IND.—Bids will not be received Aug. 11 for constructing lateral sewers, as noted July 23, the council having withdrawn the advertisement. James A. Price, Cy. Clk.

HOLLAND, MICH.—A mass meeting was held last week to consider the construction of a sewer system, for which Alvord & Shields, of Chicago, have prepared plans, estimated cost, about $20,000.

PANA, ILL.—The council has appropriated $8,000 for sewers.

MILWAUKEE, WIS.—Contracts for sewers were awarded July 28 as follows: To J. S. O'Neill, at 98 cts. a lin. ft.; J. P. Ryan, pipe, $1.03; H. Hohensee, pipe, $1.07, J. C. F. Brand, pipe, $1.13; J. O'Donnell, brick, $2.25; pipe, $1.45; James Markey, $2.69.

OAKLAND, CAL.—Two sewer contracts have been awarded to N. S. Douglass and one each to E. Cavanaugh and John Geary.

SAUSALITO, CAL.—The trustees are considering an ordinance providing for an issue of bonds for a sewer system.

TORONTO, ONT.—C. H. Rust, Deputy Cy. Engr., writes us that the matter of the construction of the proposed trunk sewer has been held over and it is quite probable that nothing will be done this year.

GARBAGE DISPOSAL—STREET CLEANING.

YORK, PA.—The city officials are reported to be inspecting the garbage crematories in other cities.

WILMINGTON, DEL.—The contract for garbage collection for two years is reported to have been awarded to James B. Stidham..

INDIANAPOLIS, IND.—Local papers state that the city officials have secured information from cities in all parts of the country in regard to garbage contracts and hope to have the matter in shape in a few weeks for action in this city.

STREETS AND ROADS

RUTLAND, VT.—Sidney Smith, Cy. Engr., informs us that probably 100 ft. of retaining wall, which was washed out by spring freshets, may be replaced this season at the intake of the water-works. About 1,000 ft. of street macadam and 2,600 ft. of macadam sidewalks in parts are projected; may be done by day work.

ARVERNE, N. Y.—There is talk of issuing $50,000 in bonds for macadamizing and sewering this village.

BROOKLYN, N. Y.—Bids were received by the shore road commission Aug. 5 for filling in portion of the wharf at the foot of 96th St. Edwin C. Swezey, Engr. in Charge, 3d Ave. and 39th St.; Elijah R. Kennedy, Pres.; Geo. Ingram, Secy. Comn. Plans for the shore drive have been in preparation for some time by Olmsted, Olmsted & Eliot, landscape architects and engineers, and it is stated that the construction will soon be in progress. The road will be about three miles in length, of easy grade, by gentle windings from 67th St., in Bay Ridge, to the concourse at Fort Hamilton.——It is probable that Leonard St. will soon be paved with asphalt between Greenpoint Ave. and Broadway, at a cost of about $70,000.

BUFFALO, N. Y.—Bids are asked until Aug. 25 for paving in Forest Ave. and John St. R. G. Parsons, Secy.

LOCKPORT, N. Y.—Bids are asked until Aug. 17 for 2,088 sq. yds. of brick paving in Locust St. Chas. H. Cornes, Cy. Engr.

NEW YORK, N. Y.—Bids are asked until Aug. 12 for paving with asphalt and stone; 19 contracts. Chas. H. T. Collis, Comr. Pub. Wks.——The park commissioners are reported to have awarded the contract for the construction and improvement of the third section of Riverside Park drive, from 120th St. to 129th St., to Bart Dunn, at $119,090.

NEW YORK, N. Y.—Bids are asked by the park department until Aug. 17 for about 24,000 sq. yds. of asphalt pavement with concrete base and about 30,000 sq. yds. without concrete base.

OSWEGO, N. Y.—Bids are asked until Aug. 17 for asphalt and brick paving, as stated in our advertising columns. E. A. Cooke, Clk. Dept. of Wks.

PATCHOGUE, N. Y.—A public meeting was held last week to consider the question of improving the roads; committee has been appointed.

BOUND BROOK, N. J.—Bids are asked until Aug. 11 for macadamizing 1,700 lin. ft. of Hamilton St. F. N. Voorhees, Clk.

JERSEY CITY, N. J.—The street commissioners have ordered the improving of eight streets, nearly all of which connect with the Hudson County boulevard.

PHILADELPHIA, PA.—Bids are asked until Aug. 12 for paving streets and other work. Thos. M. Thompson, Dir. Pub. Wks.

WASHINGTON, D. C.—Bids are asked by the district commissioners until Aug. 15 for furnishing red paving brick, as stated in our advertising columns.

CANTON, O.—A report from Youngstown, O., states that W. W. Young, Pres. Cy. Council; L. E. Chapin, Cy. Engr., and others have been inspecting the brick pavements in that city.

CLEVELAND, O.—Bids are asked until Aug. 26 for 8,084 sq. yds. of asphalt paving in Giddings Ave., and 9,200 sq. yds. in Murray Hill Ave. The bids recently received for this work ranged from $23,239 to $25,593 for the Giddings Ave. work, and $32,534 to $33,439 for the Murray Hill Ave. work. D. E. Wright, Dir. Pub. Wks.

TOLEDO, O.—Bids are asked until Aug. 31 for paving in two streets with brick. L. P. Harris, Cy. Clk.

EVANSVILLE, IND.—Bids are asked until Aug. 8 for 13,000 sq. yds. of brick paving, estimated to cost $10,000. Aug. Pfaefflin, Cy. Engr.

MARION, IND.—Contract for paving with brick Fourth St. and the Public Square was awarded to the Capitol Paving & Construction Co., of Indianapolis.

EAST ST. LOUIS, ILL.—Bids are asked until Aug. 15 for 23,600 sq. yds. of vitrified brick paving on 6 ins. concrete foundation. L. L. Harper, Cy. Engr.

THE DALLES, ORE.—A local paper states that County Surveyor Goit has returned from making a survey of the proposed free road leading from Dufur across Deschutes and on to the Cook county line. The heaviest expense will be the construction of a bridge across the river, but it is thought that the cost of the road and bridge will not be more than $3,500.

STOCKTON, CAL.—The council is reported to have passed a resolution in faver of macadamizing Main St. Geo. A. Bidwell, Supt. of Streets.

NELSON, B. C.—The Nelson "Tribune" states that John R. Patton, of Rossland, an experienced railway builder, has contracted to complete the first 10 miles of the Sanca-Shite Grouse wagon road in 30 days, at $950 per mile. Mr. Patton began work July 22. The remaining 8 miles will be let and work commenced as soon as the grade is established.

MANUFACTURING PLANTS.

BARTON LANDING, VT.—E. L. Chandler's box and sounding-board factory was destroyed by fire July 29. The mill, machinery and stock are a total loss. The loss on the mill and contents is from $18,000 to $20,000.

ATTLEBORO, MASS.—The Mossberg Mfg. Co. is asking the citizens to subscribe $50,000 for building a new factory.

ALBANY, N. Y.—P. J. McArdle, M. Freeman and Edward White are interested in the erection of an ice plant to cost about $50,000.

GLOVERSVILLE, N. Y.—It is stated that Jacob Adler & Co. will enlarge their glove factory by erecting a three-story addition, 32 × 24 ft. They will also erect a new brick boiler house.

COHOES, N. Y.—Work has been begun on the addition which is to be built to the American Hosiery mill on Mohawk St. Charles McCarthy, the proprietor, has awarded the contract for the mason work to Stanton & Neary, at $10,500. The addition will be 22 × 122 ft., four stories high with an attic. On the southwest corner will be built a tower six stories high in the top of which is to be placed a large water tank.

ROME, N. Y.—The Rome Mfg. Co. is erecting a factory 260 × 70 ft., with a boiler house 40 × 60 ft.; cooking utensils are to be made.——The Columbia Knitting Mill Co. is putting up a factory 124 × 54 ft., three stories high

SYRACUSE, N. Y.—The Tourist Cycle Co.'s works was burned Aug. 3. Loss, $35,000, fully insured.——The Barnes Cycle Co. has made arrangements for the building of a new factory in Water St., just east of its present building. It will be five stories high.

BEAVER FALLS, PA.—The McCool Tube Co., of Beaver Falls, is tearing down part of the old cutlery works buildings in order to make room for a building 100 × 200 ft., in which to manufacture seamless steel cycle tubing. Each bench will be run by a separate 20-HP. electric motor. This company was recently organized and has applied for a charter; capital stock, $300,000; Wm. A. McCool, Harry W. Reeves, of Beaver Falls; A. S. Reeves and J. M. Kreamer, of Philadelphia, and Hunter Eckert, of Reading, Pa.

BRADDOCK, PA.—On July 31, a recently erected boiler house at the Edgar Thomson Steel Works that cost $8,000 was demolished by the gale. It was a brick building and was blown completely over. Three large smoke stacks were also blown over, causing probably $3,500 damage.

LATROBE, PA.—Hamilton Bros., of Pittsburg, who have been looking for a site for their glass plant, which is now located at Pittsburg, are stated to have accepted the Piper farm, located ½ mile east of here. The works will consist of four large furnaces, each employing 100 men, and several structural steel buildings, costing $40,000. The cost of the entire plant will be about $75,000.

PHILADELPHIA, PA.—The main building of the extensive phosphate and fertilizer works of the Baugh & Sons Co. was destroyed by fire Aug. 4. Supt. Wells estimates the company's loss at $200,000, which is partly covered by insurance. A large vat of grease boiling over into a fire started the flames.

PHILADELPHIA, PA.—The plant of the Philadelphia Paving & Construction Co., manufacturers of asphaltum, was destroyed by fire Aug. 2; loss is about $12,000.——The paint shop in the yards of the Cramp Ship & Engine Building Co. was destroyed by fire Aug. 1, with most of its contents, entailing a loss of about $40,000. The burned structure was of frame, 200 × 90 ft.

WHEELING, W. VA.—The Principio Forge Co. is to double its capacity by the addition of more forge fires, and also a new 5,000 lb. steam hammer.

FLAT ROCK, N. C.—The Hart Knitting Mills Co. will double the capacity of its plant and put in Mayo automatic knitters.

MEBANE, N. C.—A large cotton mill to cost over $100,000 is to be built at this place at an early date.

ATLANTA, GA.—The Whittier cotton mills located near this city will double its capacity by installing 10,000 more spindles.

BARNESVILLE, GA.—An underwear factory to turn out 100 suits of underwear daily is to be built and equipped at this place; $10,000 was subscribed by the business men last week for that purpose.

CHATTAHOOCHE, GA.—It is stated that the Whittier Cotton Mills contemplates doubling its plant. It has 10,000 spindles in operation now.

CORDOVA, ALA.—It is stated that ground has been surveyed for a new cotton mill. The main building will be 328 × 128 ft., three stories high. In addition there will be an engine room, a boiler room, a ware room and a commissary—all of brick.

CHATTANOOGA, TENN.—It is stated that the Chattanooga Foundry & Pipe Co. is to build a blast furnace in connection with its plant, to make its own iron.

CENTRALIA, ILL.—The Centralia brewery and ice plant, two miles from the city, burned Aug. 1. Estimated value of plant, $20,000; insurance, $7,000. The plant was owned by St. Louis capitalists and under the management of J. Himple of that city.

FRIAR'S POINT, MISS.—The Delta Veneer & Box Co.'s plant burned July 31. Loss, $100,000, partially insured. The plant was owned by the Chicago National Bank.

ARGENTINE, KAN.—A press dispatch states that a party of Ohio capitalists has bought the plant of the Kansas

City Steel & Iron Works. The works will at once be enlarged and steel will be manufactured under a new process.

TELLURIDE, COLO.—The Telluride Foundry & Machine Co. expects to commence the construction of its main building within a few days; the molding room is now under construction. V. J. H. Schram, Mgr.

SALINAS, CAL.—It is stated that Claus Spreckles may build a large beet sugar factory here.

MINING.

SHAMOKIN, PA.—The Royal Oak Co., Ltd., will erect a new 600-ton coal breaker, according to report.

CISCO, CAL.—It is reported that Heath & Doolittle are developing their Lost Emigrant mine 16 miles southeast of this place.

GRANITEVILLE, CAL.—Bids were asked until Aug. 1 for driving a main tunnel, 5 × 6½ ft., on the Gaston Ridge or California mine, by power drills, 700 ft. Dana Harmon, Mgr. Shasta Mining Co.

JACKSON, CAL.—It is reported that a 30-stamp mill is to be put in at the Union Consolidated mine. Capt. W. S. Davis and W. T. Matson, of San Francisco, are interested.

SAN BERNARDINO, CAL.—A. G. Campbell will double the capacity of his stamp mill at the Boomerang mine and expects to spend $60,000 for machinery, according to reports.

SONORA, CAL.—Supt. Neville is reported as to put in new hoisting machinery at the Alabama mine.

TRAIL, B. C.—The Lillooet, Fraser River & Caribos Gold Fields, Ltd., has purchased the rights and title to the property of the Columbia & Western Ry. in this locality amounting to one square mile. The price paid was $50,000.

MISCELLANEOUS CONTRACTS.

STONE CRUSHER.—Folsom, Nev.—It is reported probable that a second stone crusher will be put in at the new state plant.

STEAM ROAD ROLLER.—Greenfield, Mass.—The selectmen are reported as considering the purchase of a steam road roller.

SUBWAY.—Boston, Mass.—Bids are asked until Aug. 20 for constructing Section 5 of the subway. A. Carson, Ch. Engr.; B. L. Beal, Secy.

DREDGING.—Portland, Me.—Bids are asked until Aug. 24 for dredging, as stated in our advertising columns. Lt.-Col. A. N. Damrell, U. S. Engrs.

ICE MACHINE.—Columbus, O.—Bids are asked until Aug. 20 for an ice-making and cold storage apparatus. A. B. Richardson, Secy. State Hospital.

SNAGBOAT.—Portland, Ore.—Bids are asked until Aug. 20 for constructing a snagboat, as stated in our advertising columns. Capt. W. L. Fisk, U. S. Engrs.

WHARF.—San Pedro, Cal.—The Kerckhoff-Cuzner Mill & Lumber Co. has been granted an extension of time in which to complete its wharf, until Dec. 24, 1897.

CEMENT AND SAND.—Portland, Me.—Bids are asked until Aug. 15 for cement and sand, as stated in our advertising columns. Lt.-Col. A. N. Damrell, U. S. Engrs.

DREDGING, ETC.—Chicago, Ill.—Bids are asked until Aug. 24, for dredging and pier extension, as stated in our advertising columns. Maj. W. L. Marshall, U. S. Engrs.

TELEPHONE FRANCHISE.—Wilmington, Del.—The Delaware & Atlantic Telegraph & Telephone Co. has been granted a franchise to lay underground conduits in all parts of the city.

WHARF.—Stockton, Cal.—An ordinance has been passed by the council providing for the construction of a wharf at least 100 ft. long on the south side of Stockton channel. J. M. McCall, Cy. Clk.

STREET SWEEPING MACHINE.—San Diego, Cal.—Bids are asked until Aug. 13 for furnishing a street sweeping machine, as stated in our advertising columns. F. H. Dixon, Secy. Bd. Pub. Wks.

LEVEE WORK.—Talluhah, La.—Bids are asked until Aug. 10 for the raising and enlargement of levees in Madison and Tensas parishes; 15 contracts. F. L. Maxwell, Pres. 5th Dist. Levee Bd.; A. L. Lane, Secy.

TUNNEL.—Beaver Meadow, Pa.—A tunnel through Spring Mountain to drain the Coxe collieries into the Quakaka Valley is reported as to be built; length, 1½ miles. Eckley B. Coxe is the originator of the plan.

RIVETED STEEL PIPE.—Redding, Cal.—Bids are asked until Aug. 27 for furnishing 4,800 ft. of 30-in. riveted steel pipe, as stated in our advertising columns. Geo. Kent Radford, Consult. Engr., 2312 Warring St., Berkeley.

STONE WALL.—San Francisco, Cal.—Bids are asked until Aug. 27 for the construction of a stone wall along the southern boundary of Military Reservation at Presidio. Lieut.-Col. J. C. G. Lee, Deputy Q. M. Genl., U. S. A., 36 New Montgomery St.

CANAL AND BASIN ENLARGEMENT.—Kings Park, N. Y.—Alonzo E. Smith, of Islip, has been awarded two contracts aggregating $20,000, for enlarging the basin and widening the canal leading from the Nissequogue River to the store house on the hospital grounds.

COAL CONVEYING PLANT.—Kings Park, N. Y.—C. W. Hunt & Co., of West New Brighton, Staten Island, have been awarded the contract at $12,041, for constructing a dock, trestle work, iron work bridge, steam engine and hoisting apparatus for handling coal at the state hospital.

READING SUBWAY.—Philadelphia, Pa.—The awarding of contracts for constructing a portion of the Reading subway is noted in another column under Contract Prices. It has been decided to have the tunnel the length planned originally, about 2,800 ft., and new bids will be asked in a few days for this work.

ROCK CRUSHER.—Vancouver, B. C.—The city engineer has been instructed by the board of works to ascertain terms for the purchase of a rock crusher and land for a site for the same. There is no money available to purchase the property this year, but it is desired to know on what terms owners will be willing to sell.

COAL CONVEYOR.—Schenectady, N. Y.—Bids are asked until Aug. 10 for furnishing a coal hoisting and conveying plant, as stated in our advertising columns. The Stanwix Engineering Co., Engrs.; Geo. T. Ingersoll, Supt. W. W.

CRIBS.—Detroit, Mich.—The following bids were received July 31 for furnishing the material and labor for constructing and placing 7 cribs in Hay Lake Channel, St. Mary's River, Mich., as advertised in Engineering News:

Eslow & Munroe, Charlevoix, Mich.	$5,622
Beauvais & Coulter, Charlevoix, Mich.	6,416
McCurdy Bros, Duluth, Minn.	6,432
C. E. Mitchell & Co., Ludington, Mich.	6,804
J. V. Gearing, Detroit, Mich.	9,178

CONTRACT PRICES.

READING SUBWAY.—Philadelphia, Pa.—The bids for the construction of temporary tracks in connection with the abolishment of grade-crossings on the line of Pennsylvania Ave. and Noble St. (Reading Subway), as advertised in Engineering News, were published July 30. The following ten contracts have since been awarded: E. D. Smith & Co., Philadelphia, contract No. 13, blocks T, R, I and K, at $79,744; No. 14, excavation of core, construction of bridges, etc., at $742,028; No. 23, retaining walls and reconstruction of buildings, blocks F and O, at $78,364; No. 28, block Q, at $15,547; P. H. Flynn & Co., 211 South 9th St., Philadelphia, contracts No. 12, blocks U, V and S, at $212,602; No. 17; retaining walls and buildings, blocks B and K, at $101,027; No. 19, blocks C and L, at $131,570; No. 21, blocks D and M. at $110,561; No. 22, retaining walls and reconstructing buildings, blocks E and N, at $84,730; No. 24, retaining walls, etc., in blocks P, G and H, at $142,852; time for completion of each of the ten contracts has been changed to 18 months. The detailed bids for contracts 13 and 14 were as follows:

Bids for Contract No. 13, Reading Subway, Philadelphia, Pa.

Quantities.		Geo. S. Good & Co., Lock Haven, Pa.	P. H. Flynn & Co., 211 S. 9th St., Phila.	B. E. Malone, Girard House, Philadelphia.	P. McManus, 1430 S. Penn Sq., Phila.	McGraw & Gray, 410 Walnut St., Phila.	E. D. Smith & Co., Philadelphia.	M. McManus, 414 Wood St., Philadelphia.	Ryan & Kelley, 1126 N. 40th St., Phila.
Excavation	25,700 cu. yds.	$1.40	$0.90	$1.40	$1.40	$0.93	$0.60	$1.04	$1.25
Rubble masonry, above neat line	5,300 “ “	6.50	6.00	5.00	5.20	5.95	5.75	4.85	5.47
Rock-faced coursed ashlar masonry	1,800 “ “	10.50	8.62	9.00	10.50	8.97	8.60	8.70	7.90
Rubble masonry, below neat line	2,300 “ “	6.25	6.00	4.75	5.20	5.60	5.00	3.65	5.22
Brick masonry,	24 “ “	11.50	9.00	9.50	10.50	8.50	8.50	9.80	8.00
Coping, 10 × 30 ins.	950 lin. ft.	1.00	2.25	1.60	1.50	1.75	1.25	3.45	1.55
Foundation platform	10,000 ft. B.M.	30.00	25.00	30.00	35.00	30.00	25.00	30.00	35.00
Piles	2,500 lin. ft.	.35	.20	.26	.50	.09	.60	.15	.35
Concrete	100 cu. yds.	6.00	6.50	4.00	5.50	6.50	5.50	6.65	7.50
Temporary wooden railing	500 lin. ft.	.05	.10	.15	.50	.20	.12	.65	.30
Railing No. 4	100 “ “	2.25	2.00	1.44	2.03	2.00	1.60	2.13	1.65
Railing No. 5	100 “ “	2.00	1.75	1.35	1.76	1.75	1.60	1.76	1.35
Railing No. 6	400 “ “	1.10	1.05	1.04	1.07	1.12	.95	1.24	.90
Newel Post No. 4	2 each	8.00	7.50	8.00	7.70	8.00	9.15	9.85	9.20
Newel post No. 5	2 “	6.00	5.50	7.00	5.50	6.00	4.35	4.85	4.30
Newel post No. 6	2 “	5.00	4.25	4.00	4.12	5.00	2.75	3.20	2.75
Additional steel work	2,000 lbs.	.05	.04	.04	.03¼	.03	.03¼	.03¾	.04
French drains	2,200 lin. ft.	.20	.02	.15	.50	.45	.25	.20	.75
4-in. cast-iron pipe weepers,	540 “ “	.60	.70	.08	.50	.50	.25	.30	.40
Terra cotta pipe, 6 or 8 ins. diameter	200 “ “	.20	.50	.50	.85	.50	45	.48	.75
12 or 15 ins. diameter	100 “ “	.45	.60	1.00	1.95	1.25	.85	1.00	1.50
Manhole with cover	2 each	35.00	25.00	25.00	35.00	50.00	25.00	28.00	30.00
Yellow pine timber	3,000 ft. B.M.	35.00	27.00	30.00	37.00	40.00	30.00	32.00	35.00
Hemlock lumber	3,500 “ “	25.00	22.00	30.00	27.50	30.00	22.00	18.00	25.00
Repaving with granite blocks	1,000 sy. yds.	4.00	.50	2.50	.57	.50	1.15	2.70	.50
Repaving sidewalks with brick	250 “ “	2.00	1.00	.15	.55	.35	.45	.90	.75
Total		$113,345	$90,499	$96,947	$102,103	$90,922	$79,743	$86,599	$95,010
Time		12 mos.	30 mos.	12 mos.	9 mos.	8 mos.	24 mos.	8 mos.	6 mos.

Bids for Contract No. 14, Reading Subway, Philadelphia, Pa.

Quantities.		Mason, Hoge & Co. Frankfort, Ky.	E. D. Smith & Co., Philadelphia.	P. McManus, 1430 S. Penn Sq., Philadelphia.	P.H.Flynn & Co., 211 S. 9th St., Philadelphia.	Ryan & Kelley, 1126 No. 40th St., Philadelphia
Excavation	530,000 cu. yds.	$0.68	$0.59	$1.30	$0.57	$0.70
Rubble masonry, above neat line	2,800 “ “	5.75	5.75	6.50	6.00	5.47
Rock-faced coursed ashlar mas., do. do	900 “ “	9.00	8.60	11.50	8.62	10.00
R.f. or r.p. c'rsed ash. mas, bdg piers	1,600 “ “	12.00	15.00	21.00	20.00	13.00
Rubble masonry, below neat line	2,400 “ “	5.75	5.00	6.50	6.00	5.22
Concrete	200 “ “	6.00	5.50	6.00	6.50	7.00
Coping, 10 × 30 ins.	1,800 lin. ft.	2.00	1.25	1.50	2.25	1.55
Foundation platform	5,000 ft. B.M.	35.00	25.00	35.00	25.00	35.00
Piles	1,000 lin. ft.	.35	.60	.50	.20	.35
For bridges at Broad, 15th, &c., in place complete		307,866	298,000	379,112	304,278	297,400
Additional steel work	10,000 lbs.	.06	.03¼	.03¼	.04	.04
Railing No. 1	400 lin. ft.	2.64	2.30	3.08	3.00	2.25
Railing No. 2	400 “ “	2.64	2.30	2.50	2.60	2.35
Railing No. 3	400 “ “	1.84	1.60	2.03	2.25	1.65
Railing No. 4	400 “ “	1.84	1.60	2.03	2.00	1.55
Railing No. 5	600 “ “	1.61	1.40	1.76	1.75	1.35
Railing No. 6	800 “ “	1.00	.95	1.07	1.05	.90
Special railing for Broad St. bridge	568 “ “	22.80	22.00	35.00	75.00	19.00
Newel post No. 1	8 each	14.00	11.95	11.00	11.00	12.00
Newel post No. 2	8 “	13.75	11.55	16.50	16.00	11.60
Newel post No. 3	8 “	16.00	11.55	9.35	9.50	10.25
Newel post No. 4	8 “	11.00	9.15	7.70	7.50	9.20
Newel post No. 5	12 “	6.00	4.35	5.50	5.50	4.30
Newel post No. 6	16 “	4.00	2.75	4.12	4.25	2.75
Temporary wooden railing	700 lin. ft.	.50	.12	.50	.10	.30
Additional granite block repaving	1,000 sq. yds.	1.75	1.15	1.75	1.50	2.45
Granite block paving in depressed y'd	12,000 “ “	3.50	2.60	2.75	2.35	2.95
Additional granite block paving	500 “ “	4.25	2.90	3.25	2.75	3.85
Resetting of old curb	100 lin. ft.	.30	.20	.20	.20	.25
6-in. curved granite curb	100 “ “	2.25	1.45	1.55	1.28	1.45
6-in. granite curb	200 “ “	1.35	1.05	1.10	.93	1.05
8-in. granite curb	100 “ “	1.50	1.45	1.55	1.30	1.40
8-in. curved granite curb	50 “ “	2.50	1.60	1.80	1.50	1.60
6-in. bluestone curb, 24 ins. deep	2,600 “ “	1.10	1.10	1.10	.60	1.00
Granite crossing stones	100 “ “	1.25	1.00	1.20	.45	1.00
Additional asphalt on 6 ins. concrete	200 sq. yds.	2.60	3.00	3.30	2.00	2.00
Repaving brick sidewalks	50 “ “	1.00	.45	.55	1.00	.90
Brick sidewalk	50 “ “	1.00	.95	1.25	1.00	1.00
Granolithic sidewalks	25 “ “	2.80	2.70	2.50	1.75	2.00
Repaving flag sidewalks	25 “ “	2.60	.45	.55	1.75	.80
Bituminous concrete	25 “ “	38.00	30.00	40.00	9.00	35.00
Sheet asphalt binder and surface	50 “ “	2.85	1.75	2.00	1.50	2.25
Granolithic wearing surface	25 “ “	2.50	1.50	1.75	1.50	1.60
Flag paving	25 “ “	2.50	2.40	2.50	1.75	2.25
Con. & brk conduit, 12 ins. wide, earth	1,650 lin. ft.	3.00	1.80	4.15	1.75	2.47
12 ins. wide in rock	1,700 “ “	2.00	1.90	2.60	2.00	1.91
15 ins. wide, in earth	60 “ “	3.00	1.90	2.95	2.00	2.47
15 ins. wide, in rock	600 “ “	2.50	2.00	2.95	2.00	1.93
French drains, 18 × 18 ins	200 “ “	.25	.25	.50	.10	.75
4-in. cast-iron weepers	100 “ “	.25	.25	.50	.70	.40
Circular, brick sewer, 2 ft. diameter	40 “ “	6.00	2.25	6.20	2.00	4.25
6 or 8-in. diam. T. C. pipe, not in con.	100 “ “	.50	.45	.85	.50	.50
12 or 15 ins. diam. T. C. pipe in con.	100 “ “	1.50	1.85	2.30	1.25	1.50
12 or 15 ins. diam. T.C. pipe, not in con.	100 “ “	1.00	.85	1.95	.90	1.10
No. 1, B. & S. inlets	5 each	95.00	100.00	95.00	70.00	96.00
No. 2, B. & S. inlets	5 “	85.00	95.00	85.00	60.00	87.00
No. 3, B. & S. inlets	10 “	80.00	90.00	80.00	50.00	81.00
No. 4, B. & S. inlets	5 “	45.00	85.00	65.00	35.00	50.00
Total		$813,615	$742,028	$1,235,456	$775,952	$803,368
Time		30 mos.	24 mos.	24 mos.	30 mos.	24 mos.

SEWERS.—Dayton, O.—The contract for a sewer in Wayne Ave. and Anderson St. has been awarded to W. N. Carlisle, Port Huron, Mich., at $8,200, the price being reported as follows: 36-in. brick, 2-ring, 1,810 ft., $1.85 per ft.; 30-in. brick, 2-ring, 2,434 ft., $1.57; 24-in. D. strength, 90 ft., $1; 12-in. pipe, 970 ft., 27 cts.; catch-basins, 44, $10; manholes, 12, $16; stone, 10 perch, $3.25; street railway drips, 2, $7. J. Connelly & Son, Cleveland, bid $9,299; P. E. Lehman, $10,732; Teigter & Gabler, $9,189; Munger & Co., $9,531; D. A. Onkst, $9,943; Bruno Ritta, $10,020.

BRICK PAVING.—Lowell, Mass.—The contract for 2,000 sq. yds. of brick paving on the Moody St. bridge has been awarded to the Boston Paving Co., at $2.10 a sq. yd. for metropolitan brick; Staple Bros., Lowell, bid $2.25, and the Davis Co., Philadelphia, $2.80.

BRICK PAVING.—Fort Dodge, Ia.—J. W. Campbell, of Des Moines, is reported to have been awarded a $40,000 brick paving contract in this city, at $1.22 a sq. yd. for Fort Dodge brick; said to be the first paving to be done in town.

ASPHALT PAVING.—New York, N. Y.—The following bids were opened July 29 for asphalting 126th St., from Second to Fourth Ave.: California Asphalt Co., $3.09 a sq. yd. and 70 cts. for the curb; Sicilian Asphalt Paving Co., $2.88 and 65 cts.; Barber Asphalt Paving Co., $2.95 and 80 cts.; Warren-Scharf Asphalt Paving Co., $2.53 and 65 cts. For two asphalt strips, 4 ft. wide, along various streets, for bicycles, the bids are reported as follows: Sicilian Asphalt Paving Co., $2.23 and $2.16; Barber Asphalt Paving Co., $2.25; California Asphalt Co., $2.15 and $2.31.

CURBING AND STREET WORK.—Milwaukee, Wis.—Local papers state that contracts for curbing (lowest bids ever received) have been awarded as follows: A. Kellner, 33 cts. per lin. ft.; Arthur Froemming, 32⅔ cts.; John

Wilce, 33½ cts.; C. Edson, 32.49 cts.; J. H. Donahue, 33 cts. Seven contracts were awarded for paving alleys with cobblestones in various wards, the prices ranging from 34½ cts. to 42 cts. a sq. yd.; J. H. Kearney will furnish $2,000 worth of crushed stone for repairs of First Ward streets, at $1.08 a cu. yd.; John Morgan, $1,000 worth of gravel for the Sixth Ward at 65 cts.; T. R. Wiesemann, slag for repairs in four south side wards at from 46 to 56 cts., and C. Beck, slag for the Fourteenth Ward at 54 cts. a cu. yd.

BRIDGE.—New Bedford, Mass.—Wm. F. Williams, Cy. Engr., has sent us the following statement of the bids received July 15 for building that portion of the New Bedford & Fairhaven Bridge way and approaches, between the harbor commissioners' line, near the west shore of Pope's Island, and the west line of Main St., Fairhaven, 2,825 lin. ft., as noted in Engineering News of July 9; Wm. Sanders, Chn. County Comrs.; cost of items for double-tracking electric railway are omitted in table and also all the totals except the lowest total of each bidder for completed structure on engineer's plans; where more than one method of doing work is given the estimated quantitites are repeated:

BIDS FOR CONSTRUCTING 2,825 FT. OF THE NEW BEDFORD & FAIRHAVEN BRIDGE, NEW BEDFORD, MASS., JULY 15, 1896.

Quantities.	Beattie & Wilcox.	Boston Bridge Co.	Groton Bridge Co.	Wrought Iron Bridge Co.	New Jersey Steel & Iron Co.	Edge Moor Bridge Co.	Steward & Mc-Dermott.	E. W. Everson.	Youngs-town Bridge Co.	Berlin Iron Bridge Co.	King Bridge Co.	J. W. Bishop & Co.	C. H. Sears.
Retaining walls: Excavation.......1,000 cu. yds.	$0.59	$0.70	$0.40	$1.50	$1.43	$1.10	$1.00	$1.00	$1.00	$1.95	$1.50	$0.80	$0.65
Dredging .... 200 " "	.59	1.00	.60	.40	.51	1.10	.50	1.00	1.00	.50	1.50	1.00	.95
Coursed masonry, above grade....2,260 " "	11.80	15.00	10.00	9.75	9.77	12.00	12.00	11.00	10.50	11.70	15.00	19.00	14.65
Un-coursed masonry, above gr.....2,260 " "	9.44	10.00	7.00	7.75	8.49	8.50	7.00	8.00	9.00	11.00	12.50	10.00	13.65
Coursed masonry, below gr........2,600 " "	10.62	15.00	12.00	9.50	10.80	12.00	9.00	11.00	11.50	11.70	14.00	19.00	15.95
Un-coursed masonry, below gr.....2,600 " "	9.44	9.00	9.00	7.50	9.52	9.00	7.50	8.50	9.75	11.50	12.50	10.00	14.95
Rubble masonry, below gr.........2,600 " "	8.26	9.00	9.00	6.75	7.21	7.50	5.50	7.00	8.00	7.20	9.50	5.50	15.95
Portland cement concrete.........1,000 " "	8.26	7.50	7.00	6.00	6.43	7.50	7.50	6.75	7.00	6.90	9.00	8.00	12.60
Rosendale cement concrete........1,000 " "	7.08	6.00	6.00	6.00	5.40	6.50	6.00	6.00	5.50	6.00	8.00	5.00	11.60
Rubble mas. f'ndations, Port. cem.1,000 " "	9.44	9.00	9.50	7.75	6.43	8.25	5.50	7.50	8.75	7.50	10.00	5.50	14.95
Rubble mas. f'ndations, Ros. cem..1,000 " "	8.26	8.00	8.00	6.50	5.40	7.50	4.50	7.00	8.00	7.25	9.50	4.50	14.35
Sheet piling, per M. ft....................	35.40	60.00	50.00	30.00	40.87	55.00	42.00	50.00	35.00	40.00	40.00	45.00	65.00
Coping, ...8,600 cu. ft...	1.18	.90	1.10	.75	.82	1.50	1.10	1.25	1.30	.90	1.50	1.25	1.70
Piles in place ....9,000......	5.90	6.25	4.25	3.25	4.30	4.40	5.00	4.00	7.00	6.00	7.50	5.00	6.00
Yellow pine timber .... 80 M. ft ..	35.40	55.00	30.00	35.00	41.00	35.00	30.00	30.00	30.00	35.00	35.00	40.00	85.00
Iron railing ....3,000 lin. ft..	2.36	2.00	2.00	1.50	2.00	2.20	2.10	2.00	1.25	1.50	1.75	1.50	1.75
Piers and abutmts: Crsd mas. Plan A2,324 cu. yds.	21.24	28.00	16.75	11.00	11.00	19.00	18.00	18.50	12.75	15.90	18.00	22.50	18.00
Coursed masonry, Plan B.........1,334 " "	18.88	28.00	17.00	11.00	11.00	19.00	17.00	18.00	12.75	15.00	19,00	20.00	15.95
Concrete fndatn., Port.cem.,Plan B 670 " "	9.44	7.50	8.00	6.00	6.70	9.00	7.00	7.50	7.00	7.50	9.00	10.00	12.80
Concrete fndatn, Ros. cem., Plan B.1,000 " "	7.08	6.00	6.00	6.00	5.70	8.00	5.00	6.50	6.00	7.00	8.00	6.00	11.80
Piles driven and cut off.......... 804 piles...	8.26	6.25	4.25	4.50	4.80	4.50	5.50	4.00	8.00	6.00	8.00	5.00	6.00
Sheet piling and wale timbers.... 80 M. ft...	41.30	60.00	50.00	30.00	40.00	55.00	36.00	50.00	35.00	40.00	40.00	45.00	65.00
Yellow pine timber in place....... 130 " "	35.00	55.00	30.00	35.00	40.00	35.00	30.00	30.00	30.00	35.00	35.00	45.00	85.00
Riprap .... 400 cu. yds.	2.36	3.00	2.00	2.50	1.75	3.50	2.00	3.00	3.00	2.50	2.00	2.00	5.50
.Coping and bridge seats.........4,500 cu. ft..	1.18	1.00	1.10	1.00	.77	1.50	1.25	1.30	1.30	1.15	1.40	1.25	1.70
Dredging .... 800 cu. yds.	1.77	1.00	.60	.50	.51	1.10	.50	.50	.50	.50	1.50	1.00	.95
Roadways, walks, etc.: filling.....32,500 " "	.59	.70	.55	.30	.48	.55	.33	.40	.55	.60	.55	.50	.65
Trinidad asph. on 6 ins. concrete..9,575 sq. yds.	3.00	2.75	2.55	2.40	2.40	2.75	2.75	2.40	2.85	2.50	2.40	3.25	2.40
Macadam ....9,575 " "	.82	2.00	1.30	.75	1.30	1.40	1.40	1.25	1.10	.88	.75	1.25	.85
Granite block on 6 ins. concrete...9,575 " "	3.25	2.25	2.89	2.25	2.90	3.50	2.75	3.25	3.10	2.35	2.20	4.25	2.30
Granite curbing ....4,300 lin. ft..	.70	1.05	.70	.55	.81	.75	.50	.60	1.00	.50	.54	.90	.95
10-in. drain pipe ....1,117 " "	.60	1.15	.79	.25	.25	.55	.70	.50	.50	.75	.60	.45	.60
15-in. " " .... 35 " "	.89	1.50	1.00	.45	.48	.55	1.00	.50	.75	1.50	.75	.65	.75
12-in. " " .... 643 " "	.70	1.15	.65	.35	.34	.55	.90	.50	.60	.90	.65	.50	.65
8-in. " " .... 432 " "	.47	.90	.51	.20	.22	..45	.50	.40	.40	.60	.60	.40	.60
6-in. " " .... 210 " "	.47	.90	.45	.18	.16	.45	.45	.30	.35	.50	.48	.35	.48
Brick catch basins .... 16 each...	83.00	100.00	45.00	30.00	25.00	35.00	50.00	25.00	25.00	70.00	60.00	55.00	60.00
Brick manhole .... 1........	60.00	50.00	45.00	40.00	70.00	35.00	65.00	25.00	50.00	35.00	19.00	40.00	19.00
Trin. asph. on concrete, sidewalks.3,820 sq. yds.	3.00	3.00	2.40	2.05	2.00	2.25	2.50	2.00	2.15	2.00	2.00	2.50	2.00
Cement concrete, sidewalks ....3,820 " "	1.18	2.00	2.00	1.80	2.50	2.25	2.25	2.00	1.60	.75	1.50	1.30	1.50
Tar-concrete sidewalks ....3,820 " "	.70	2.00	1.25	.65	.82	1.10	1.45	.80	1.50	.70	.55	1.00	.60
Superstructure: 9 plate-girder deck spans, wood floor, erected, painted, etc..................	74,930	66,600	74,250	62,500	71.300	64,000	58,845	58,208	54,500	66,896	61,466	66,622	62,080
Same, with Trin. asph. floor, etc..............	120,360	91,593	106,412	93,500	93.820	85,000	83,460	80,100	85,000	94,315	90,931	91.593	91,840
Removal present bridge east of Pope's Island....	.....	.....	1.00	.....	.....	1,000	1,000	1,000	6,000	4.000	.....	2,000	4.500
Total	$241,712	$265,066	$229,083	$180,336	$207,935	$232,402	$197,400	$206,604	$208,870	$220,538	$249,857	$223,319	$280,348

CEDAR BLOCK PAVING.—Grand Forks, N. Dak.—F. A. Brown, Cy. Audr., writes us that the following bids were received July 24 for about two miles of cedar block paving, press reports stating that the contract has been awarded to P. McDonald, of Duluth, Minn.:

Bidder.	Cedar blocks, sq. yd.	Granite curb, lin.ft.
P. McDonald, Duluth, Minn.............	$0.92	$0.90
A. & D. Saug, Duluth, Minn.	1.03	.88
James Dinnie, Grand Forks, N. Dak	1.02	.90
J. M. Carroll, Grand Forks, N. Dak. ...	1.13	.90
Geo. E. Osgood, Fargo, N. Dak.	1.13	.95

SEWER.—Jersey City, N. J.—The following bids were received for constructing a sewer in Baldwin Ave. and other streets, as noted in Engineering News:

Bids for Constructing Sewer, Jersey City, N. J.

Items.	Edward O'Neill.	William T. Ard.	M. R. Van Keuren.	Sanford & Stillman Co.	Joseph H. Jones.	Philip Tumulty.	John F. Mullery.	P. H. Flaherty, Jr., & Co.	Henry Byrne.	Patrick T. Plunkett.	F. C. Meehan.
18-in. vitrified pipe sewer, per lin. ft..............	$1.50	$1.50	$1.09	$1.35	$1.50	$1.04	$1.80	$1.23	$0.01	$3.00	$1.90
20-in. " " " " " "	1.10	2.50	1.12	1.50	1.75	1.16	1.90	1.23	3.00	2.00	1.90
24-in. brick oval sewer, per lin, ft.	2.80	2.35	2.40	2.95	2.50	1.76	2.40	2.18	1.00	3.00	2.50
34-in. circular sewer, per lin, ft., upland.........	3.20	3.35	3.16	3.50	2.50	2.26	2.70	3.02	8.00	2.70	3.00
34-in. circular sewer, per lin. ft., on piles.........	2.80	3.60	3.20	3.40	2.50	2.26	2.80	3.02	.50	4.60	3.90
Rock excavation, per cu. yd.	2.90	2.00	2.00	2.25	2.00	5.00	3.40	2.25	5.00	.01	2.50
Concrete, per cu. yd.	.01	4.00	1.00	5.50	.01	5.00	1.00	.50	.01	.01	.05
Piles, per lin. ft.	.15	.14	.15	.18	.15	.16	.15	.14	.01	.14	.15
Capping, per M. ft.	18.00	21.00	28.00	27.50	20.00	18.00	15.00	27.00	.10	20.00	20.00
Flooring, per M. ft.	15.00	15.00	20.00	25.00	14.00	15.00	20.00	25.00	.10	20.00	20.00
Sheathing and lumber in bottom (cradles), per M.ft.	10.00	13.50	20.00	25.00	10.00	15.00	.01	17.00	.10	.01	12.00
Receiving basins, each	70.00	65.00	75.00	85.00	60.00	90.00	100	82.00	1.00	100	50.00
Iron bolts, per lb.	.04	.05	.03	.03	.05	.05	.05	.04	.01	.03	.01
Iron spikes, per lb.	.04	.05	.03	.03	.05	.05	.05	.02	.01	.03	.01
28-in. steel pipe sewer on piles, per lin. ft.........	5.50	6.50	4.00	3.70	4.00	5.66	6.00	5.90	4.00	5.30	8.00
15-in. spurs, each	10.00	12.00	15.00	10.00	1.00	100	6.00	5.00	.10	10.00	200
Masonry, per cu. yd.	5.00	7.00	2.00	3.50	5.00	9.00	6.00	6.00	.10	.01	5.00
20-in. connections, each	10.00	15.00	20.00	20.00	1.00	25.00	6.00	5.00	.10	10.00	50.00

SEWER MATERIALS.—Watertown, Mass.—The committee on sewers for the east end of Watertown is reported to have received the following bids July 26: For 15,400 ft. of 16 to 18-in. sewer pipe, Berry & Ferguson Co., Boston, 62% discount; David W. Lewis, Hyde Park, 62½%; Fiske, Holmes & Co., Boston, 63%; Waldo Bros., Boston, 63½%; M. B. Page, Peabody, 64½%; Portland Stoneware Co., Boston, 65%; George B. Teele, Watertown, 65%; Kennedy, King & Co., 72%; 73% if inspected at the factory. For hard-burned sewer brick, 250,000, the bids were as follows: Perry Bros., Cambridge, $8.50 per 1,000; W. H. Peveer & Co., Watertown, $8 and $8.50 (awarded contract). For 700 bbls. Rosendale cement: H. A. George, $1.07 per bbl.; Berry & Ferguson, $1.09; Chester, Sprague & Co., $1.15; for 200 bbls. Portland cement: H. A. George, Watertown, $2.07; Berry & Ferguson, $2.28; Chester, Sprague & Co., Watertown, $2.30; both contracts awarded to H. A. George. For manhole sets, about 70: Waltham Iron Foundry Co., $7 per set (awarded contract); Mechanics' Iron Foundry, $7.22. The system of sewers for East Watertown will be built by the town, and no contract labor will be employed. Work was begun July 26.

ORDNANCE SUPPLIES.—Washington, D. C.—The following bids were opened at the war department Aug. 3, according to press reports:

For 10-in. disappearing gun carriages—American Hoist & Derrick Co., St. Paul, ten or more at $11,800 each; Weimar Machine Works, Lebanon, Pa., 30, more or less, $17,250 each; Bethlehem Iron Co., five, at $16,800 each, or ten or more at $16,400 each; Robert Poole's Son & Co., of Baltimore, 30, at $13,748 each; Cramp & Sons, Philadelphia, 30, at $17,000 each; John H. Dialogue, Camden, N. J., five, at $20,300 each; Kilby Mfg. Co., Cleveland, O., six, at $17,500 each; Morgan Engineering Co., Alliance, O., one for $18,500, or six for $17,180 each; Pond Machine Tool Co., Plainfield, N. J., one for $24,147, ten for $169,470, and 20 for $330,940, if over 20, at $16,500 per carriage; Southwark Foundry & Machine Co., of Philadelphia, one for $12,660, all above ten at $11,500 each; Niles Tool Works, Hamilton, O., six at $15,975 each; and each additional carriage at $15,175 each.

Motor carriages—American Hoist & Derrick Co., 20 or more, at $5,618 per carriage; Weimar Machine Works, all of the carriages, but not less than ten, at $8,500 per carriage; the Dixon Mfg. Co., Scranton, Pa., ten spring return carriages at $8,950 each; Robert Poole's Son & Co., 56 or more spring return carriages, at $5,396 each; West Point Foundry Co., Cold Spring, N. Y., 20 or less spring return carriages, at $7,300 each; Morgan Engineering Co., one carriage for $8,150, or 12 for $6,980 each; Walker Mfg. Co., Cleveland, O., 56, more or less, at $8,250 per carriage; Niles Tool Works, ten for $7,575 each, and additional carriages at $7,175 each; Kilby Mfg. Co., six 12-in. carriages at $7,850 each; Southwark Foundry & Machine Co., one for $6,450, and all above ten for $5,750 each; Pond Machine Tool Co., five for $41,244, or 20 for $151,780; Builders' Iron Foundry, Providence, R. I., 50 or more at $6,136 each, less than 20 at $6,819 each.

Forgings for 10, 12 and 16-in. guns—Bethlehem Iron Co., 18 sets for 10-in. guns, at 23.6 cts. per lb.; for 12-in., 23.9 cts. per lb., and for 16-in., 24 cts. per lb.; Midvale Steel Co., 18 sets, for 10-in., 23.85 cts. per lb.; 18 sets for 12-in., 23.65 cts. per lb., and one set for 16-in., at 30 cts. per lb.

Mortar forgings—Bethlehem Iron Co., 60, more or less, for 12-in., 23½ cts. per lb.; Midvale Steel Co., 60 sets, at 29.3 cts. per lb.

Finishing and assembling 12-in. mortars—Builders' Iron Foundry, Providence, R. I., 30 or more, $3,759 each; less than 20, at $3,875 each.

Completing mortars—Bethlehem Iron Co., 20 complete, $12,250 each; over 20, at $12,000 each.

Rapid-fire guns—American Ordnance Co., 6-pdr., Driggs-Schroeder type, $1,565 each; Thomas F. Lane, 6-pdr., with mounts, Maxim types, $1,795 each.

Bids for deck-piercing shell were submitted by the Carpenter Steel Co., the Sterling Steel Co., and the Midvale Steel Co., and ranged from $162 and $141 for the 800-lb. shell to $208, and $175 each for the 1,000-lb. projectile. The same firms submitted proposals for furnishing armor-piercing shot.

The bids for $1,000,000 worth of steel gun forgings, for use in manufacturing two 8-in., 50 6-in., 35 5-in., and 20 4-in. breech-loading rifles opened at the navy department Aug. 3 were as follows: Bethlehem Iron Co., 4, 5 and 6-in. forgings, 26½ cts.; 8-in. forgings, 23.7 cts.; Midvale Steel Co., 4 and 5-in. forgings, 27 cts.; 6-in. forgings, 26 cts., 8-in. forgings, 23.9 cts. Secretary Herbert has intimated that he would not pay over 24 cts. for naval guns, this being the price allowed the army in the fortification act.

LEVEE WORK.—New Orleans, La.—James Hingle, Jr., Home Place, has been awarded 13 contracts for levee work, at 11 and 11.3 cts. a cu. yd.

EXTENDING WATER TUNNEL.—Ontario, Cal.—Arthur S. Hobby, Jr., Engr., Rose Block, Ontario, writes us that the bids received July 13 for extending the Bodenhamer tunnel have been rejected and the work is being done under the direction of the engineer at a much less cost than the lowest bid, the 3½ × 2½ × 6 ft. tunnel costing only $3.65 under present management; bids were as follows; all lumber for timbering to be furnished by the water company: Hall & Anderson, Monrovia, Cal., main tunnel to be retimbered, 20 ft. $4 a lin. ft.; main tunnel, 4½ × 3½ ft., extended, 50 ft., $6.40 a lin. ft.; lateral drifts, 3½ × 2½ × 6 ft., 420 ft., $6.25 a lin. ft.; shaft, 4 × 4 ft., 60 ft., $7 a lin. ft.; total, $3,445. Carmichael & McGillard, Pasadena, $10, $8.50, $6.75, $6.25 and $3,735, respectively.

CHANNEL EXCAVATION.—Vicksburg, Miss. — Bids were opened July 25 by Maj. J. H. Willard, U. S. Engr., for 150,000 cu. yds. of excavation in the Yazoo River canal. A. P. Martin, of Louisiana, was the lowest bidder at 19⅜ cts. Work is to begin as soon as the contract is awarded and must be completed by Dec. 25.

BRICK PAVING AND GRADING.—Des Moines, Ia.—The following bids were received for the paving of West Eighth St. and the grading of 18th St., from University Ave. to Forest Ave. For paving: A. P. Herrick, $1.45 a sq. yd.; J. L. Black, $1.43.9; J. A. Bryan, $1.37; W. A. Youngerman, $1.40; H. V. King, $1.43; for the grading: Herrick, 15.9 cts. per yd.; John A. Jones, 22½ cts.; J. A. Black, 15.9 cts.; William Jubb, 18⅜ cts.; and H. V. King, 12⅛ cts.

INDUSTRIAL NOTES.

THE SYRACUSE BELTING CO., Syracuse, N. Y., has made an assignment; liabilities, $16,000.

THE MERRIMACK WHEEL & GEAR CO., Amesbury, Mass., has had its plant closed by order of the mortgagee; liabilities, about $60,000; assets, $30,000.

THE CARNEGIE STEEL CO., Pittsburg, Pa., is stated to have put in blast furnace D at Braddock, Pa. This will give employment to 150 men who have been unemployed several months.

THE PORTLAND DOOR, SASH & BLIND CO., Portland, Me., will soon begin the manufacture of fireproof elevator and partition doors to be made of asbestos. The concern will employ between 40 and 50 men.

MR. JAMES H. LANCASTER, 169 and 171 Broadway, New York city, informs us that he has received from Kern Bros. Packing Co., Portland, Ore., an order for three 1¼-yd. grapples for the excavation of 300,000 yds. of earth.

THE EAST CHICAGO IRON & STEEL CO., of Hammond, Ind., made an assignment in the county court July 29 to David L. Evans. Parkhurst & Wilkinson, whose failure was noted last week, were interested in the concern.

THE AMERICAN HOIST & DERRICK CO., of St. Paul, submitted the lowest bid Aug. 3 for 10-in. disappearing gun carriages, at $11,800 each for ten or more, and will probably be awarded the contract by the War Department. The company bid $5,618 each for 20 or more motor carriages and may receive this contract also.

THE STAR FILE WORKS, Buffalo, N. Y., has changed hands and is now a stock company of which the following are the officers: Pres., Thos. B. Cloyes; Vice-Pres., Victor Hill; Secy., Ulysses J. Rogers; Treas., F. Cloyes. The company will continue to manufacture files and will also build bicycles. The factory is located on Adams St.

THE CARBOLINEUM WOOD-PRESERVING CO., of Nashville, Tenn., has opened an office at 21 Cliff St., New York, to which customers from the eastern and middle states are invited to send their orders direct. The manager of the company, Mr. C. S. McKinney, is now in personal charge of the New York office. The company reports an increasing demand for its Carbolineum Avenarius.

THE LUX & TALBOTT STONE CO., Logansport, Ind., has just completed the building of side tracks into its quarries in Logansport, Cass county, Ind., and is about prepared to deliver a superior quality of steel blue magnesia lime stone for building purposes. The company has erected a crushing plant with a capacity of 200 cu. yds. per day, for furnishing crushed rock for concrete or paving.

THE AMERICAN AIR POWER CO., Rome, N. Y., has delivered three Hardie air-motors to the Third Ave. R. R. Co., of New York, and is building trial air-motor for the Manhattan Elevated Ry. The company was incorporated a few months ago with a capital stock of $1,250,000, and has offices at 160 Broadway, New York; Pres., E. A. Willard; Vice-Pres., Edward Comstock; Treas., Henry Marquand; Secy., Samuel Lee; Gen. Mgr., Henry D. Cook; Engr., E. E. Pettee. Allen C. Washington, Pres. Iron Steamboat Co., and Arthur W. Soper, Pres. Safety Car Heating & Lighting Co., are among the stockholders.

THE BROWN HOISTING & CONVEYING MACHINE CO., of Cleveland, Ohio, General Eastern office, Havemeyer Bldg., New York, has just received an order from Fried. Krupp at Essen, Germany, for a complete hoisting and conveying plant for his blast furnace at Rheinhausen This plant consists of three standard Brown overhead bridge tramways, to be operated by electricity, each machine having independent winding drums and electric motors. The Brown Hoisting & Conveying Machine Co. is to furnish all the working parts, including the sheaves, engines, motors, hoisting and conveying machines, etc.: in fact, everything put the bridges proper, which will be built in Germany, the Brown Co. sending a man abroad for that purpose. There will be three Elwell-Parker motors used of about 60 HP. each. The entire plant is to be in operation by the early part of 1897.

THE GENERAL ELECTRIC CO., Schenectady, N. Y., has the order for installing electricity in the coal mines of Ellsworth, Morris & Co., Hartford, O. The system to be employed is the three-phase system of the General Electric Co., and the plant will consist of one 135-HP. electric generator and eight coal cutters of the new induction motor chain type. These will be placed in two mines at Trail Run and Hartford, O., distant from each other 2½ miles. The power house will be located centrally and the current will be carried for nearly two miles, over aerial wires, which will be run through drill holes into the entries of the mines and be carried to the various points where the cutters are employed. Induction motor cutters were adopted in place of direct current motor cutters for the reason that compared with the latter the former is lighter in make, possesses many characteristics rendering the method of applying power to the cutter superior, decreases the amount of copper required to equip the mine, has no commutator or brushes, has no starting rheostat and does not spark. The Hutson Coal Co., owning and operating coal mines at Deerfield, Portage Co., O., has also adopted electrical apparatus for cutting its coal. The plant consists of one 100-HP. three-phase generator and one 6-ft. coal cutter. The particular mine in which the cutter is working has just been opened. The entry is driven in only a few hundred feet and there is only room at present for one cutting machine.

NEW COMPANIES.—Reliance Engineering Co., Aurora, Ill.; to manufacture engines and ice machines; $250,000; John Alexander, Willis Hoyt, J. J. McLallen, and Henry Slaker.

American Clay Mfg. Co., Pittsburg, Pa., $1,000; Treas., Charles P. Hill.

Cicero Telephone Co., Austin, Ill.; $10,000; R. H. Trail, W. O. Cline, Louis Nissen.

Globe Chuck Co., Alexandria, Va.; $100,000; Albert Stephans, John A. Schneider.

Buhl Steel Co., Sharon, Pa.; $300,000; J. H. Buhl, K. S. Fruit, T. J. Foraker, John Carley.

Portland Elevator Co., Portland, Me.; $50,000; John W. Loud, Geo. P. Westcott, Chas. Percy.

Inter-State Equipment Co., New York, N. Y.; $5,000; John H. Sprall, F. W. Spier, H. L. Sprague.

Electrical Tool Co., New York city; $100,000; Stanley Cunningham, Abraham M. Johnston, L. A. Smith.

Patton Mfg. Co., Columbus, O.; to manufacture castings, $50,000; A. G. Patton, W. E. Joseph, N. B. Abbott.

Buhl Steel Co., Sharon, Mercer county, Pa.; $30,000; F. H. Buhl, T. D. Buhl, J. S. Fruit, T. J. Farker and John Carley.

Moffatt Bearing Co., Council Bluffs, Ia.; to manufacture and sell a ball roller bearing; $3,000,000; A. B. Hunt, B. Silloway, and Goerge F. Wright.

La Campania Aceite Mascotta de Los Estados Unidos de Norte America, Los Angeles, Cal.; to develop oil territory; $200,000; commencing with $500; H. L. Williams, L. A. Grant, K. H. Wade, E. L. Doheney, all of Los Angeles.

Philipsburg & Clearfield Telephone & Telegraph Co., Philipsburg, Pa.; $1,000, all paid in; Treas., Thomas J. Lee, Philipsburg, Pa.

Globe Electric Heating Co., Camden, N. J.; $100,000, commencing with $1,200; J. C. Haywood, Geo. B. Fraley, Amos B. Paulson.

Coronet Steel Co., Hoboken, N. J.; $500,000, commencing with $5,000; H. Richard Payne, New York city; Wm. R. Hinsdale, Orange, N. J.; Edward C. Sicardi, Brooklyn, N. Y.

Reading Schale Brick Co., Reading, Pa.; $75,000; commencing with $7,500; Treas., Wm. W. Seitzinger, 711 North 5th St., Reading, Pa.

M. Kollman & Co., San Francisco, Cal.; to manufacture electrical devices; $100,000; A. Iverson, M. Greenblatt, R. Capelli.

Carr Trolley Head Co., Bath, Me., to purchase, own and control patents, and patent rights useful in operating electric railways; $10,000, commencing with $200; W. H. Carr, C. R. Donnell.

New Hammondsport Wire Co., Hammondsport, N. Y.; $50,000; Edwin C. Cook, Bath; Benj. W. Wallington, Corning, N. Y.; Wm. H. Doty, of Yonkers, N. Y.

Knight Asbestos Mfg. Co., Newark, N. J.; $15,000, all paid in; Edward M. Knight, New York city; Thomas J. Regan, Wm. M. Clarke, Newark, N. J.

Acetylene Gas Apparatus Co., New York city; $100,000; commencing with $100; Ernest Hopkinson, D. N. Maxon, Brooklyn, N. Y.; David A. Davis, New York city.

Anti-Chill Core Compound Co., Peoria, Ill.; to manufacture castings; $2,500; Geo. M. Spangler, Charles E. Anderson, and Wm. P. Roberts.

The Durbrow & Hearne Mfg. Co., New York city; to manufacture machines and machinery; $25,000; Victor H. Schneider, of New York city; and W. E. Eatkins and John W. Leech, of Brooklyn.

Sussex Bicycle Co., Poughkeepsie, N. Y.; to manufacture bicycles; $5,000; Albert H. Gleason, C. H. Broas and Charles A. Stewart, of New York city.

American Falls Water Power Co., Milwaukee, Wis.; $200,000; to purchase and sell land, develop water power for navigation, manufacturing, mining, etc.; E. D. Rigby, J. E. Clayton and James M. Dunn.

Carbon Rheostat & Electrical Mfg. Co., Chicago, Ill.; $10,000; Sidney Stein, Henry R. Platt, Frank Crowe.

United Traction Co., Pittsburg, Pa.; $15,000; to commence with $1,500; Treas., John W. Taylor, Pittsburg.

Plunger Elevator Co., Towell, Mass.; $28,000; M. P. Higgins, G. I. Alden, J. W. Higgins and W. F. Cole.

Stevenson Wrench Co., Elkton, Md.; $10,000; George W. Cosden, James Mallen, Charles H. Squier, John S. Simcoe.

Alcade Oil & Mineral Association, Los Angeles, Cal.; J. F. Hall, W. H. Gilbert, G. W. Hack, all of Los Angeles.

Abbott & Hoyle Railway Supply Co., Atlanta, Ga.; $10,000; Frank J. Hoyle, Chas. A. Abbott, E. M. Roberts.

Adams County Telephone Co., Gettysburg, Pa.; $10,000; commencing with $1,000; Treas., George E. Stock, Gettysburg.

Poplar River Improvement Co., Duluth, Minn.; $50,000; to improve Poplar River, in Cook county, from its head waters to Lake Superior, especially with a view of improving navigation and logging; J. H. Younker, J. F. Dufur, A. W. Sanborn, A. Brace and A. H. Dufur, all of Ashland, Wis.

Warsaw Drainage & Sewer Co., Warsaw, Ind.; $10,000; J. D. Kutz, J. A. Frank, L. E. Harter, J. F. Beyer, R. I. Long.

Atlantic Mining & Smelting Co., New York, N. Y.; $10,000; Charles F. Phillips, Charles Roblee, Daniel R. Hendricks, of Brooklyn, N. Y.

British Columbia Smelting & Refining Co., Jersey City, N. J.; $2,500,000; to commence with $1,000; Geo. W. Mark, Stanley Gifford, New York; Edwin S. Maturin, Jersey City.

Columbia Motor Mfg. Co., Trenton, N. J.; $10,000; to commence with $1,000; John B. Powell, Philadelphia: Wm. Wallace, Henry J. Ingram, Trenton.

California Power & Exploration Co., San Francisco, Cal.; $500,000; to commence with $25; Chas. W. Willard, P. J. Muller, R. T. Harding, H. L. Atkinson, A. H. Winn, all of San Francisco.

West Melville Telephone Co., New Bethlehem, Pa.; $3,000; to commence with $300; Treas., J. F. Sloan, Hawthorn, Pa.

Pittsburg Fire Protection Co., Pittsburg, Pa.; $250,000, commencing with $25,000; Geo. B. Hill, Treas., 333 4th Ave., Pittsburg, Pa.

American Engineering Works, New York city; to manufacture and deal in machinery and gas and electric apparatus; $5,000; Frank M. Ashley, of Brooklyn, N. Y., and John J. Hankenhof, New York city.

Cisco Oil Mills Co., Cisco, Tex.; to manufacture cotton seed oil; $75,000; J. T. Reynolds, W. D. Reynolds, P. W. Reynolds, D. C. Campbell.

Palmetto Oil Co., Los Angeles, Cal.; $100,000, commencing with $50; J. F. Holbrook, J. L. Boyle, H. D. Thompson, all of Los Angeles.

Chas. F. Parker & Co., Jersey City, N. J.; to carry on general construction business; $125,000, commencing with $1,000; Chas. F. Parker, Frank Lazarus, J. Rockfield Furman, all of New York city.

Rarig Engineering Co., Columbus, O.; to manufacture engines, boilers, build blast furnaces, elevators, or hoists, foundations, make castings, and repair machinery; $200,000; A. K. Rarig, Theodore Leonard, E. N. Huggins, C. E. Morris and F. J. Sager.

Franklin Machine & Steam Boiler Works, Brooklyn, N. Y.; $14,000; Abella McNeil, Archibald McLean, and Jos. S. Montgomery, of Brooklyn.

Schlight Combustion Co. of Long Island; to manufacture and deal in machinery; $300,000; Thomas H. Harris, New York city; L. H. McKinney and Arthur H. Spear, of Brooklyn, N. Y.

Standard Radiator Mfg. Co., Buffalo, N. Y.; $750,000; Nelson Holland, Nelson C. Holland, and William H. Harris, all of Buffalo.

Interstate Equipment Co., New York city; to manufacture, sell and lease locomotives, cars and railway equipment; $5,000; John H. Pratt, F. W. Speir and H. L. Sprague.

BOSTON TRANSIT COMMISSION.

BOSTON SUBWAY, SECTION 5.

SEALED BIDS FOR BUILDING SECTION 5, open incline and subway, will be received at the office of the Boston Transit Commission, 20 Beacon Street, Boston, Mass., until 12 o'clock m. of Thursday, August 20, 1896. Each bid must be accompanied by a certified check for the sum of $1,000. Section 5 extends from the southerly end of Section 4, in Tremont Street, near Warrenton Street, to Pleasant Street. Some of the items are estimated to be as follows: 5,000 cubic yards earth excavation; 90 tons iron and steel, furnished by the Commission, to be set in place; 2,000 cu. yds. concrete, brick and cut stone masonry. Plans can be seen and specifications and forms of contract can be obtained at 20 Beacon Street, fifth floor. A bond will be required for the faithful performance of the contract in the sum of 20 per cent. of the amount. The commission reserves the right to reject any and all bids.

GEORGE C. CROCKER, Chairman.
CHARLES H. DALTON,
THOMAS J. GARGAN,
GEORGE F. SWAIN,
ALBERT C. BURRAGE,
Boston Transit Commission.
HOWARD A. CARSON, Chief Engineer.
D. LEIGHTON BEAL, Secretary.
32-2t

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., July 30, 1896.—Sealed proposals will be received at this office until 2 o'clock p. m., on the 27th day of August 1896 ,and opened immediately thereafter, for all the labor and materials required for the INTERIOR FINISH, PLUMBING AND GAS PIPING for the U. S. Post-office building at TAUNTON, MASS., in accordance with the drawings and specifications, copies of which may be had at this office or at the office of the Superintendent, at Taunton, Mass. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any and all bids or to waive any defect or informality in any bid should it be deemed in the interest of the Government to do so. All proposals received after the time stated will be returned to the bidders. Proposals must be enclosed in envelopes, sealed and marked, "Proposals for interior finish, etc., for the U. S. Post-office, Taunton, Mass.," and addressed to WM. MARTIN AIKEN, Supervising Architect. 32-2t

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STEEL RAILS.

Department of Public Works,
Sydney, 30th June, 1896.

Supply of 150,000 tons of steel rails, and other permanent way materials, to be manufactured in the Colony of New South Wales.

Offers are hereby invited by the Government of New South Wales, and will be received by the Secretary for Public Works in Sydney, and the Agent-General for New South Wales in London, up to 11.30 o'clock on the 30th of December, 1896, from persons willing to contract for the supply of 150,000 tons of steel rails and the necessary quantity of Fish-plates, Fish-bolts, and Spikes manufactured in the Colony of New South Wales, out of iron-ore and other necessary minerals the natural product of, and with coal, coke, or other fuel, smelted, gotten, and raised within, the said Colony, upon the Terms and Conditions which can be seen at the Offices of the Minister for Public Works, Sydney (or the Agent-General for New South Wales, London).

J. H. YOUNG,
Minister for Public Works.
32-o-a-m-4t

COAL CONVEYOR.

Water Commissioner's Office,
Schenectady, New York,
July 28, 1896.

Sealed proposals will be received at this office until 10 o'clock a. m., of August 10th, 1896, for furnishing and erecting a complete plant for hoisting coal from boat and conveying same to coal shed. All information regarding the apparatus can be obtained from the Stanwix Engineering Company, at their office in the city of Schenectady. The commissioners reserve the right to reject any or all bids.

E. NOTT SCHERMERHORN,
WALLACE E. VAN DEUSEN,
DE WITT C. SMITH,
32-1t Water Commisioners.

PAVEMENTS.

Oswego, N. Y., August 1, 1896.

Sealed proposals will be received until 2 o'clock p. m., August 17, 1896, by the Department of Works of this city, for the construction of the following pavements:

ASPHALT PAVEMENT.

In West First, from Bridge Street to Utica Street, with vitrified brick in the center of street between street railway tracks and two feet on either side of tracks.

BRICK PAVEMENT.

In East Utica Street, from the east end of the bridge to Second Street, of vitrified brick.

All the above according to plans and specifications on file in the city engineer's office, copies of which will be furnished on application.

The right is reserved to reject any and all bids.

By order of the Department of Works.
32-2t E. A. COOKE, Clerk.

U. S. ENGINEER OFFICE, 1637 Indiana Avenue, Chicago, Ill., Aug. 3, 2896.—Sealed proposals for the following River and Harbor works will be received here until 12 m. Aug. 24, 1896, and then publicly opened: DREDGING in Calumet River, Ill.; DREDGING in Calumet Harbor, Ill.; PIER EXTENSION, Calumet Harbor, Ill. Information furnished on application. W. L. MARSHALL, Maj. Engrs. 32-2t

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U. S. ENGINEER OFFICE, 537 Congress St., Portland, Me., July 23, 1896.—Sealed proposals for DREDGING at Lubec Channel, Camden Harbor, and Belfast Harbor, Me., will be received here until 3 p. m., August 24, 1896, and then publicly opened. Information furnished on application. A. N. DAMRELL, Lieut. Col. Engrs. 32-3t

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U. S. ENGINEER OFFICE, 39 Whitehall St., New York, Aug. 3, 1896.—Sealed proposals for DREDGING in Port Chester Harbor and in Mamaroneck Harbor, N. Y., will be received here until 12 o'clock noon, Sept. 3, 1896, and then publicly opened. Information furnished on application. H. M. ADAMS, Major Engrs. 32-4t

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STREET SWEEPING MACHINE

SAN DIEGO, CAL

Notice is hereby given that the Board Public Works of the City of San Diego, Ca fornia, invites sealed proposals to be deli ered at the office of said board between t hours of 10 and 11 o'clock a. m.

13TH DAY OF AUGUST,

for furnishing one street sweeping machine the latest improved pattern and best qualit

All proposals shall be made on the print forms furnished by the board and accor panied with a check for $50, certified to a responsible bank and payable to the ord of the City Clerk.

The Board reserves the right to reject a and all bids.

By order of the Board of Public Works.
F. H. DIXON, Secretary.
San Diego, Cal., July 23, 1896. 32-

A NEW LINE
OF PULLMAN DRAWING-ROO
SLEEPING CARS.

The popular Southern Railway, Piedmont A line, has recently equipped its Washingto and South-Western Vestibule Limited betwe New York and New Orleans, with Pullman latest Double Drawing-Room, Smokin Room and Ten-Section Sleeping Cars. The cars were built by the Pullman Compa especially for this line, and are known the "Empire" style. They are most el gantly finished in every respect, and ha all of the most modern conveniences that a necessary to give the traveling public safet comfort, etc. The Southern Limited leav New Yorw daily at 4:30 p. m.

SPARK DEFLECTORS IN COACHES

The Southern Railway, Piedmont Air Lin always looks after the comfort of its pa rons. They have recently placed Spark D flectors for use in their through-fa Coaches; the use of the device will ad materially to the comfort of its coach pa sengers.

Contract Work Should Always be Advertised in a Paper Read by Contractors.

Nearly Every Prominent Contractor and Manufacturer of Contractors' Supplies in North America Reads Engineering News

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PERSONALS.

Mr. N. M. Brandon, City Engineer, of Meridian, Miss., died Sept. 14.

Mr. Thomas Sharp, iron manufacturer, of Salem, O., died Sept. 10.

Mr. Chas. E. Putnam has been appointed Superintendent of Parks of Boston, Mass.

Mr. William F. Hunt, ex-County Surveyor, of Crawfordsville, Ind., died Sept. 12.

Mr. Hudson Ansley, President of the Salamanca (N. Y.) Water-Works Co., has resigned.

Mr. Arthur D. Seavy, ex-Water Commissioner and Auditor of Saratoga, N. Y., died Sept. 21.

Mr. F. P. Graf has been appointed Receiver for the Ohio Southern R. R., in place of Mr. J. R. Megrue, resigned.

Mr. Robert B. Lloyd, of the firm of Lloyd & Asson, contractors and builders, of New York city, died Sept. 9.

Mr. Harvey N. Loomis has been appointed General Manager of the Trojan Car Coupler Co., of New York city.

Mr. Jacob D. Valentine, of the firm of Valentine & Co., iron manufacturers, died at Bellefonte, Pa., Sept. 16, aged 75.

Mr. W. H. Hudson, Master Mechanic of the Southern Ry., at Atlanta, Ga., has been promoted to be Master Mechanic of the new shops at Salisbury, N. C.

Mr. Thomas Somerville, Superintendent of the Fairland, Franklin & Martinsville Branch of the Cleveland, Cincinnati, Chicago & St. Louis Ry., died Sept. 9.

Mr. W. A Stone, Master Mechanic of the Southern Ry., at Selma, Ala., has been transferred to Birmingham, in the same capacity, to succeed Mr. W. L. Tracy.

Prof. John J. Parson, of the School of Civil Engineering of Cornell University, Ithaca, N. Y., was married Sept. 15, to Miss Bertha Champlin, of Washington, D. C.

Mr. H. C. Stanley, an officer of the Department of Railways of Queensland, Australia, is making an examination of the railway systems of the United States and Canada.

Mr. Vernon H. Gridley, Assistant Engineer in the Bureau of Construction and Maintenance of the Department of City Works of Brooklyn, N. Y., died of typhoid fever, Sept. 17.

Mr. William B. Caton, an engineer on the Kansas City R. R., was killed in a railway accident near that city recently. He was formerly connected with various South American railways. He was 62 years of age.

Dr. Edward Coe Seymour, Principal of the Academic Department of the Polytechnic Institute of Brooklyn, N. Y., died Sept. 17. He had held this position for 37 years and was prominent as a mathematician.

Maj. M. B. Millen, railway contractor and builder, of Atlanta, Ga., died Sept. 13, aged 75. He built the Central of Georgia Ry. from Savannah to Macon, and was one of the best known contractors in the South.

Majors R. L. Hoxie, W. H. Hein and J. H. Gregory, of the Engineer Corps, U. S. Army, have been appointed as the Board of Engineers on the new bridge which it is proposed to erect across the Ohio River at Ironton, O.

Mr. George M. Lehman, late Assistant Engineer on the Lake Erie and Ohio River ship canal, has accepted the position of Assistant Engineer in charge of the government survey of the Allegheny River under Maj. R. L. Hoxie.

The following officers have been elected by the Board of Directors of the Oregon Improvement Co.: Mr. Elijah Smith, President; Mr. C. A. Dolph, Vice-President; Mr. Prosper W. Smith, Treasurer, and Mr. N. Poston, Secretary.

Mr. Benjamin Thackara, founder of the Thackara Manufacturing Co., of Philadelphia, Pa., died Sept. 15. He was born at Haddonfield, N. J., June 4, 1820, and was one of the largest gas fixture manufacturers in the country.

Mr. Edward H. Kendall has been appointed Consulting Architect of the Department of Docks of New York city. He is an ex-President of the American Institute of Architects and was Consulting Architect for the Washington Bridge over the Harlem River.

Mr. James M. Ashley, founder and ex-President of the Ann Arbor R. R., and father of Mr. H. W. Ashley, General Manager of the same, died in Alma, Mich., Sept. 16. He commenced the road in 1878, without capital, and was the chief executive for many years.

Mr. George F. Elms, mechanical engineer, of Chicago, Ill., has been appointed as an expert to investigate the various water meters in the market with a view to ascertaining which is the best for use in that city. He will be associated with two others and they will make their report to Commissioner Downey.

Mr. W. H. Newman, Third Vice-President of the Chicago & Northwestern Ry., has resigned to accept the position of Second Vice-President of the Great Northern Ry., to succeed Mr. Wm. W. Finley, whose election to the office of Second Vice-President and General Manager of the Southern Ry. was announced in our issue of Sept. 10.

Mr. Arthur J. Hubbard, Local Manager of the Standard Oil Co., at Toledo, O., fell from a train on the Lake Shore & Michigan Southern Ry., near Blissfield, Mich., Sept. 17, and died soon after of his injuries. He was 57 years of age and had been in the employ of the company all his life looking after their leases and wells in the western territory.

Mr. Edwin P. Dawley, M. Am. Soc. C. E., Division Engineer of the New York, New Haven & Hartford R. R., with office at Providence, R. I., has been appointed Resident Engineer of the new union station at Boston, Mass., to succeed Mr. George Blinn Francis, whose appointment to this position was announced in our issue of July 9.

Prof. Henry Moissan, of the University of Paris, arrived in New York, Sept. 21, by the "La Gascogne," from Havre. He comes as a representative of the University of Paris to the Princeton sesqui-centennial, which will be celebrated on Oct. 20, 21 and 22. He is President of the French Chemical Society and while in this country will be the guest of Prof. Marquand, of Princeton.

Mr. R. B. Gemmell, Superintendent of Telegraph of the Atchison, Topeka & Santa Fe Ry., died at Topeka, Kan., Sept. 14. He was born in Greensburg, Pa., April 27, 1839, and entered railway service in 1854 as a telegraph operator on the Pennsylvania R. R., remaining there until 1866. In 1866 he was appointed Chief Clerk to the General Superintendent of the eastern division of the Union Pacific Ry. In 1874 and 1875 he was Superintendent of the Lawrence & Southwestern R. R., and in 1875 he became Chief Clerk to the General Freight agent of the Atchison, Topeka & Santa Fe. He was appointed Superintendent of Telegraph in 1878 and held this position until his death.

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ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

INDIANAPOLIS ENGINEERING CLUB.
Sept. 26. Secy., C. C. Brown, Indianapolis, Ind.

ENGINEERS CLUB OF PHILADELPHIA.
Oct. 3. "The Cement Laboratory of the City of Philadelphia," by R. L. Humphrey. Secy., L. F. Rondinella, 1122 Girard St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Oct. 4. Secy., O. Von Geldern, 819 Market St., San Francisco, Cal.

WESTERN SOCIETY OF ENGINEERS.
Oct. 4. Secy., Nelson L. Litton, Monadnock Block, Chicago

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 5. Secy., C. L. Annan, City Engineer's Office.

ENGINEERS' SOCIETY OF WESTERN NEW YORK.
Oct. 5. Secy., Carleton Greene, Library Bldg., Buffalo.

COLUMBIAN ENGINEERING SOCIETY.
Oct. 6. Secy., F. W. Hart, 15th and H Sts., N. W., Washington, D. C.

AMERICAN RAILWAY ASSOCIATION.
Oct. 7. Annual meeting in New York city. Secy., W. F. Allen, 24 Park Place, New York city.

ENGINEERS' CLUB OF ST. LOUIS.
Oct. 7. "Some Notes on the Operation of the St. Louis Water-Works Conduit," by S. Bent Russell. Secy., Wm. J. Bryan, Turner Bldg.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Oct. 7. "The Reconstruction of Grand River Bridge," by W. A. Rogers. Secy., C. W. Hunt, 127 E. 23d St., New York.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Oct. 8. Secy., C. H. McLeod, Montreal, Can.

ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Oct. 8. Secy., James K. Zollinger, Norton Bldg., Louisville, Ky.

ENGINEERING ASSOCIATION OF THE SOUTH.
Oct. 8. Secy., L. P. Brown, Nashville, Tenn.

MONTANA SOCIETY OF ENGINEERS.
Oct. 10. Secy., Forrest J. Smith, Denver Block, Helena.

ENGINEERS' CLUB OF KANSAS CITY.
Oct. 12. Secy., F. W. Tuttle, Baird Bldg.

DENVER SOCIETY OF CIVIL ENGINEERS.
Oct. 13. Secy., Walter Pearl, 36 Jacobson Bldg.

NORTHWEST RAILWAY CLUB.
Oct. 13. Secy., T. A. Foque, Soo Line, Minneapolis, Minn.

NORTHWESTERN SOCIETY OF ENGINEERS.
Oct. 13. Secy. D. W. McMorris, 635 Burke Block, Seattle, Wash.

WISCONSIN POLYTECHNIC SOCIETY.
Oct. 13. Secy., W. K. Means, Loan and Trust Bldg., Milwaukee, Wis.

NEW ENGLAND RAILROAD CLUB.
Oct. 14. Secy., Edw. L. Jones, P. O. box 1158, Boston.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS.
Oct. 14-16. Secy., D. L. Fulton, Allegheny, Pa.

ENGINEERS' CLUB OF CINCINNATI.
Oct. 15. Secy., J. F. Wilson, P. O. box 333.

NEW YORK RAILROAD CLUB.
Oct. 15. Secy., W. W. Wheatley, Brooklyn Heights R. R., Brooklyn, N. Y.

TACOMA SOCIETY OF CIVIL ENGINEERS AND ARCHITECTS.
Oct. 16. Secy., 201 Washington Bldg.

ENGINEERS' CLUB OF COLUMBUS.
Oct. 17. Secy., M. S. Hopkins, Columbus, O.

ENGINEERS' CLUB OF MINNEAPOLIS.
Oct. 19. Secy., Elbert Nexsen, 1620 S. E. 4th St., Minneapolis, Minn.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.
Oct. 20. Annual meeting at **Chicago. Secy., S. F. Patterson, Concord, N. H.**

ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
Oct. 20. Secy., Daniel Carhart, 410 Penn Ave., Pittsburg.

WESTERN RAILWAY CLUB.
Oct. 20. Secy., W. D. Crossman, The Rookery, Chicago.

AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 20-23. Annual convention at St. Louis. Secy., T. C. Penington, 2020 State St., Chicago.

ENGINEERS' AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Oct. 21. Secy., **F. Van Vleck, Los Angeles.**

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Oct. 21. Secy., J. A. Pilcher, Roanoke, Va.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Oct. 21. Secy., S. E. Tinkham, City Hall.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Oct. 21. Secy., R. W. Pope, 26 Cortlandt St., New York city.

WESTERN FOUNDRYMEN'S ASSOCIATION.
Oct. 21. Secy., A. Sorge, Marquette Bldg., Chicago.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
Oct. 27. "Gas Producers and the Mechanical Handling of Fuel for Same," C. L. Saunders. Secy., F. A. Colburn, Case Library Bldg.

RAILWAY SIGNALLING CLUB.
Nov. 10. Secy., Geo. M. Bashford, The Rookery Bldg., Chicago.

CENTRAL RAILWAY CLUB.
Nov. 13. Secy., H. D. Vought, Buffalo "Courier," Buffalo, N. Y.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 19. Kimball House, Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.

NORTHWESTERN TRACK AND BRIDGE ASSOC.
Dec. 11. Secy., D. W. Meeker, St. Paul, Minn.

AMERICAN SOCIETY OF IRRIGATION ENGINEERS.
Dec. 11 and 12. Annual meeting to be held in Denver, Colo. Secy., John S. Titcomb, Room 36, Jacobson Bldg., Denver, Colo.

NATIONAL IRRIGATION CONGRESS.
Dec. 15, 16 and 17. Annual meeting to be held in Phoenix, Ariz. Secy., C. M. Heintz, Los Angeles, Cal.

MICHIGAN STATE ENGINEERING SOCIETY.—The following officers have been elected: Pres., Geo. Wells, Bay City; Secy. and Treas., Francis Hodgman, Climax; Directors, D. Skeels, Grand Rapids; Wm. B. Sears, Saginaw; C. E. Greene, Ann Arbor, Mich.

AMERICAN SOCIETY OF RAILROAD SUPERINTENDENTS.—At the recent meeting at Niagara Falls, N. Y., noted in our issue of Sept. 17, some new officers were elected, the President, Mr. Price, however, holding office for another year, and the Secretary, Mr. C. A. Hammond, also holding his office. The new officers are as follows: First Vice-President, W. F. Potter (Flint & P. Mar. R. R.), Saginaw, Mich.; Second Vice-President, G. R. Brown, Fall Brook Ry., Corning, N. Y.; Members of the Executive Committee, C. A. Brunn, Erie R. R., Buffalo, N. Y., and Ralph Peters, Pittsburg, Cincinnati, Chicago & St. Louis Ry., Cincinnati, O.

ENGINEERS' CLUB OF PHILADELPHIA.—At the regular meeting on Sept. 19, Mr. E. F. Smith presented a paper on "The Water Supply of Philadelphia—Considered with Reference to the Minimum Flow of the Schuylkill River." He presented tabulated statistics, comparing the Philadelphia water supply with that of other eastern cities. Mr. Smith referred to the great area and population of this city, and said there was need of several impounding reservoirs to insure a full supply during seasons of drought. The great need of Philadelphia is a larger storage capacity, and this might be secured by constructing several large reservoirs, with a capacity of about 20,000,000 gallons, with which to feed the other reservoirs.

WESTERN SOCIETY OF ENGINEERS.—At the meeting held Sept. 16, two papers on "Parks and Roads" were read by Mr. H. C. Alexander and Mr. J. F. Foster. The following are the papers to be read at the coming meetings of 1896: Oct. 7, "Railway Yards and Terminals," by H. G. Hetzler; Oct. 21, "Steel for Boilers and Fire Boxes," by T. L. Condron, and "Steel Forgings," by H. F. J. Porter; Nov. 4, "Medical Treatment of Men on Engineering Work," by Dr. S. W. Maphis; Nov. 18, "Cableways," by Frank B. Knight; Dec. 2, "The Equipment of Manufacturing Establishments with Electric Motors and Electric Power Distribution," by D. C. Jackson, and "Electric Traction," by Edward Barrington; Dec. 16, "Modern Pumping Machinery," by E. E. Johnson.

WESTERN FOUNDRYMEN'S ASSOCIATION. — The regular meeting of the association was held at the Great Northern Hotel, Chicago, Sept. 16, and two papers were read, by Mr. Curtis W. Shields, on "Compressed Air and Its Economies in the Foundry," and by Mr. Geo. A. True, on "Compressed Air as a Hoisting Power in the Foundry." The committee appointed to report upon an apprenticeship system presented its final report. The report divided foundry work into three classes, viz.: (1) General machinery work; (2) Agricultural and stove molders; (3) Bench and brass molders; and gave a form of indenture for each class. The meeting was followed by a banquet in the evening. A. Sorge, Marquette Building, Chicago, is the secretary of the association.

WESTERN RAILWAY CLUB.—The first of the regular monthly meetings of the club for the year 1896-7 was held at the Auditorium Hotel, Chicago, Ill., Sept. 15. The paper of Mr. David L. Barnes on "The Relation of Speed to the Power and Efficiency of Direct Current Series Electric Motors for Railways," was discussed and also the paper by Prof. W. F. M. Goss on "Notes Concerning the Performance of the Purdue Locomotive, 'Schenectady.'" For topical discussion the subject was "Metal Underframing for Tenders and Cars," In the evening a banquet was held at the hotel. The club begins its new year's work with a membership of 888 railway men, and its prospects are bright for an active and valuable year's work. Among the pleasing announcements made is the one that a complete subject index of the proceedings of the club since its organization, twelve years ago, is now in the hands of the printer and nearly ready for distribution. Mr. A. M. Waitt, General Master Car Builder, Lake Shore and Michigan Southern Ry., is president of the club, and Mr. Walter D. Crossman, The Rookery, Chicago, is the secretary.

MASTER CAR BUILDERS' ASSOCIATION.—The following is the list of subjects for committee reports to be presented at the meeting in June, 1897:

1. "Automatic Couplers" (Continued). To advise what changes may be desirable in the standard size of M. C. B. automatic coupler shank, and to recommend a standard yoke or pocket strap for rear attachment to car.

2. "Uncoupling Arrangements for M. C. B. Automatic Couplers" (Continued). To consider whether a standard uncoupling device is practicable and the details thereof, and to recommend a device which would be applicable to the greatest number of couplers possible.

3. "Loading Logs, Poles, Bark and Long Structural Material on Cars." To suggest modifications of or additions to recommended practice, if found desirable.

4. "Trains Parting." To consider the extent and causes of break-in-twos with automatic couplers, and to suggest remedies.

5. "Passenger Car Pedestal and Journal Box for Journal 4¼ × 8 ins." To suggest designs.

6. "Specifications and Guarantee for Cast-Iron Wheels." To propose a revision of the recommended practice of the Association, and to consider therewith the form of wheel.

7. "Air-Brake and Signal Instructions." To confer with a committee from the American Railway Master Mechanics' Association and to propose a revision of the code adopted in 1892.

8. "Freight Car Buffers." To follow up and report upon experiments about to be made with improved buffers.

9. "Box-Car Side and End Doors." To submit designs for side and end doors, including fixtures, for adoption.

10. "Arch Bars and Column Bolts for Diamond Trucks." To recommend forms in detail, for cars of 60,000 lbs. capacity, and to submit designs for same for cars of 80,000 lbs. capacity.

11. Independent Committee of Five to present individual report on Designs for Steel Car Frames.

12. Subjects for 1898. Jno. W. Cloud, Secy.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.—The twenty-seventh annual convention was held at the Park Avenue Hotel, New York city, Sept. 9 to 11, over 100 members being present. The convention discussed: "The Application of Compressed Air in Burning Paint Off Cars," "The Cause and Prevention of the Flatting of Varnish on Coaches and Engines," "Is it Advisable to Paint Locomotive Jackets, either Planished Iron or Black Steel? If so, Which is the Best and Most Economical Method," "Painting Galvanized Iron," "The Practical Painting of a Locomotive." In the last discussion it was brought out that the cost of painting locomotives on different railways varies widely. Mr. D. M. Little presented a table showing the cost on eleven different roads to vary from $113.59 for passenger and $90.97 for freight engines to $46.55 for passenger and $23.87 for freight; the average cost on the eleven roads being respectively $68.68 and $59.88. The discussion on this topic dealt more with the artistic than the practical.

For painting jackets and superheated parts, Mr. W. J. Josenhaus recommended the following: 13 lbs. keg lead, ⅛ gallon coach japan, ½ gallon rubbing varnish, ¼ gallon turpentine, 1 lb. lamp-black and ¼ lb. Prussian blue. The convention advised the painting of jackets of rusted planished iron or steel for the purpose of preservation; the surface to be carefully cleaned before the application of the paint. It was stated that paint in imitation of planished iron could be made but no formulas were given.

On the question of housing passenger equipment, the majority of the members expressed themselves as favoring car sheds not only for idle cars but for those remaining standing only from one train to another. This housing must, however, be done in well lighted and well ventilated buildings, or else the varnish and paint will be spoiled.

It was the opinion of the convention that the one great cause of trouble with railway painted work is that the paint is not allowed sufficient time to dry.

Other questions discussed were as follows: "Which is the Most Economical and Durable, a Sandpaper or a Pumice Stone Surfacer?" "Spontaneous Combustion in the Railway Paint Shop," "Is it Advisable for the Association to Employ a Practical Chemist for the Accommodation of Members?"

The old officers were elected for the ensuing year: Pres., C. E. Copp, Boston & Maine R. R.; first Vice-Pres., C. W. Mason, Pennsylvania R. R.; second Vice-Pres., D. B. Vail, New York, Lake Erie & Western R. R.; Secy., Robt. McKeon, Kent, O. The next meeting will be held at Old Point Comfort, Va.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Sept. 16, Mr. E. Sherman Gould read an abstract of his paper on "The Water-Works of Havana, Cuba," giving a very interesting account of the methods of work and the peculiar conditions controlling contract work under Spanish rule, which latter part of the paper was commented upon in our issue of Sept. 3. The specifications called for wrought iron service pipes, but these were corroded by the soil in about three months and the contractors had to keep on making renewals, as they were not allowed to follow their wishes and use the ¾-in. and 1-in. cast-iron pipe which can be obtained from English makers (though not manufactured in the United States). Eventually, however, the authorities permitted the use of a patent pipe which resisted corrosion and thus avoided further trouble. The cast-iron mains were not allowed to be coated, the specifications having been prepared many years ago, before the present coatings were in use, and it was the idea of the engineer who framed these specifications that a coating was merely a method of concealing defects. The pipes were therefore laid bare and rusty, but there was not so much trouble from discoloration of the water as Mr. Gould had expected.

In the discussion, Mr. Tratman referred to the author's remarks on the handling of large blocks of stone by merely manual power, and said that in clearing the site for the new Dalhousie Square station of the Canadian Pacific Ry. at Montreal, boulders and large stones were moved and rolled up planks into the carts by gangs of five or six men, or as many as could get a hand on the stone to hoist or push it along, no derricks being used. He also asked whether the concrete was laid wet, as the author described the methods by which the finished work was kept constantly wetted down for some months. In answer to this Mr. Gould said that it was laid fairly wet, though it was difficult to exactly describe the consistency. While he did not approve of very wet concrete (as favored by the Spanish engineers) he considered that very dry concrete was even worse. Mr. Chibas described the red tape and the "metallic influence" required to get permission from the local and home authorities to carry out the simplest engineering works in Cuba, even the construction of a plantation tramway, the time occupied being often from four to six years; in the Spanish-American countries the system is entirely different, based more on American practice. Mr. Wegmann referred to the use of asphalt pipes, described in a German paper, but no members seemed to know anything about said pipes. The secretary read a discussion from Mr. Emile Low describing a brine reservoir with four basins, built at Saltsville, Va. Two of the basins were 120 × 75 ft., 12 ft. deep, and two were 72 × 57 ft., 7 ft. deep. The floor was of concrete (laid very wet), and the walls of brick. The brickwork was laid in mortar instead of cement for reasons of cheapness, but parts failed and fell down, the mortar never having hardened and being so soft that it could be washed off the fallen bricks with water from a hose. The work was rebuilt with brick laid in cement.

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NEW PUBLICATIONS.

RULES FOR LOADING LONG MATERIALS.—Rules Governing the Loading of Lumber and Timber on Open Cars and Loading and Carrying Structural Materials, Plates, Rails, Girders, Etc. Adopted by the Master Car Builders' Association as Recommended Practice. 1896. Published by the Association; Secretary, John W. Cloud, 974 Rookery Building, Chicago. Paper; 8vo.; pp 20; illustrated. 5 cts.

These rules were given practically in full in our issue of July 23, 1896.

THE WISCONSIN ENGINEER.—University of Wisconsin Engineering Journal, Quarterly, Madison, Wis., June, 1896. Pamph.; 8vo.; pp. 160. $1.50 per year.

This is the first number of a new engineering periodical published quarterly by the students of the College of Engineering of the University of Wisconsin. It is a very creditable publication, and contains a number of interesting articles on engineering subjects written by the professors and instructors in the college. A special feature is an alphabetically arranged classified index of current engineering literature, covering the leading American, English, French and German periodicals. The index in the first number covers the dates Dec., 1895, to April, 1896, inclusive.

TRADE PUBLICATIONS.

WESTINGHOUSE ENGINES.—The Westinghouse Machine Co., Pittsburg, Pa. Pamph.; 6 × 9 ins.; pp. 43.

This pamphlet contains a number of half-tone cuts of important installations of Westinghouse engines, with lists of sizes, with some account of their material, workmanship, testing, steam economy, etc. It informs us that in the 14 years that these engines have been on the market there have been 7,000 of them put into operation in all parts of the world.

TABLES OF DIMENSIONS OF GATE VALVES AND FITTINGS.—The Walworth Mfg. Co., Boston, Mass. Pamph.; 10 × 13 ins.; pp. 32.

We believe these tables which this enterprising firm has just published will be found a great convenience in every water-works office and by every engineer and contractor engaged in water-works construction. The tables show clearly every important dimension of each size and weight of the gate valves, flanges, elbows, tees and crossings, and screwed fittings which the firm manufactures. The trouble and delay caused when a fitting is ordered for some especially contracted situation and has to be returned because it proves too large, can all be obviated by the use of these handy tables; and the enterprise of the manufacturers in publishing them will doubtless be appreciated by their customers.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work. Place.	See Eng. News.
Sept. 24.	Canal work (3 contracts), Albany, N. Y.	Sept. 17
Sept. 24.	Levees, masonry, etc., Albany, Ill.	Sept. 17
Sept. 24.	Levee work, New Orleans, La.	Sept. 17
Sept. 24.	Brick paving (20,858 sq.yds.), Macomb, Ill. Advertised, Engineering News, Sept. 17.	Sept. 17
Sept. 25.	Dredging in Newtown Creek, N. Y. Advertised, Eng. News, Sept. 3 to 24.	Sept. 3
Sept. 25.	Dredging in Bay Ridge Channel, N. Y. Advertised, Eng. News, Sept. 3 to 24.	Sept. 3
Sept. 25.	Steel bridge, Mound City, Ill. Advertised, Eng. News, Aug. 27 to Sept. 17.	Aug. 27
Sept. 25.	Gravel road, Mound City, Ill. Advertised, Eng. News, Aug. 27 to Sept. 17.	Aug. 27
Sept. 25.	U. S. building work, Kansas City, Mo. Advertised, Eng. News, Sept. 10 and 17.	Sept. 10
Sept. 25.	Pipe (2,500 tons), Holyoke, Mass. Advertised, Eng. News, Sept. 10 and 17.	Sept. 10
Sept. 25.	Chemical fire engine, Glenfield, Pa.	Sept. 17
Sept. 25.	Levee work, New Orleans, La.	Sept. 17
Sept. 25.	Asphalt block paving, New York, N. Y.	Sept. 17
Sept. 25.	Brick sewer (1,550 ft.), St. Louis, Mo.	Sept. 17
Sept. 25.	Laying water mains (13 Sts.), New York,	Sept. 17
Sept. 25.	Brick conduit, Boston, Mass.	Sept. 24
Sept. 25.	Water mains (32 streets), Pittsburg, Pa.	Sept. 24
Sept. 25.	Steel tank, boilers, etc., Pittsburg, Pa.	Sept. 24
Sept. 26.	Granite block paving, etc., Boston, Mass.	Sept. 24
Sept. 26.	School building, Montclair, N. J.	Sept. 24
Sept. 26.	Ditch excav. (5 m.), Winnipeg, Man.	Sept. 24
Sept. 26.	Levee work, New Orleans, La.	Sept. 17
Sept. 26.	Rubble-stone, Newburyport Harbor, Mass. Advertised. Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 26.	Rubble-stone, Gloucester, Mass Advertised, Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 26.	Rock (5,000 tons), New Orleans, La. Advertised, Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 28.	Dredging in Town River, Mass. Advertised, Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 28.	Dredging in Chelsea Creek, Mass. Advertised, Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 28.	Dredging in Scituate Harbor, Mass. Advertised, Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 28.	Dredging in Weymouth River, Mass. Advertised, Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 28.	Dredging in Weymouth Back, Mass. Advertised, Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 28.	Sewers, Washington, D. C. Advertised, Engineering News, Sept. 3.	Sept. 3
Sept. 28.	Asphalt paving, Toledo, O.	Sept. 3
Sept. 28.	Dredging, Norfolk, Va Advertised, Eng. News, Aug. 27 and Sept. 17.	Aug. 27
Sept. 28.	City hall, Yonkers, N. Y.	Sept. 10
Sept. 28.	Dikes, etc., Philadelphia, Pa.	Sept. 10
Sept. 28.	Electric Ry. franchise, San Diego, Cal.	Sept. 10
Sept. 28.	Addition to school, Cincinnati, O.	Sept. 10
Sept. 28.	Fire hose (2,000 ft.), Troy, N. Y.	Sept. 17
Sept. 28.	County jail, Fincastle, Va.	Sept. 17
Sept. 28.	Plans for school, Milwaukee, Wis.	Sept. 17
Sept. 28.	Cement sidewalks, Indianapolis, Ind.	Sept. 17
Sept. 28.	Grading, etc., (12,000 cu. yds.), Boston	Sept. 24
Sept. 28.	Steel bridge (100 ft.), Red Bluff, Cal.	Sept. 24
Sept. 28.	Steel bridge (225 ft.), Sacramento, Cal.	Sept. 24
Sept. 28.	Repairing dams (2), Albany, N. Y.	Sept. 24
Sept. 28.	Removing wrecks, Wilmington, Del.	Sept. 24
Sept. 28.	Sewers, Allegheny, Pa.	Sept. 24
Sept. 28.	Paving, grading, etc., Allegheny, Pa.	Sept. 24
Sept. 28.	Asphalt paving, etc., Pittsburg, Pa.	Sept. 24
Sept. 28.	Pumping engine, Zanesville, O.	Sept. 24
Sept. 28.	Water bonds ($20,000), Huntsville, Ont.	Sept. 24
Sept. 28.	Pipe, sewers, Waterloo, Ia.	Sept. 24
Sept. 28.	Feed pumps, Chicago, Ill.	Sept. 24
Sept. 28.	Coal conveyor plant, Chicago, Ill.	Sept. 24
Sept. 29.	Improving street, Jersey City, N. J.	Sept. 24
Sept. 29.	Electric light plant, Staunton, Ill.	Sept. 24
Sept. 29.	Plumbing, etc., Omaha, Neb.	Sept. 10
Sept. 29.	Pipe sewers, Oneida, N. Y. Advertised, Engineering News, Sept. 10.	Sept. 10
Sept. 29.	Dredging in Chatham Harbor, Mass. Advertised, Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 29.	Dredging in Powow River. Mass. Advertised, Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 29.	Dredging in Merrimac River, Mass. Advertised, Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 29.	Dredging in Mystic River, Mass. Advertised, Eng. News, Sept. 3 to 17.	Sept. 3
Sept. 30.	U. S. building work, Sioux City, Ia. Advertised, Eng. News, Sept. 10 and 17.	Sept. 10
Sept. 30.	Hire of dredge, New Orleans, La.	Sept. 10
Sept. 30.	Iron bridge, Newark, N. J. Advertised, Engineering News, Sept. 17.	Sept. 17
Sept. 30.	Addition to school building, Ripley, N. Y.	Sept. 17
Sept. 30.	Macadam road (3,100 ft.), Suffield, Conn.	Sept. 24
Sept. 30.	Sewer, Cleveland, O.	Sept. 24
Sept. 30.	Pipe sewers (34,000 ft.), Coffeyville, Kan.	Sept. 24
Sept. 30.	Water-works, Dawson, Pa.	Sept. 24
Sept. 30.	Cement (4,000 bbls.), Brooklyn, N. Y.	Sept. 17
Sept. 30.	Bridge girders (5), Indianapolis, Ind.	Sept. 24
Sept. 30.	Pipe sewers, West Hoboken, N. J.	Sept. 24
Sept. 30.	Cement sidewalks, (30 sts.), Chicago, Ill.	Sept. 24
Oct. 1.	Pump'g station work, N. Bedford, Mass. Advertised, Engineering News, Sept. 24.	Sept. 24
Oct. 1.	Brick school building, Boston, Mass.	Sept. 24
Oct. 1.	Water bonds ($30,000), Laurens, S. C.	Sept. 24
Oct. 1.	College building, Charlotte, N. C.	Sept. 17
Oct. 1.	Office building (6 stories), Jacksonville, Fla.	Sept. 17
Oct. 1.	Electric light bonds, Kinston, N. C.	Sept. 17
Oct. 1.	Pumping engine, Toledo, O.	Sept. 17
Oct. 1.	Hospital, etc., Fort Wadsworth, N. Y. H. Advertised, Eng. News, Sept. 10 and 24.	Sept. 10
Oct. 1.	Plumbing, etc., Fort Wadsworth, N. Y. H. Advertised, Eng. News, Sept. 10 and 17.	Sept. 10
Oct. 1.	Electric lighting, etc., Irvington, N. J.	Sept. 10
Oct. 1.	Electric lighting, East Liverpool, O.	Sept. 10
Oct. 1.	Water-works, Franklin, La.	Sept. 10
Oct. 1.	Water bonds ($25,000), Franklin, La.	Sept. 10
Oct. 1.	Dredging in Baltimore Harbor, Md. Advertised, Eng. News, Sept. 10 to 24.	Sept. 10
Oct. 1.	Levee bonds ($325,000), Clarksdale, Miss.	Sept. 3
Oct. 1.	Brick paving, Charleston, Ill. Advertised, Eng. News, Aug. 27 to Sept. 17.	Aug. 27
Oct. 1.	Brick sewers, Charleston, Ill. Advertised, Eng. News, Aug. 27 to Sept. 17.	Aug. 27
Oct. 1.	Pipe sewers (5 miles), Charleston, Ill. Advertised, Eng. News, Aug. 27 to Sept. 17.	Aug. 27
Oct. 2.	Cement and tile drains, Mount Vernon, N.Y. Advertised, Eng. News, Sept. 10 and 17.	Sept. 10
Oct. 2.	Pipe sewers (8,500 ft.), Roselle, N. J. Advertised, Engineering News, Sept. 24.	Sept. 24
Oct. 2.	Improving street, Richmond, Ind.	Sept. 24
Oct. 2.	Asphalt paving, etc., Rochester, N. Y.	Sept. 24
Oct. 2.	Pipe sewers (8,500 ft.), Roselle, N. J. Advertised, Engineering News, Sept. 24.	Sept. 24
Oct. 3.	Steel bridge, Hackensack, N. J.	Sept. 24

Oct. 3. Water bonds ($20,000), Blanchester, O. ..Sept. 24
Oct. 3. Headstones (5,000), New York, N. Y...Sept. 10
Oct. 5. Bridge, Kalama, Wash ....Sept. 3
Oct. 5. Dredging, in Cooper Creek, N. J.........Sept. 10
Advertised, Eng. News, Sept. 10 to Oct. 1.
Oct. 5. Ordnance supplies, etc., Washington, D. C. Sept. 10
Oct. 5. Electric lighting, La Grange, Ill. ....Sept. 17
Oct. 5. Bridges (2), Leavenworth, Kan. ....Sept. 17
Oct. 5. Pipe sewers (4,200 ft.), New Brunswick..Sept. 24
Advertised, Engineering News, Sept. 24.
Oct. 5. Trestle (600 ft.), Sidney, Wash...........Sept. 24
Oct. 5. Wagon road (1 mile), Martinez, Cal.......Sept. 24
Oct. 5. Steel tank and brick tower, Minonk, Ill..Sept. 24
Advertised, Engineering News, Sept. 24.
Oct. 5. Water bonds ($10,000), Jackson, Mich. ....Sept. 24
Oct. 5. Boiler house and stack, Los Angeles, Cal..Sept. 24
Oct. 5. Electric r'y franchise, Los Angeles, Cal...Sept. 24
Oct. 5. Garbage disposal (5 yrs.), Brooklyn, N. Y. Sept. 24
Oct. 5. Brick paving (3 streets), Cincinnati, O....Sept. 24
Oct. 6. Laying water mains, Boston, Mass.......Sept. 24
Advertised, Eng. News, Sept. 24 and Oct. 1.
Oct. 6. Electric lighting, Dunmore, Pa. ....Sept. 24
Oct. 6. Bridges (4, 150 to 52 ft.), Duluth, Minn..Sept. 24
Oct. 6. Lateral sewer, Mount Vernon, N. Y.....Sept. 24
Oct. 6. Macadam road, Mount Vernon, N. Y.....Sept. 24
Oct. 6. Dredging (270,000 cu.yds.), Milwaukee, Wis. Sept. 17
Oct. 6. Pumping engine, Millvale, Pa. ....Sept. 17
Oct. 6. Extension to post office, Buffalo, N. Y....Sept. 17
Advertised, Eng. News, Sept. 17 and 24.
Oct. 6. Iron and steel work, St. Paul, Minn. ....Sept. 17
Oct. 6. Subway, Boston, Mass. ....Sept. 17
Advertised, Eng. News, Sept. 17 to Oct. 1.
Oct. 6. Water main extensions, St. Louis, Mo. ....Sept. 17
Oct. 6. Macadam road, Merchantville, N. J.......Sept. 10
Advertised, Eng. News, Sept. 10 and 17.
Oct. 6. Hospital building, Cherokee, Ia. ....July 30
Oct. 7. Lodge hall, Springfield, O. ....Sept. 17
Oct. 7. Asphalt and brick paving, Cincinnati, O. ..Sept. 17
Oct. 7. Foundation for new East River bridge, N. Y. Sept. 17
Advertised, Eng. News, Sept. 17 and 24.
Oct. 7. Repairs to engine house, New York, N. Y..Sept. 24
Oct. 7. County court house, Detroit, Mich.......Sept. 24
Oct. 7. Wooden bridge, Corvallis, Ore. ....Sept. 24
Oct. 7. Pipe sewers, Buffalo, N. Y. ....Sept. 24
Oct. 7. Paving, grading, etc., Buffalo, N. Y.......Sept. 24
Oct. 8. Dredging in Christiana River, Del......Sept. 24
Advertised, Eng. News, Sept. 24 and Oct. 1.
Oct. 8. Plumbing, heating, etc., Toronto, Ont.....Sept. 24
Oct. 8. Iron and steel bridge, Big Timber, Mont..Sept. 24
Oct. 8. Dikes, etc., Portland, Ore. ....Sept. 24
Advertised, Eng. News, Sept. 24 and Oct. 1.
Oct. 8. Asphalt and granite paving, Cincinnati, O. Sept. 24
Oct. 9. U. S. building work, Martinsburg, W. Va..Sept. 24
Advertised, Eng. News, Sept. 24 and Oct. 1.
Oct. 9. Masonry bridge piers (5), Portland, Me...Sept. 24
Advertised, Engineering News, Sept. 24.
Oct. 9. Electric light plant, Bryon, O. ....Sept. 24
Oct. 10. County court house, Wise, Va. ....Sept. 17
Oct. 12. Officers' quarters, Fort Ethan Allen, Vt..Sept. 24
Oct. 12. Extending levee, Arkansas City, Ark.....Sept. 24
Oct. 13. Paving bonds ($130,000), Macon, Ga......Sept. 24
Oct. 13. Water and light bonds, Anaheim, Cal. ....Sept. 17
Oct. 14. School building, Hoboken, N. J. ....Sept. 24
Oct. 12. Bridge, Houston, Tex. ....Sept. 24
Oct. 14. Grading (9 miles), Cleveland, O. ....Sept. 24
Oct. 15. Bridges (2), Elk Point, S. Dak..........Sept. 24
Oct. 15. Asphalt paving (5,000 sq. yds.), Niles, O..Sept. 24
Advertised, Engineering News, Sept. 24.
Oct. 15. Electric lighting, Manistee, Mich. ....Sept. 24
Oct. 15. Pipe (1,215 tons, 30-in.), Evansville, Ind..Sept. 24
Advertised, Engineering News, Sept. 24.
Oct. 15. County court house, South Bend, Ind.....Sept. 10
Oct. 17. Pumping engine, Kansas City, Mo. ......Sept. 17
Advertised, Eng. News, Sept. 17 and 24.
Oct. 17. Dredging, Philadelphia, Pa. ....Sept. 24
Oct. 17. Dredging in Lemon Creek, N. Y..........Sept. 24
Advertised, Eng. News, Sept. 24 to Oct. 15.
Oct. 17. Increased water supply, Watervliet, N. Y. Sept. 24
Oct. 17. Paving bonds ($17,000), Niles, O. ....Sept. 24
Advertised, Engineering News, Sept. 24.
Oct. 19. Dredging in South River, N. J...........Sept. 24
Advertised, Eng. News, Sept. 24 to Oct. 15.
Oct. 19. Brick paving, Cincinnati, O. ....Sept. 24
Oct. 20. Drainage channel, Peoria, Ill. ....Sept. 17
Advertised, Eng. News, Sept. 17 to Oct. 1.
Oct. 20. Rip-rap embankment at Agate Bay, Minn..Sept. 24
Advertised, Eng. News, Sept. 24 to Oct. 15.
Oct. 22. Improving roads, Stapleton, N. Y. ....Sept. 24
Nov. 14. Pumping engines (6), Chicago, Ill.......Sept. 24
Advertised, Eng. News, Sept. 24 to Oct. 22.
Nov. 14. Grain elevators, etc. (2), Galveston, Tex..Sept. 24
Nov. 14. Sewage pumping mach'y, Mexico, Mex...Aug. 27
Dec. 30. Steel rails (150,000 tons), Sydney, N.S.W. Aug. 6
Advertised, Eng. News, Aug. 6 and Sept. 3.

RAILWAYS.

East of Chicago.

BROOKLYN WHARF AND WAREHOUSE.—This company is making rapid progress in the work of providing railway facilities along the water front in connection with its system of warehouses in Brooklyn, N. Y.

BROOKVILLE.—The Brookville, Pa., "Republican" states that the work of construction is being pushed, 140 men being now employed. The tracks have been laid for a distance of about six miles, nearly one-half of the entire length of the road.

CHICAGO, INDIANA & EASTERN.—A press report states that this railway, extending from Fairmount to Matthews, Ind., ten miles, has suspended operations, the receiver, George B. Sweetser, Marion, Ind., finding it unprofitable to operate the line. Receiver Sweetser has petitioned for an order of sale for the rolling stock to pay the labor claims.

CARP & ALMONTE.—The Almonte, Ont.; "Gazette" states that Bell & Wilkie, surveyors, have their staff at work making a preliminary survey of the proposed new line of railway from Carp to Almonte. Almonte and Carp business men subscribed between $200 and $300 to pay for the survey.

CAMBRIA COUNTY.—Geo. S. Good & Co., Lock Haven, Pa., have the contract for building this branch of the Beech Creek R. R., and will commence work at once. It is reported that it will extend from Wigton colliery to Spangler, Pa., a distance of seven miles; the company is capitalized at $100,000. When the road is completed a large quantity of coal mined at Spangler and Barnesboro will be shipped over it to the Beech Creek. Pres., Marlin E. Olmstead, Harrisburg, Pa.; directors, W. M. Ogelsby, A. C. Stamm, H. C. Houtz, of Harrisburg, and F. E. Herriman and William T. Grier, both of Philadelphia.

FALL BROOK.—Geo. S. Good & Co., Lock Haven, Pa., have also been awarded several arches and other masonry, as well as trestle filling in the Cowanesque Valley for the Fall Brook R. R. Co. Pres., Geo. J. Magee, Corning, N. Y.

JOHNSTOWN & ARMAGH.—The Johnstown, Pa., "Democrat" states that T. C. Du Pont, John Fulton, M. B. Stevens, W. H. Matthews and N. F. Thompson were appointed a committee by the Johnstown board of trade to negotiate the building of this railway. It is stated that the Pennsylvania Ry. Co. will build the line if aid can be secured along the route.

LIMA NORTHERN.—A press report from Adrian, Mich., states that a party of Lima Northern officials and promoters visited that city Sept. 13, and consulted local citizens in regard to arrangements for building the road directly into the city. It now connects with the Wabash, 10 miles south, and will run its trains to Adrian over the latter company's tracks. Asst. Ch. Engr., N. M. De Bruin, Lima, O.

NORTH SHORE.—A press dispatch from New Brighton, Pa., states that this railway, noted in our issue of Sept. 17, is capitalized at $200,000; incorporators, Theo. Oatman, John Reed, Charles J. Coats, W. J. Barr, W. J. Smith, D. D. Mills, J. B. Campbell, J. J. Lovinger and E. S. Kennedy.

SENECA COUNTY.—The Buffalo, N. Y., "Enquirer" announces that work will begin the latter part of this month. The foreman is at Geneva, and considerable material has been accumulated in the way of ties and railroad iron.

SHELBYVILLE SOUTHERN.—W. S. Dawley, C. E., Chicago, writes us that this is a branch of the Chicago & Eastern Illinois from Shelbyville to Altamont, Ill., a distance of 24½ miles; the line is located and the right of way is nearly all purchased. Contract is let to M. S. Cartter & Co., Oriel Bldg., St. Louis, Mo., who have 200 teams at work. Two pile drivers and masons are at work on the foundations for a viaduct over the Kaskaskia River, 1,400 ft. long and 100 ft. above the bed of the stream. Ch. Engr., N. R. Olcott, Altamont, Ill. Baxter L. Brown, Resident Engr., Shelbyville, Ill., also writes us as above, and states that sub-contractors are Johnson Bros. & Fought, St. Elmo, Ill.; Myers Construction Co., St. Louis, Mo.; Detroit Bridge Co., Detroit, Mich.

Southern.

BALTIMORE & OHIO.—The Martinsburg, W. Va., "Independent" states that the branch from Green Spring to Romney may be extended to Moorefield. Surveyors are now at work laying out the route. Ch. Engr., N. T. Manning, Baltimore, Md.

CAROLINA, TENNESSEE & OHIO.—Gillis & Black, contractors, Wilmington, N. C., write us that the projected length is 30 miles from Navassa, via El Paso and Town Creek, to Southport, N. C. The work is now half completed. Gillis & Black and Frank H. Blodgett, Willston, O., are the contractors. Pres., J. C. Challenger, Philadelphia, Pa.; Ch. Engr., Walter G. MacRae, Wilmington, N. C.

LOUISVILLE & NASHVILLE.—This company proposes to renew its main track in Newport, Ky., during October, with 80-lb rails.

SISTERSVILLE.—E. J. Miller, Ch. Engr., Wheeling, W. Va., writes us that the preliminary survey has been completed as far as Middlebourne, W. Va., a distance of 12 miles. This is the most difficult part of the route. The road is projected to extend from Sistersville to some point in Tyler county.

Northwest.

GREAT NORTHERN.—A press dispatch from Aneta, N. Dak., states that this company is extending its Hope branch to Aneta, in the southeastern part of Nelson county, N. Dak. It will be completed about the middle of October. The terminus will be Aneta, N. Dak. Ch. Engr., J. F. Stevens, St. Paul, Minn.

KANSAS CITY & OMAHA.—This company has been incorporated to build a railway 170 miles long, beginning at Fairfield, Clay county, Neb.; capital stock, $3,000,000; incorporators, W. R. Kelly, Frank W. Hills, W. J. Carroll, Erastus Young and Frank D. Brown. It is reported that the Union Pacific is interested.

LUMBER.—A press dispatch from Dickerson, Minn., states that D. F. Brooks and M. J. Scanlon, of Scanlon, Gibson Lumber Co., Minneapolis, Minn., and Engineer Cox have been looking over the proposed route for a new logging railroad, on which they expect to commence work immediately. The line will run north into Carleton county, through a large tract of timber which this company recently purchased.

PEORIA, LACON & NORTHERN.—E. C. Howlett, Secy., Peoria, Ill., writes us that the projected length is 51 miles from Spring Bay, via Holton and Lacon, to Spring Valley, Ill., The surveys are made, right of way well in hand; capital not all secured; contracts will be let as soon as money is subscribed. Pres., Jno. M. McNabb, Mount Palatine, Ill.; Ch. Engr., Geo. F. Wigton, Lacon, Ill.

Southwest.

BATON ROUGE & CENTRAL LOUISIANA.—The Alexandria, La., "Town Talk" states that F. M. Welch is promoting the building of this railway. The capital stock is said to be fixed at $3,000,000; he is trying to secure a 5-mill 10-year tax from the parishes through which the road will be built. It is proposed to have the line in operation by Jan. 1, 1898.

Rocky Mountain and Pacific.

ALVISO.—The San Jose, Cal., "News," dated Sept. 9, states that all impediments to the project of the Alviso Ry. are now removed and that it is now ready for construction; contractors were on the ground last week making estimates, which will be submitted to the railway people next week. It is expected that actual work on the construction of the road will commence in two or three weeks, and it will be pushed rapidly to completion.

BRITISH COLUMBIA SOUTHERN.—A press report states that this company has given notice of an application to Parliament for power to extend its line of railway from its present authorized terminus in Crow's Nest Pass, easterly to MacLeod and Lethbridge, in the Province of Alberta, British Columbia. The line has been subsidized with a land grant of 4,000,000 acres.

COLUMBIA & RED MOUNTAIN.—A press dispatch, dated Sept. 12, stated that tracklaying from Spokane, Wash., will begin next week, and the road will be hauling ore in 80 days. It has a grade from Northport, where connection is made with the Spokane line, of 3%, The altitude of Rossland at the terminal is 2,100 ft. above Northport, and the line is 22 miles long.

SONORA.—This company has advertised for bids for furnishing 15,000 ties, 6 × 8 ins. and 8 ft. long; to be delivered not later than Dec. 31, 1896. Address, the office of the company, at Guaymas, Mex.

WILCOX.—A press dispatch states that a railway will be built from Wilcox, Ariz., on the Southern Pacific, southward to Nacosari, to open a copper camp. A company, with a capital of $6,000,000 has been formed for the purpose of building and the plans and specifications are being made. Work will begin inside of four months and the surveyors will begin as soon as the plans are completed. Prof. Ricketts will have charge of the engineering corps.

STREET AND ELECTRIC RAILWAYS.

SOUTH PORTLAND, ME.—The Portland "Express" states that the Portland & Cape Elizabeth Ry. Co. has petitioned the selectmen of South Portland to allow it to build a single track electric railway with the necessary turnouts and switches from the junction of the shore road and Angell St., to the town line between South Portland and Cape Elizabeth. A hearing will be held at the town hall, Sept. 28.

BARRE, VT.—The Barre Electric Ry. Co. is said to have filed a bond to the amount of $3,000 with the city clerk to the effect that it will have the proposed electric railway in operation by Sept. 1, 1897. F. C. Kennedy, Burlington, Vt., is interested.

BOSTON, MASS.—The "Transcript" states that the New York, New Haven & Hartford Ry. may equip its suburban lines with the third rail electric system, such as is now in use on the Nantasket Beach route.

NEWTON, MASS.—The Wellesley & Boston St. Ry. Co. has been granted permission to build an electric railway.

WORCESTER, MASS.—The "Telegram" states that A. L. Kneeland has succeeded in organizing the Westminster St. Ry. Co., to build an electric street railway to Mount Wachusett, a distance of about 10 miles; capital stock, $100,000. Among those interested are: D. C. Miles, Wm. Mayo, F. A. Merriam, Artemus Merriam, P. P. Ellis, and S. F. Lamb, of Westminster; W. B. Ferguson, of Malden; W. E. Putney, of Fitchburg, and Geo. H. Mellen, of Worcester.

WEYMOUTH, MASS.—The Weymouth & Braintree St. Ry. Co. has been granted permission to extend its tracks.

WEST HAVEN, CONN.—The Winchester Ave. St. Ry. Co. has been granted permission to extend its lines.

COHOES, N. Y.—It is stated that an electric railway 1¾ miles long will be built to connect, through Watervliet and Green Island, the lines of the Cohoes City and the Albany City Ry. companies, and thus connect Cohoes and Albany. Houlihan & Larkin are the contractors. Work will begin at once.

TOTTENVILLE, N. Y.—The Edgewater trustees have granted permission to the Midland Electric R. R. Co. to construct a double track on Richmond road from Broad St. to Osgood Ave.

CARLISLE, PA.—M. B. Cumbler, Ch. Engr., Carlisle, Pa., writes us that it is the Cumberland Valley Traction Co. and not the Lamb Valley that is building the electric railway from Carlisle to Boiling Spring, as stated in our issue of Sept. 10. Pres., Geo. W. Cumbler, Steelton, Pa.

DOYLESTOWN, PA.—The stockholders of the Doylestown & Willow Grove Turnpike have leased the road to the Bucks County Ry. Co. for building an electric railway. It is stated that work on the extension from Willow Grove to Doylestown will begin by Oct. 15. The distance is 12 miles. Henry J. Harris, Doylestown, is interested.

CONNELLSVILLE, PA.—A charter has been issued to the Connellsville Suburban St. Ry. Co. to build a line to connect Connellsville and South Connellsville, by way of the village of Gibson; capital stock, $25,000; directors, S. R. Slaymaker, John F. Barrey, Lancaster; Joseph Soisson, John D. Frisbee, H. S. Newmyer, John Soisson, R. W. Soisson, Connellsville.

BALTIMORE, MD.—Rights of way through private property have been secured by the City & Suburban Ry. for the proposed extension of its Walbrook line from Mount Holly to Electric Park. Grading will probably be finished this winter and tracks laid early next spring. The road will be double-tracked and 2½ miles long.

FREDERICK CITY, MD.—It is stated that the Frederick & Middletown Electric Ry. Co. has obtained the right of way over the Baltimore & Frederick turnpike and will soon begin work on an extension to the Frederick fair grounds. It is expected to have the road completed by Oct. 12.

GOSHEN, IND.—A press report states that the Commercial exchange is advocating a proposition to secure the completion of the electric line between Goshen and Elkhart. It is proposed to levy a ½% tax for the purpose and a special election is soon to be called to vote on the question.

PEORIA, ILL.—The "Herald" states that the village trustees of North Peoria granted a franchise to the Glen Oak & Prospect Heights Electric Ry. Co.

SOUTH MILWAUKEE, WIS.—The Milwaukee Electric Ry. Co. has been granted permission to extend its lines into South Milwaukee. An agreement with the Racine Electric Ry. Co. has been prepared and awaited only the granting of the franchise to be signed by the officers of the two lines. It arranges for an interchange of cars and a continuous passage between the two cities without change, a distance of about 25 miles. It is stated that the grading has been completed to a point within four miles of the corporate limits of the village and within six miles of the terminus. Ties have been distributed along the line and large quantities of steel are awaiting distribution. All the work has been completed for several miles out of Racine.

KANSAS CITY, MO.—A proposition to give a franchise to the West Side St. Ry. is being considered.

EMPORIA, KAN.—The Emporia Electric Light, Ry. & Gas Co. has been incorporated; directors: F. R. Beidler and A. M. Coffman, Baltimore, Md.; J. A. Bendure, Atchison, Kan.; William Addis, H. Parkman, D. W. Hainer and J. O. Patterson, Emporia.

CANON CITY, COLO.—Jos. B. Crosby, London, Eng., is said to be the promoter of an electric railway to connect Canon City with the Cripple Creek district. It would be used for hauling ore. The plan includes the erection of two mills and the building of a power plant to illuminate Cripple Creek. The estimated cost of all is $1,250,000.

TACOMA, WASH.—The "Ledger" says that the King county commissioners have ordered recorded the acceptance of a franchise to Frank C. Ross for a street railway across the East Tacoma tide flats.

LOS ANGELES, CAL.—The city council will receive bids until Oct. 5 for a franchise for an electric street railway. C. A. Luckenbach, Cy. Clk.

SAN JOSE, CAL.—It is reported that the supervisors have granted the petition of L. M. Hale for six months' extension of time in which to commence the work of constructing an electric railway from the western boundary line of San Jose to Saratoga.

LIVERPOOL, N. S.—It is reported that an electric railway is to be built at once from Liverpool, five or six miles to the pulp mill at Milton, to carry its products, as well as passengers, to the seaport.

QUEBEC, QUE.—A company of Quebec capitalists is said to be in the process of formation to take over the franchise of Mr. Beemer and construct the electric railway. The capital necessary for this purpose is estimated to be $400,000. Among those interested are: E. E. Webb, T. H. Dunn, A. Breakey, F. W. Ross, A. Thompson, E. M. Methot, E. Sharples, G. T. Davie. It is said to be the intention of the promoters to put between 400 and 500 men at work at once to equip and put in operation the Lower Town section as far as the St. Valier tollgate this fall.

ELECTRIC LIGHT AND POWER.

NEAZIE, ME.—It is reported that the Public Works Co., of this place, is soon to put in a new 750-HP. engine at its power plant.

COLLINS, N. Y.—An electric light plant will be placed in the state farm hospital at Collins. About 1,000 incandescent lights and sufficient wiring and a dynamo will be required; also a 400-HP. boiler, etc., for the new pumping plant. Arch., A. C. Essenwein, 316 Pearl St. Buffalo, N. Y.

SYRACUSE, N. Y.—The council has granted franchises for electric light and power and telephone systems to Eugene Hughes & Co. R. R. Stuart, Cy. Engr.

DOVER, N. J.—It is stated that the site for the proposed new plant of the Dover Electric Light Co. has been selected; it is probable that contracts for the erection of the plant will soon be awarded.

DUNMORE, PA.—Bids are asked until Oct. 6 for lighting this place with 55 arc lights for five years, commencing Feb. 1, 1897. Address H. B. Gilligan.

AUGUSTA, GA.—Local papers state that a company is being organized to build a new electric light plant in this city. E. A. Swete, Arlington Hotel, is reported as interested.

BRUNSWICK, GA.—It is proposed to build an electric light plant in this city. J. B. Abrams, Chn. Com.

JACKSONVILLE, FLA.—It is stated that the Jacksonville Textile Mill Co. is securing estimates for a 60-light dynamo.

SHREVEPORT, LA.—The mayor is reported as interested in a projected light plant.

ROSEVILLE, GA.—J. W. Stevenson has been granted a franchise for an electric light and power plant.

BRYAN, O.—Bids are asked until Oct. 9 for constructing an electric light plant. Engr., Frank B. Rae, 134 Monroe St., Chicago, Ill.; John W. Nelson, Mayor; A. E. Snyder, Chn. Com.

JASPER, IND.—The Jasper Electric Light Co. is reported to have been granted a franchise for lighting this city, a plant for which will be built at once.

MANISTEE, MICH.—Bids are asked until Oct. 15 for lighting the streets with 100 arc lights. James L. Sibben, Cy. Clk.

GILLESPIE, ILL.—It is stated that Smith & Querback, of Staunton, Ill., have been granted a franchise for lighting this place with electricity for ten years.

STAUNTON, ILL.—Bids are asked by the city clerk until Sept. 29 for constructing an electric light plant. Consult. Engrs., Bryan & Humphrey, Turner Bldg., St. Louis, Mo.

OCONTO, WIS.—It is reported that estimates are wanted for constructing a 100-arc light-plant. C. A. Bridger, Cy. Clk.

BRITT, IA.—The Britt Light & Power Co. is reported to have been granted a franchise. The company wants bids for two 25 K-W. machines, engines, boilers, lamps, wire.

CARTHAGE, MO.—The council is reported as considering the question of putting in a municipal electric light plant.

FERGUSON, MO.—It is reported that the Olive Branch Electric Light & Supply Co. proposes to build a duplicate plant.

ST. LOUIS, MO.—The board of public improvements will soon ask for bids for lighting the streets of this city with electricity for 23 years. Robt. E. McMath, Pres.

BALLINGER, TEX.—An electric light plant is to be constructed by the Ballinger Mfg. Co., according to reports.

TACOMA, WASH.—The fire and water committee has decided to recommend to the council the granting of the request of the board of public works for $6,000 worth of improvements in the light department. T. E. Doherty, Comr. Pub. Wks.

MARIPOSA, CAL.—The Mariposa Electrical Co. was incorporated last week. It proposes to dam the Merced River and thus secure about 6,000 HP. The works will be 7½ miles from the dam and the plant will be in the center of the mother lode. It is said that nine-tenths of the mines are now idle because steam power is too dear.

SAN JOSE, CAL.—A resolution has been adopted by the council granting the Peninsular Lighting Co. permission to erect poles, string wires and make all preparations for equipping an electric light line from San Francisco Creek to Mayfield and Mountain View. H. A. Pfister, Clk.

GRANBY, QUE.—It is reported that an electric plant is projected to light this place, Adamsville, Farnham Centre and East Farnham.

WINCHESTER, ONT.—An electric light plant for this place is proposed, according to reports.

LIMA, PERU.—It is stated that the corporation of the city of Lima has approved a contract with an American electric lighting and tramway company to which is accorded concessions to the amount of 70,000 ($34,000) sols per annum. Feberico Bergmann, Consul Gen., 25 Whitehall St., New York, N. Y.

NEW COMPANIES.—Amherstburg Electric Light, Heat & Power Co., Limited, Amherstburg, Ont.; $20,000; W. H. McEvoy, Amherstburg; F. C. Armstrong, Toronto, Ont.; J. J. Ashworth, Toronto; Mary A. McEvoy, Amherstburg; Mary A. Kane, Amherstburg.

Marquette Electric Co., Chicago, Ill.; $2,500; Edwin O. Lamphere, Henry J. Brubaker, Ripley N. Baylis.

Bradley Electric Light, Heating & Power Co., Cleveland, O.; $100,000; George Lillis, John C. Burgess, S. H. Holding, M. W. Neal, Frank S. Masten.

San Luis Potosi Electrical Co., Charleston, W. Va., $100,000, with $500 paid in; Chas. H. White, Fred. J. Curnick, Geo. A. Waddell, New York, N. Y.; Justin D. White, Newark, N. J.; P. Du Pratt White, Nyack, N. Y.

BRIDGES.

PORTLAND, ME.—Bids are asked until Oct. 9 for building five masonry bridge piers, as stated in our advertising columns. Geo. N. Fernald, Comr. Pub. Wks.

FALL RIVER, MASS.—The construction of an $18,000 bridge in the park is being considered. Phillip D. Borden, Cy. Engr.

BEVERLY, MASS.—The question of building a temporary drawbridge at a cost of $2,500 is being discussed by the council. The draw of the permanent bridge is to be widened at once.

WOONSOCKET, R. I.—An appropriation of $21,500 has been made for new bridge abutments, etc. Plans will be ready in about ten days. Frank H. Mills, Cy. Engr.

HARTFORD, CONN.—The committee has awarded J. J. Goodwin the contract at about $2,000 for building an ornamental stone bridge over Park River at Asylum Ave.

TORRINGTON, CONN.—The Berlin Iron Bridge Co., of East Berlin, Conn., has been awarded the contract at $6,895 for constructing a new bridge over the Naugatuck River at Main St.

BINGHAMTON, N. Y.—The Owego Bridge Co., Owego, N. Y., has been awarded the contract for building two new bridges over the Seneca River at a cost of $19,400.

BUFFALO, N. Y.—The New York Central & Hudson River R. R. Co. has signed a contract with the grade crossing commissioners to abolish the grade crossing at Chicago St. A large viaduct will be built.——The council has asked the board of public works to prepare plans and specifications for rebuilding the unsteady piers of the Elmwood Ave. bridge.

NEW YORK, N. Y.—Plans have been prepared by M. A. Kellogg, Ch. Engr. Park Dept., for an approach for the southern end of the Central bridge. The improvement will widen 153d St. 40 ft., giving it a total width of 70 ft

HACKENSACK, N. J.—Bids are asked until Oct. 3 for building a bridge with steel beams and flagging at Wortendyke. John H. Post, Chn. Com., Hackensack.

BEAVER FALLS, PA.—The viewers have recommended the purchase by the county of the bridge over the Beaver River at Bridgewater, which has recently been condemned; its value is reported at $37,000.

ELLWOOD CITY, PA.—The county commissioners have awarded to Nelson & Buchanan, Chambersburg, Pa., the contract for the cantilever bridge over the Connequenssing River. It will be 468 ft. long with a 24-ft. roadway, and two 5-ft. sidewalks.

PHILADELPHIA, PA.—The board of surveys has recommended the construction of a bridge over the railway tracks at Butler St. at a cost of about $100,000. T. M. Thompson, Dir. Pub. Wks.

PHILADELPHIA, PA.—It is stated that the engineer of bridges of the Pennsylvania R. R. Co. is preparing plans for a 10-span steel viaduct bridge on the Phoenixville branch, near Chickering Valley station.——H. P. Nichols, of the Philadelphia & Reading R. R., is preparing plans for an iron and stone bridge at the Falls Road, Falls of Schuylkill.

BOYDS, MD.—Press reports state that the contract for erecting a steel bridge for the Baltimore & Ohio R. R. Co., over Little Seneca Creek, near Boyd's, has been let to the Pennsylvania Steel Co., Steelton, Pa. Work has commenced on the bridge, which is expected to be finished by Dec. 15, 1896. The new bridge will replace a wooden structure. It will be over 400 ft. long and about 100 ft. high. The construction will be under the management of John W. Carroll, of Harrisburg, Pa. The masonry, which was awarded to Bennett & Talbott, of Greensburg, Pa., is rapidly nearing completion under the supervision of C. A. Grannell, of Smithfield, Pa. The engineers in charge of the work are P. H. Irwin, C. M. James and Webb. M. Kefauver, of Baltimore, Md.

HASTINGS, FLA.—The citizens have petitioned the county commissioners at St. Augustine for a new bridge over Deep Creek.

CLEVELAND, O.—The Erie R. R. Co. is considering plans for a bridge over its tracks at Martin St.

INDIANAPOLIS, IND.—Bids will be received Sept. 30 for five girders under bridge over canal at West St.

DETROIT, MICH.—Chas. F. Payne, Engr. Michigan Central R. R. Co., has prepared plans for an iron bridge to carry the railway tracks over Woodward Ave.; estimated cost, $53,000.

CHICAGO, ILL.—L. B. Jackson, Cy. Engr., has ordered the rebuilding of the bridge over the river at Northwestern Ave.——It is stated that the Milwaukee Bridge Co., of Milwaukee, Wis., was the lowest bidder Sept. 2 for the construction of the bridge for the Elgin, Joliet & Eastern R. R. Co., over the Chicago drainage canal, as advertised in Engineering News, at $33,477, and also for the Southwest Boulevard bridge at $15,200: Benzette Williams, Chicago, was the lowest bidder at $34,444, for the masonry for the latter bridge. James Reddick, Clk. Sanitary District.

FOSTER, ILL.—The township committee has voted to build a 65-ft. and a 50-ft. bridge in Drury township. Joseph Fitzpatrick, Chn. Com.; F. P. Gillitt, Town Clk.

DULUTH, MINN.—Bids are asked until Oct. 6 for constructing four bridges of 150 to 52 ft. span. O. Halden, County Audr.; F. Davis, County Surv., Trust Co. Bldg.——The council has voted to request the St. Paul & Duluth R. R. Co., the Northern Pacific R. R. Co., and the Duluth Transfer Ry. Co. to build a viaduct over their tracks at Garfield Ave. Henry Truelsen, Mayor.——The Duluth-Superior Bridge Co. has filed a second general mortgage covering an issue of $300,000 of general second mortgage bonds subject to the first mortgage of $650,000. The mortgage is given to the Central Trust Company, of New York, and runs 30 years at 5%. The piles for the pivot pier for the bridge have been driven and work on the masonry has been begun. Ch. Engr., A. P. Boller, 71 Broadway, New York, N. Y.

ST. PAUL, MINN.—The city engineer has been directed to prepare plans for an iron bridge at Summit Ave., over the railway tracks. L. W. Rundlett, Cy. Engr.

HILLSBORO, N. DAK.—The following bids were received Sept 8 for constructing nine county bridges; Geo. O. Stomner, County Audr., Hillsboro:

Gillette-Herzog Mfg. Co., Minneapolis, Minn.	$9,939
L. H. Johnson, Minneapolis	10,000
S. M. Hewett & Co., Minneapolis	10,050
Milwaukee (Wis.) Bridge & Iron Works	9,592
Wrought Iron Bridge Co., Canton, O. (accepted)	9,395

ELK POINT, S. DAK.—Bids are asked until Oct. 15 for constructing a 220-ft. wooden and iron pile bridge at the mouth of the Broken Kettle, and also a 161-ft. pile bridge over the Big Sioux River. A. P. Asbjeld, County Audr.

BIG TIMBER, MONT.—Bids are asked until Oct. 8 for constructing an iron and steel bridge over the Yellowstone River, near Big Timber. J. W. Bailey, Chn. Bd. County Comrs.

BILLINGS, MONT.—The construction of a 150-ft. bridge over the Musselshell River, at a cost of $5,000, is being considered. J. C. Bond and P. O. Grennell are the commissioners. A. A. Morris, County Surv., Billings.

HOUSTON, TEX.—Bids are asked until Oct. 12 for erecting a bridge over Green's Bayou on the Houston and Crosby Road; bond, $2,000. John G. Todd, County Judge, Houston.

WICHITA, KAN.—We are informed that the county commissioners received the following bids Sept. 15 for constructing a 225-ft. steel bridge, each company submitting its own plan:

Oregonia Bridge Co., Oregonia, O.	$4,718 and $4,899
St. Louis Br. & Ir. Co., St. Louis, Mo.	4,050 and 4,375
Mo. Valley Br. & Ir. Co., Leavenworth, Kan.	4,195
Farnsworth & Blodgett, Kansas City, Mo.	4,100
Massillon Bridge Co., Massillon, O.	5,200
Geo. E. King Bridge Co., Des Moines, Ia.	4,000
Groton Bridge & Mfg. Co., Groton, N. Y.	4,985
Canton Bridge Co., Canton, O.	3,960
Wrought Iron Bridge Co., Canton, O.	$3,600 to 4,300
Kansas City Bridge Co., Kansas City	4,300 and 4,406
Youngstown Bridge Co., Youngstown, O.	3,550 to 4,700

DENVER, COLO.—The city engineer has been directed to prepare plans and specifications for completing the 14th Street viaduct. W. W. Booth, Pres. pro tem. Bd. Pub. Wks. T. J. Milner, Ch. Engr.

KANSAS CITY, MO.—Daniel O'Flaherty, Kansas City, has prepared plans for a new viaduct from Main to Wall St., on 8th St.; estimated cost, $20,000. H. A. Wise, Cy. Engr.

SIDNEY, WASH.—Bids are asked until Oct. 5 for constructing a 600-ft. trestle in Section 15. Joseph Pitt, County Audr.

CORVALLIS, ORE.—Bids are asked until Oct. 7 for constructing a wooden bridge over the Luckiamute River. V. E. Watters, County Clk.

OAKLAND, CAL.—The council is considering the question of filling in the space at the 8th St. bridge and of rebuilding the bridge at a cost of about $19,000.

RED BLUFF, CAL.—Bids are asked by the city clerk until Sept. 28 for constructing a 100-ft. steel bridge.

SACRAMENTO, CAL.—Bids are asked until Sept. 28 for constructing a steel or combination bridge over the Cosumnes River on the Stockton road, near McConnell's Station. The structure is to be 225 ft. long with a roadway 20 ft. wide; and until the same date for an 80-ft. trestle. J. C. Boyd, County Surv.; Wm. B. Hamilton, Clk.

SAN RAFAEL, CAL.—The city trustees have accepted plans and specifications for a concrete bridge.

SONOMA, CAL.—The street committee has authorized the city clerk to advertise for bids for building a new bridge at Fourth St.

BUILDINGS.

BURLINGTON, VT.—Bids are asked until Oct 12 for the construction, plumbing, heating, etc., of one double set of officers' quarters at Fort Ethan Allen. Capt. Guy Howard, Asst. Q. M., Burlington.

BURLINGTON, VT.—It is reported that the Central Vermont R. R. Co. will soon build a new round house in this city. F. W. Baldwin, Gen. Supt., St. Albans, Vt.

BOSTON, MASS.—Estimates are being secured for erecting a 5-story brick office building on Fulton St., near Barrett St., for the estate of Thos. E. Proctor. Archs., Winslow & Wetherell, 3 Hamilton Place.——Bids are asked until Oct. 1 for constructing, heating and ventilating a brick school building at Chambers and Poplar Sts. Arch., John L. Faxon, 7 Exchange Place; Edward H. Dunn, Chn. Com.

BOSTON, MASS.—The American Congregational Association has appointed a committee to secure plans, etc., for a new building on Beacon St. adjoining the Boston Atheneum. The building will be a 10-story steel frame structure. Rev. Joshua Coit, Wm. H. Emerson, Jonathan A. Lane, Rev. Dr. A. H. Quint and Samuel B. Capen compose the committee.

MELROSE, MASS.—Tristram Griffin, 172 Washington St., Boston, and Malden, Mass., has prepared plans for a new high school building to cost $100,000. The building will be 154 × 76 ft. Royal P. Barry, Chn. Com.; Oliver A. Roberts, Chn. School Bd.

NORTHAMPTON, MASS.—It is reported that bids will soon be asked by Joseph Heckert for erecting a Masonic temple to cost $65,000. Archs., Putnam & Bayley, Northampton.

BROOKLYN, N. Y.—We are informed that the following bids were received by the bureau of docks and yards, Washington, Sept. 21, for repairs to the hospital at the Brooklyn Navy Yard, as advertised in Engineering News:

Thomas Dwyer, 106 E. 116th St., New York	$47,000
M. Gibbons & Son, 318 Columbia St., Brooklyn	29,975
Isaac A. Walker & Son, 1213 Filbert St., Phila.	26,491
D. S. Hess & Co., 876 Broadway, New York	38,900
Arthur H. Weeks, 2150 Fulton St., Brooklyn	32,000

BUFFALO, N. Y.—Eckel & Ackerman, 46 Niagara St., have prepared plans for an addition to engine house No. 2. It will be of brick and stone, 20 × 116 ft., and is to cost $20,000. Bids will probably soon be asked.——I. G. Perry, State Arch., Albany, has prepared plans for the $400,000 armory of the 74th Regiment of the National Guard. There is an appropriation of $25,000 to begin the work.

COLLINS, N. Y.—The trustees of the state farm at Collins have instructed A. C. Essenwein, 316 Pearl St., Buffalo, to add to the original plans a hospital wing for 120 patients, costing $60,000, a dining room for 800, to cost, $20,000, a kitchen and servants' wing to cost $30,000, and a laundry.

MOUNT VERNON, N. Y.—The committee has reported the cost of a new city hall at $150,000. Edwin W. Fiske, Mayor.

NEW YORK, N. Y.—Bids are asked until Oct. 7 for makiing repairs, etc., to the fire department building at 160 Chambers St.; bond, $7,000. O. H. La Grange, Pres. Comrs. Fire Dept, 189 East 67th St.——Hoppen & Koen are preparing plans for an office building at Broadway and 37th St. for Mrs. Wm. J. FitzGerald. Col. S. V. R. Cruger and H. W. McVickar can be addressed.——It is stated that R. T. Wilson, a New York banker, proposes to erect an office building at 32 and 34 Broadway.——Local papers state that there is some talk of constructing two hotels at Broadway and 36th St., and at 37th St. E. A. Cruikshank & Co. are the representatives.——Plans have been filed by Phillip Kloeberg for a 4-story brick dwelling on Riverside Drive, near 73d St., to cost $55,000, and by G. L. Lawrence for a 5-story brick store on Amsterdam Ave., near 106th St., to cost $45,000.

NEW YORK, N. Y.—Plans have been filed by the New York Building & Improvement Co., 156 Broadway, for a 12-story brick store building at 625 Broadway, to cost $318,000.

SYRACUSE, N. Y.—Benson & Brockway, 225 Bastable, Syracuse, and 55 Broadway, New York, have prepared plans for a building for the Bank of Syracuse. The structure will be 70 × 27 ft. and is estimated to cost $50,000.

HOBOKEN, N. J.—Bids are asked until Oct. 14 for constructing a new school building at Park Ave. and Newark St. Archs., Fall & Maxson, 1214 Washington St.; M. V. McDermott, Cy. Clk.

MONTCLAIR, N. J.—Bids are asked until Sept. 26 for erecting a school building on Maple Ave. John J. H. Love, Clk. Bd. Education.

NEWARK, N. J.—Plans are being considered by the board of health for a hospital to cost $200,000.

ALLEGHENY, PA.—Geo. J. Holler, 151 Washington Ave., Allegheny, has been awarded the contract for erecting a new school building in Ward No. 6, at $96,400. The total cost will be about $125,000.

APOLLO, PA.—Edward Stotz, 347 Fifth Ave., Pittsburg, has prepared plans for a brick school building. Address S. S. Jack, Apollo.

LANCASTER, PA.—The grand jury has ordered the county commissioners to build a new court house at once. Plans for this building were prepared some time ago, according to reports.

PHILADELPHIA, PA.—J. F. Stuckert & Son, 49 North 13th St., are reported as preparing plans for a 7-story brick and iron store house at Columbia and 10th Aves., for Hatfield Bird, of Philadelphia. The structure will be 160 × 40 ft.

PHILADELPHIA, PA.—The United Singers of America have decided to erect a hall at Fotteral Square, 11th and York Sts., in which to hold the Saengerfest or Musical Festival in 1897. The structure will be 400 ft. long, 300 ft. wide, and 65 ft. high, built of wood and iron and lined with macrite. Arch., Carl Selensinger.

PITTSBURG, PA.—Alden & Harlow are preparing plans for two branch library buildings, one of which will cost $30,000 and the other $15,000.——Chas. Bickel, 524 Penn Ave., has prepared plans for an 8-story building at Fifth Ave. and Federal St., to cost $80,000.——A. L. Huff, 5817 Harvard St., Pittsburg, is preparing plans for a 2-story office building for the Shoenberger Steel Co.——E. C. Trittin, 502 Walnut St., Philadelphia, Pa., is preparing plans for a new school building in East End, to cost $30,000.——Ground has been broken for a new town hall in East Pittsburg to cost $9,000. A jail will be attached.

BROOKLYN, N. Y.—A contract has been awarded to Thomas B. Rutan to build the new Central Presbyterian Church at Marcy and Jefferson Aves. The building will cost about $95,000, and will have a total seating capacity of 1,797. Its architecture will be Gothic, and it will cover a plot 100 × 130 ft. Henry J. Brown & Son have the contract for the carpenter work. Rev. J. F. Carson is the pastor.——The following bids were received Sept. 16 by W. E. Sylvester, M. D., Gen. Supt. State Hospital, for erecting buildings, etc., at the Long Island State Hospital, as advertised in Engineering News:

submitted by Emil Guenther, A. C. Swarts, J. W. Bones and Harry Thomas, of this city; J. W. Curtis, of Los Angeles; McDougall Bros., of Bakersfield, Cal.; V. L. Brown and W. J. Cuthbertson.

MADERA, CAL.—An election is to be held soon to vote on the question of issuing $50,000 in bonds for constructing a county court house and jail.

PASADENA, CAL.—Prof. T. S. C. Lowe is reported as making arrangements for erecting a new hotel in this city.

SAN JOSE, CAL.—An ordinance has been adopted calling a special election for Oct. 31, to vote on the proposition to issue bonds to the amount of $115,000, of which $75,000 will be used for the construction of a high school building.

VISALIA, CAL.—The supervisors are reported to have rejected the bids for building the new county jail.

BOISE, IDAHO.—Plans and suggestions have been received from eastern and western architects for a new state prison. The inmates of the penitentiary will get out rock for the foundation and other material. The board hopes to secure enough money from the sale of timber lands allotted to the penitentiary to erect the building.

CAPE BRENTON, N. S.—Guy King, 431 Walnut St., Philadelphia, Pa., has prepared plans for a $50,000 hotel at this place, according to reports.

TORONTO. ONT.—Bids are asked until Oct. 8 for the plumbing, ventilating, electric wiring, etc., for the new municipal buildings now being erected on West Queen St. Archs., E. J. Lennox, King and Yonge Sts.; R. J. Fleming, Mayor and Chn. Bd. of Control.

WATER-WORKS.

WINOOSKI, VT.—E. J. Tubbs, of Putnam, Conn., has been awarded a contract for sinking an artesian well for the Burlington Woolen Co.

BOSTON, MASS.—Bids are asked until Oct. 6 for laying 36 to 16-in. water mains, as stated in our advertising columns. W. N. Davenport, Secy. Metropolitan Water Bd., 3 Mount Vernon St.

CAMBRIDGE, MASS.—It is stated that the water board will purchase a 20,000,000-gallon pumping engine.

KINGSTON, MASS.—A special town meeting has been held to consider the report of the water commissioners upon the question of an additional water supply. W. S. Cole, Chn.

Bids for Constructing Buildings at Long Island State Hospital.

Bidder.	According to plans and specification.	Cottages E, F and G.	Enamel brick in cottages E, F and G.	Enamel brick for entire group except cottages E, F and G.	Basement floors.	Slated roofs.	Window trimmings.	Total.
J. B. Bussman & Co., Hancock, N. Y.	$326,931	$88,135	$1,783	$5,168	$5,558	$3,000	......	$430,344
Probst Construction Co., 160 5th Ave., N.Y. City	241,705	92,316	1,910	4,225	11,000	5,161	$1,405	357,822
Gratten & Jennings, Buffalo, N. Y.	238,000	83,662	3,014	10,268	8,849	6,106	2,095	351,994
Shanahan & Turner, Amsterdam, N Y.	271,610	97,191	1,580	5,245	8,900	2,818	1,896	337,847
Charles Hart, 531 3d St., Brooklyn	273,910	19,993	2,538	6,642	12,399	1,094	1,353	317,929
P. J. Carlin & Co., Brooklyn	211,700	79,000	2,179	4,246	6,580	5,000	1,600	310,305

ANNAPOLIS, MD.—Morrow & Bro., of Baltimore, have been awarded the contract at $15,794 for constructing a new school building in this city.

BALTIMORE, MD.—An appropriation of $20,000 has been made for two new elevators in the city hall. B. B. Owens, Inspector of Bldgs.

NORFOLK, VA.—It is reported that work will soon be begun on a new hotel for the Monticello Realty Co. The building will be six stories high, 217 × 150 ft., and will contain 230 guest rooms. Pres., D. Lowenberg; Archs., Carpenter & Peebles, 104 Main St., Norfolk.

MARTINSBURG, W. VA.—Bids are asked until Oct. 9 for constructing approaches to the post office building in this city, as stated in our advertising columns. Wm. Martin Aiken, Supervising Arch., Washnigton, D. C.

TALLADEGA, ALA.—The executive committee of the Alabama Industrial School for White Girls at Montevallo has asked for new bids for constructing the first of the three proposed wings for the school. The bids received Sept. 14 ranged from $16,500 to $21,000.

NEW ORLEANS, LA.—Harrod & Audry, Masonic Bldg., are preparing plans for a $50,000 office building.

LEITCHFIELD, KY.—W. H. Bailey, of Henderson, Ky., has been awarded the contract at $13,759 for erecting a county court house. O. F. Hughes, Geo. Fletcher and J. A. Bishop are the commissioners.

LOUISVILLE, KY.—Plans are wanted for a two-room addition to the court house, which addition is reported as estimated to cost about $250,000. Alderman De Garno, Chn. Com.——Joseph McWilliams & Co. have been awarded the contract for a new heating apparatus for the county court house, at $8,900.

RUSHVILLE, IND.—Plans are asked by the committee of the members of the Immaculate Conception Church for a new edifice to cost $25,000.

DETROIT, MICH.—Bids are asked until Oct. 7 for constructing a county building in this city. Archs., John Scott & Co., 85 Moffat Block, Detroit; Wm. Rickert, Chn. Com., County Audrs.

CHICAGO, ILL.—The residents of Irving Park have selected a committee to make arrangements for erecting a new school building.

CHICAGO, ILL.—The construction of a printing building to cost about $200,000 is proposed for the University of Chicago. C. W. Chase is the director of the University Press.

MINNEAPOLIS, MINN.—It is stated that J. J. Hill, Pres. Great Northern Ry., has been granted a permit to erect a 1,500,000-bushel elevator in this city.

HELENA, MONT.—The capitol building commission on Sept. 5 let the first contract for the excavation for the foundation and basement for the new state capitol to Gebhardt & Wegner, of Helena, at 18 cts. a cu. ft. for earth work and 50 cts. cu. ft. for rock work. Arch., Geo. R. Mann, City Hall, St. Louis, Mo.; J. E. Rickards, Chn. Com., Helena.

GALVESTON, TEX.—Plans and specifications are asked by the Galveston Wharf Co. until Nov. 14 for constructing a 500,000-bushel elevator, and also for a 250,000-bushel clearing house. John E. Baily, Secy., Galveston.

SPOKANE, WASH.—Chase & Daniels, proprietors of the Arcadia Theatre at Riverside, are receiving bids for constructing a $50,000 theatre, according to reports.

FRESNO, CAL.—The board of supervisors has examined plans and specifications for the new county orphanage,

LAWRENCE, MASS.—The contract for a new pumping engine has been awarded to the Barr Pumping Engine Co., at $9,500. A. D. Marble, Cy. Engr.

MILLER'S FALLS, MASS.—The commissioners of the water supply district are reported to have voted to receive bids this week for the construction of the works from Lake Pleasant to Miller's Falls.

NEW BEDFORD, MASS.—Bids are asked until Oct. 1 for building foundations at pumping station and constructing conduit connections, etc., as stated in our advertising columns. Geo. S. Rice and Geo. E. Evans, Engrs., Boston; R. C. P. Coggeshall, Supt.

BALLSTON SPA, N. Y.—An election was called for Sept. 24 to vote on the question of a new water supply.

BRIDGEWATER, N. Y.—E. F. Musson, of Norwich, is making preliminary surveys for works at this place. If his report is favorable the question will soon be submitted to a vote of the people. This item, by mistake, was published under Norwich, N. Y., last week.

BROOKLYN, N. Y.—The board of aldermen has appropriated $311,000 for the usual maintenance of the water system; $150,000 for diverting Horsebrook stream from Hempstead reservoir; $75,000 for the purchase of ponds near Springfield and for the cleaning of the ponds and streams now in use as water supply. Theodore B. Willis, Comr. Cy. Wks.

DELHI, N. Y.—The company has submitted a proposition to sell the works to the village for $35,000.

LITTLE VALLEY, N. Y.—Efforts are being made to secure a new reservoir for better fire protection.

WATERVLIET, N. Y.—Bids are asked until Oct. 17 for furnishing labor and material for increasing the water supply for fire protection at Watervliet arsenal. Maj. Isaac Arnold, Jr., Ord. Dept.

DOVER, N. J.—Councilmen Mulligan, Young and Baker have been appointed a committee to employ an engineer and investigate the question of municipal works; present contract expires in November, 1897.

PASSAIC, N. J.—The Passaic Water Co. is said to have awarded a contract for trenching for a 30-in. water main from the Grand St. reservoir, at Paterson, to the two others, to William Whitmore, County Engr.

ALTOONA, PA.—S. C. Corson, of this city, is preparing plans for works for the borough of Juniata; new election will be held Nov. 3; at a previous election $24,000 in bonds was voted for works, but proposed source of supply voted on then has been changed.

BEAVER FALLS, PA.—The People's Water Co. has been organized by William Sloan, Mark Wisener, Sr., J. D. Perrott and others to construct works.

DAWSON, PA.—Bids are asked until Sept. 30 for laying about 4,000 ft. of 10 to 4-in. pipe, building a 100,000-gallon brick reservoir, etc. Taylor, Romine & Scott, Engrs., McKeesport; D. J. Redding, Chn. Com.

DELTA, PA.—The board of trade is reported as considering the question of constructing a reservoir and putting in water-works.

HARRISBURG, PA.—An ordinance appropriating $10,000 to extend the intake pipe further into the river has passed first reading in select council.

LEBANON, PA.—It is reported that one or more artesian wells will be sunk at South Mountain to secure at least 2,000,000 gallons of water a day, work to be commenced at once.

McKEESPORT, PA.—The water commissioners have contracted with Jacob Hocker, of Hocker & Shaw, to sink an 8-in. test well in the river near the pumping station.

PITTSBURG, PA.—Bids are asked until Sept. 25 for laying water pipe in about 30 streets, for furnishing and erecting a steel water tank, with foundations, for building new pumping station, for furnishing and erecting boilers and for one 12-in. reducing valve. E. M. Bigelow, Dir. Pub. Wks.

ARLINGTON, MD.—Local papers state that the water board has decided to abandon the scheme to furnish West Arlington with water from an artesian well.

NORFOLK, VA.—The water board is reported to have decided to send the superintendent to Massachusetts to investigate the question of filtration.

RICHMOND, VA.—Improvements to cost $1,400 are to be made at the pumping station.

PIEDMONT, W. VA.—Pownall & Minshall, of St. Louis, Mo., have been engaged to design a system of water-works for this city. R. W. Cannon, Secy. Comrs.

LINCOLNTON, N. C.—It is reported that the North State Hotel Co. and the county have united in contracting for works at this place.

LAURENS, S. C.—Bids are asked until Oct. 1 for the purchase of $30,000 in 20-year 6% water and light bonds. L. G. Balle, Clk.

EATONTON, GA.—An election will be held Oct. 12 to vote on an issue of $25,000 in bonds for water-works.

OXFORD, ALA.—Surveys are being made for a new water supply from a spring.

CHARLESTON, MISS.—A press report states that the county supervisors have advertised in local papers for bids for sinking an artesian well, probably 500 ft. deep, but received no bids.

TUNICA, MISS.—It is reported that this town has voted to issue bonds for artesian wells.

NASHVILLE, TENN.—The board of public works is considering the question of a water supply for the Centennial; about two miles of new mains will probably be required.

LANCASTER, KY.—There is talk of sinking an artesian well. Address, J. E. Stormes.

MARION, KY.—R. E. Bigham is reported as interested in projected works at this place.

BLANCHESTER, O.—Bids are asked by the city clerk until Oct. 3, according to reports, for the purchase of $20,000 in bonds for water-works. G. L. McKibben, Engr., Van Wert, O.

CINCINNATI, O.—The superintendent has been directed to report the best means for supplying Winton Place and Chester Park with water.

DAYTON, O.—Plans are being considered for a new water supply for the insane asylum at this place; estimated cost about $16,000. J. M. Ratliff, Supt.

HIRAM, O.—B. S. Dean, Clk. Bd., writes us that the bids received Sept. 15, as advertised in Engineering News, exceeded the appropriation, and new plans are now being made, after which new bids will be opened. E. C. Cooke, Engr., Cleveland.

ZANESVILLE, O.—Bids are asked until Sept. 28 for furnishing and erecting a 6,000,000 or 8,000,000-gallon pumping engine T. D. McCaddon, Secy.

EVANSVILLE, IND.—Bids are asked until Oct. 15 for furnishing 1,215 tons of 30-in. water pipe and special castings, as stated in our advertising columns. L. Weinheimer, Clk. Water Trustees.

JACKSON, MICH.—Bids are asked until Oct. 5 for the purchase of $10,000 in 5% refunding water bonds maturing Sept. 1, 1904. W. J. Caldwell, Cy. Recdr.

VICKSBURG, MICH.—It is reported that $15,000 in water and light bonds have been sold to Grand Rapids parties.

WYANDOTTE, MICH.—The water board is reported about to purchase two new boilers, 66 × 14, and also to introduce the meter system.

ALTON, ILL.—It is stated that the water company has refused to put in a filter at the pumping station; the matter has been referred by the council to a committee with power to act.

CHICAGO, ILL.—Bids are asked until Nov. 14 for furnishing and erecting six 20,000,000-gallon pumping engines, as stated in our advertising columns. Joseph Downey, Comr. Pub. Wks.

EDWARDSVILLE, ILL.—Bids are being asked, according to reports, for sinking test wells. Joseph Edmonds and G. W. Belk are interested.

MINONK, ILL.—Bids are asked until Oct. 5 for furnishing and erecting complete a 3,000-bbl. steel tank on a 60-ft. brick tower. M. H. Pfaffle, Cy. Clk.

STOCKTON, ILL.—The contract for constructing works has been awarded to the U. S. Wind Engine & Pump Co., of Batavia, Ill., at $7,950. An issue of $4,000 in 6% gold bonds has been authorized.

BALDWIN, WIS.—Press reports state that the city council has decided to construct works; bids will be received as soon as the plans are completed.

GREEN BAY, WIS.—The council is reported as refusing to pay more hydrant rental until the water company takes steps to increase the fire pressure.

MARINETTE, WIS.—The water company has completed an artesian well and it is said that a test will soon be made to see if a sufficient supply can be obtained from wells.

MILWAUKEE, WIS.—The health commissioner has recommended that filters be put in all the schools.

PORTAGE, WIS.—The council has passed a resolution declaring that unless the water company furnishes pure water within 60 days the city will refuse to pay for its supply.

DOWS, IA.—I. C. Fenninger, Cy. Clk., writes us that the contract for constructing works, as advertised in Engineering News, has been awarded to Jackson & Moss, of Des Moines, at $4,749.

PEPIN, WIS.—A petition has been circulated and a committee appointed to construct works; cost will probably not exceed $2,000.

FORT SCOTT, KAN.—The contract for a new stand-pipe 150 ft. high, as advertised in Engineering News, has been awarded to the Springfield Iron & Boiler Mfg. Co., of Springfield, Ill.

WELLINGTON, KAN.—As a result of litigation, it is reported probable that the works will pass into new hands and improvements be made.

WAMEGO, KAN.—A press report states that the construction of water-works and an electric light plant has been postponed until after the November election.

PARKVILLE, MO.—A water-works system is being built for Park College and a proposition has been made to extend the mains through the village; a steel tank will be erected.

ST. LOUIS, MO.—The work for which bids are asked until Oct. 6, as noted last week, includes the furnishing and laying of 7,800 ft. of 36-in. and 15,100 ft. of 30-in. pipe, etc. Local papers state that George P. Prendergast, contractor for laying about 54,000 ft. of water pipe, has the work only about one-half completed and has been notified to show why his contract should not be annulled. Robert E. McMath, Pres. Bd. Pub. Improvements.

HOUSTON, TEX.—The water company will probably put in additional steel tanks.

CASTLE ROCK, WASH.—The Castle Rock Water Co. has been incorporated with a capital stock of $15,000, by H. Orchard, G. A. Doty and J. P. Atkins. A franchise was recently granted to H. Orchard, of Kalama, Wash.

GRANITE, ORE.—A water company is said to have been organized to construct works in this town.

HEALDSBURG, CAL.—The trustees are considering different sources for a proposed water supply.

LOS ANGELES, CAL.—Bids are asked until Oct. 5 for erecting a boiler house and stack to cost about $9,000, according to reports. F. K. Upham, Treas., Pacific Branch National Home for D. V. S.

SONOMA, CAL.—The trustees have voted in favor of a municipal water-works system. F. Breitenbach, Cy. Clk.

WASHINGTON, CAL.—J. H. Richardson, H. Wilson, and Hugo Frommelt have been appointed commissioners, and will take steps to construct works, according to reports; proposed supply from the Sacramento River.

HUNTSVILLE, ONT.—Bids are asked until Sept. 28 for the purchase of $20,000 in water bonds.

WINNIPEG, MAN.—The present contract expires in three years, and there is talk of municipal works after that date.

PARRSBORO, N. S.—It is reported that Prof. Butler will prepare plans for works in this town.

IRRIGATION.

CHEYENNE, WYO.—Press reports state that the officers of the Wyoming Development Co. have received notice from the secretary of the interior that their application for a reservoir site reservation has been approved by the department. The company contemplates building a storage reservoir to impound the spring waters of the Laramie River as a reserve water supply for the Wheatland colony, where a tract of 60,000 acres of land is under irrigation. Pres., J. M. Carey, Cheyenne.

SANTA BARBARA, CAL.—The land owners on the Romero Creek, in Montecito, are reported as planning to combine their interests and construct a dam and reservoir at the head of the canyon. Mr. Blayter is the manager.

BOISE CITY, IDAHO.—H. E. Miller, of Albion, Idaho, has filed plans for an extensive reservoir on Goose Creek, Cassia county, according to reports.

MEXICO, MEX.—A press report states that Sr. Telesforo Garcia has undertaken the work of utilizing the water of the River Charcon for irrigation purposes, and will proceed at once with the construction of canals and ditches to conduct the water to the plain of Tecozautla, for the inhabitants of that district and also those of Huichapan.

NEW COMPANIES.—Smith Lake Irrigating & Mfg. Co., La Salle, Colo.; $2,500; Neil McMillan, A. Walker, R. W. Devinny, James Conlin.

Black Rock Reservoir & Canal Co., Eden, Ariz.; $3,000; J. D. Holladay, J. Busby, Elijah Hancock.

SEWERAGE.

PORTSMOUTH, N. H.—The council has voted to appropriate $10,000 for sewers.

WAKEFIELD, MASS.—The construction of a better sewer system is again being discussed.

CENTRAL FALLS, R. I.—The construction of sewers in two streets, estimated to cost $6,200, is proposed.

BROOKLYN, N. Y.—The aldermen have appropriated $25,000 for a relief sewer to be constructed on the extension of Clinton Ave. to the Wallabout. T. B. Willis, Comr. Cy. Wks.

BUFFALO, N. Y.—The board of public works received the following bids Sept. 11 for constructing sewers in (1) Lang Ave. and (2) Colfax Ave.: Louis W. Miller, 1, $43,000; J. H. Franklin, 1, $34,700; John Harrer, 1, $31,900; 2, $2,590; C.A.Smith. 1, $33,700; 2, $3,460; George & Thomas Dark, Jr., 1, $39,750; Jacob Ritzmann, 1, $33,300; 2, $2,260; G. W. Moore 1, $44,943; 2, $2.994; Hy. Harter, 1, $36,890; 2, $3,351; John Mumm, 1, $31,749; 2, $2,400; F. J. Martin, 2, $3,129; Andrew Beaser, 2, $2,224; W. A. Rappich, 2, $2,394; A. Kratzmann, 2, $2,929. R. G. Parsons, Secy.

BUFFALO, N. Y.—Bids are asked until Oct. 7 for constructing 30 to 12-in. pipe sewers in ten streets. R. G. Parsons, Secy. Dept. Pub. Wks.——E. B. Guthrie, Cy. Engr., has requested that the city remedy the Hamburgh canal nuisance by making it a covered channel at an estimated cost of $500,000.

HAMBURG, N. Y.—This village will build a new system of sewers. J. W. Salisbury, Chn. Com.

MOUNT VERNON, N. Y.—Bids are asked until Oct. 6 for constructing a lateral sewer in Bridge St. Geo. M. Jenkins, Cy. Clk.

JAMESTOWN, N. Y.—An election is reported for Sept. 26 to vote on the question of extending the sewers at a cost of about $46,000. John E. Conway, Chn. Bd. Pub. Wks.

TROY, N. Y.—The council has decided to build 12 and 10-in. pipe sewers in a number of streets. E. O. Ross, Secy. Bd. Contract.

WALDEN, N. Y.—The board of trustees have been petitioned to construct a sewer in Montgomery St. J. S. Taylor, G. Robinson, S. Andrews and Wm. Van Amburgh are interested.

HOBOKEN, N. J.—Bids are asked until Sept. 30 for constructing an 18-in. pipe sewer in two streets in West Hoboken; check, $2,000. John P. McMahon, Town Clk.; Chas. J. Chandless, Chn. Com., West Hoboken.

NEW BRUNSWICK, N. J.—Bids are asked until Oct. 5 for constructing 4,200 ft. of pipe sewers in Ward 6, as stated in our advertising columns. Asher Atkinson, Cy. Surv.

OCEAN GROVE, N. J.—Niart Rogers has presented a report on sewers for this city. John A. Githeus, Washington White and Maxwell Crosbie compose the sewer committee.

ROSELLE, N. J.—Bids are asked until Oct. 2 for constructing 8,500 ft. of 12 to 8-in. pipe sewers, as stated in our advertising columns. G. A. Rawlins, Borough Clk.; H. M. Herbert, Engr., Bound Brook, N. J.

SOUTH ORANGE, N. J.—Committees have been appointed at this place and West Orange looking toward a joint sewerage system for the two townships.

ALLEGHENY, PA.—Bids are asked until Sept. 28 for constructing lateral and main sewers in 10 streets. Robt. McAfee, Dir. Pub. Wks.

BALTIMORE, MD.—The Southwest Baltimore Improvement Association has petitioned the mayor for the construction of a sewer in Stockholm St. Frank C. Wachter, Pres.

TAMPA, FLA.—Geo. E. Waring, 874 Broadway, New York, N. Y., and Newport, R. I., has prepared plans for a sewer system, 54 miles long, for this city. It is probable that bids will soon be asked.

LOUISVILLE, KY.—The board of public works has ordered the construction of a sewer in 22d St. J. H. Pearson, Cy. Engr.

NEWPORT, KY.—No work is projected in this city for this year. In 1897 the trunk sewer in District E will be constructed, in addition to the usual amount of lateral work. It is the intention to improve Columbia St. with brick or asphalt. W. L. Glazier, Cy. Engr.

AKRON, O.—McGowan & Hunt have been awarded the contract at $4,389 for constructing a main trunk sewer in South Akron. The other bidders were Hallinan & Derrig, $5,747; McGarry & McGowan, $7,360; O. N. Gardner, $6,080; Wilhelm & McCourt, $6,752. S. W. Parshall, Cy. Engr.

CLEVELAND, O.—Bids are asked until Sept. 30 for constructing a sewer in Kinkel St. D. E. Wright, Dir. Pub. Wks.——The board of control has approved plans for the Walworth Run sewer, which will be over 14,000 ft. in length. The sewer will extend along Walworth St. in the valley, having an outlet into the river near the lower end of Scranton Ave. The sewer will be 18 ft. 9 ins. in diameter at its outlet and 8 ft. at Gordon St. The contract will probably soon be let. Des. Engr., C. G. Force, The Livingston, Cleveland.——The council has voted to issue $23,000 in bonds for constructing a sewer in Willson Ave. Frank A. Emerson, Pres. Council; Howard H. Burgess, Cy. Clk.

MARIETTA, O.—The council has voted to construct additional sewers in Franklin St., from Lancaster St. to the Ohio River. S. J. Hathaway, Pres. Council; Carl Becker, Cy. Clk.

WATERLOO, IA.—Bids are asked by the city clerk until Sept. 28 for constructing 30 to 24-in. pipe sewers in two streets. M. L. Newton, Cy. Engr.

MILWAUKEE, WIS.—The board of public works has awarded nine contracts aggregating 9,422 ft. of 18 to 12-in. pipe sewers to Mathias Chybowski, at 94 cts. to $1.22 a ft. G. H. Benzenberg, Cy. Engr.

WEBSTER CITY, IA.—E. E. Fox, of Chicago, Ill., is reported as preparing estimates, etc., for a sewer system. Geo. S. Jacks, Cy. Clk.

COFFEYVILLE, KAN.—Bids are asked until Sept. 30 for constructing about 34,000 ft. of 15 to 8-in. pipe sewers, etc. John M. Walker, Cy. Engr.

PORTLAND, ORE.—The council has voted to issue $25,000 in bonds for sewers. T. M. Hurlburt, Cy. Surv.

CHINO, CAL.—It is reported that the question of constructing sewers for this place is being discussed.

SACRAMENTO, CAL.—The following bids were received Sept. 8 by the trustees for a sewage pumping plant. Des. Engr., M. H. Veach, Sacramento; Wm. Mullenny, Cy. Surv.:

Risdon Iron Wks., San Francisco, Cal.	$20,162 to $21,862
Krogh Mfg. Co.	16,805 to 19,950
San Francisco Iron Works, San Francisco	17,333
Sacramento Boiler Works, Sacramento.	14,283 to 15,124

SACRAMENTO, CAL.—The trustees have awarded to J. W. McDonald, of the City Street Improvement Co., the contract for the sewage pumping plant at S St., at $41,586.

SAN JOSE, CAL.—The council has adopted an ordinance calling an election Oct. 31 to vote on the proposition of issuing $115,000 in bonds, $40,000 of which is to be used to complete the main sewer a distance of 5,000 ft., to drain into a slough near Alviso.

ST. JOHN, N. B.—The council has voted to appropriate $11,000 for extending sewers and water mains.

WINNIPEG. MAN.—It is proposed to construct an outlet sewer in Colony St. to cost $6,000. C. J. Brown, Cy. Clk.

GARBAGE DISPOSAL—STREET CLEANING.

BROOKLYN, N. Y.—Bids are asked until Oct. 5 for the removal, collection and disposition of garbage in this city from Jan. 1, 1897, to Dec. 31, 1901; deposit, $15,000; surety, $100,000. Specifications require the construction of a plant to cremate or dispose of at least 500 tons of garbage each 24 hours. Z. Taylor Emery, Comr. of Health; T. B. Willis, Comr. Cy. Wks.

TROY, N. Y.—The garbage crematory of Zeph F. Magill, on Centre Island, was injured by fire Sept, 11 to the extent of about $1,500. Efforts are being made to have a new building ready for use this week.

READING, PA.—The following bids were received Sept. 21 for constructing a garbage disposal plant, as advertised in Engineering News:

	Building of	
Bidder.	Brick.	Cor. iron.
Columbia Mfg. Co., N. Y. City	$16,000	$16,000
M. L. Davies, Lancaster, Pa.	13,900	......
Rider Garbage Furnace Co., Pittsburg.	18,000	18,000
Wm. H. H. Acbruff, Philadelphia.	27,000	27,500
Dixon Sanitary Crematory Co., Findlay, O.	10,000	9,000

WILKESBARRE, PA.—The city council has adopted the report recommending the purchase of a 60-ton Dixon crematory to cost $10,000, as advertised in Engineering News. Bids were received from seven concerns.

BALTIMORE, MD.—The special committee appointed by the council last winter to investigate the garbage question, is said to favor the construction of a crematory, at a probable cost of $100,000. Councilman Hennighausen is chairman of the committee.

MEMPHIS, TENN.—The question of garbage removal is receiving considerable attention in this city and there is talk of a crematory or other improved method of garbage disposal.

CLEVELAND, O.—The "Leader" reports the bids opened Sept. 17 for a garbage disposal plant, as noted in Engineering News, Aug. 27, as follows: Columbian Mfg. Co., of New York city, was informal. Geo. A. Rose, of Cleveland, bid $2.55 a ton for disposing of the refuse only; $94,000 a year for the disposition of the same material for five years, or $85,000 for ten years; also $145,000 for building a crematory, including the site, the plant to be of the Textor make. The Ohio Reduction Co., of Cleveland, bid on the same material at $2.40 a ton, or $90,000 a year for five years, or $79,500 for ten years; also offered to build an Arnold crematory for $129,000, including the cost of land. M. F. Bramley, of Cleveland, offered to dispose of both refuse and garbage for $2.50 a ton, or $108,000 a year for five years, or $120,000 for ten years; would erect a Dixon crematory for $54,000, the land to be supplied by the city. Ed. Butler, of St. Louis, bid only on disposing of garbage and refuse for ten years at $143,000 a year until March 8, 1898, and thereafter $150,500 a year. The River Machine & Boiler Co., of Cleveland, offered to erect a Holthaus crematory for $147,980, the land to be supplied by the city. The Dixon Crematory Co. bid $54,000 for a crematory of its own make, the city to supply the land.

MILWAUKEE, WIS.—Aldermen Oldenberg, Stevens, Stark, Corcoran, and Stollenwork and the health commissioner have been appointed a committee to consider the advisability of the city owning and conducting its own garbage disposal plant; present contract expires next year.

HELENA, MONT.—The contract for building a garbage crematory with a stack 80 ft. high, is reported to have been awarded to H. E. Jamison, at $2,700; Gebhardt & Wegner bid $2,845.

SAN FRANCISCO, CAL.—By a decision of Judge Hebbard, Sept. 8, the disputed garbage franchise is to be awarded to the heirs of Wm. Sharon; in a previous decision in the suit of L. V. Merle against the board of supervisors, the court decided that neither Mr. Merle nor the Sharons were entitled to the franchise.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked by B. W. Wells, Supt. of Streets, until Sept. 26 for 1,000 sq. yds. of granite block paving, 470 sq. yds. of brick sidewalks, etc., and until Sept. 28 for grading in Mystic Valley Parkway. The work to include 1,300 cu. yds. of earth excavation, 10,000 cu. yds. of filling in, etc. Wm. T. Pierce, Engr. Metropolitan Park Comn., 114 Ames Bldg., Boston.

SPRINGFIELD, MASS.—The council has voted to pave South Main St., work on which will be begun at once. Chas. M. Slocum, Cy. Engr.; W. C. Dickinson, Supt. of Streets.

OLD SAYBROOK, CONN.—Samuel H. Pratt, First Selectman, informs us that the following bids were received Sept. 19 for constructing macadam road:

	Per lin. ft.
The Stone Road Construction Co., Bridgeport	$1.01
B. D. Pierce, Jr., & Co., Bridgeport	.93
John A. Doolittle & Co., New Haven	.89
C. W. Blakeslee & Sons, New Haven	.79¾
Robert Furton, Willimantic	.87
A. Brazos & Sons, Middletown	.69¾

SUFFIELD, CONN.—Bids are asked until Sept. 30 for grading and macadamizing about 3,100 ft. Edmund Halladay, Selectman, Suffield.

WATERBURY, CONN.—It is stated that the Milford Land & Cottage Co., which is to construct a new street through the centre of this city from Bank to Leavenworth Sts., has recorded deeds for property acquired for a large real estate scheme. A mortgage for $140,000 has also been recorded in favor of J. H. Wittemore, of Naugatuck, Conn., who put most of the money into the project. The company contemplates spending nearly $1,000,000 in this scheme.

ALBANY, N. Y.—It is reported that the state canal board has set aside $3,000 additional, making $10,000 in all, for repairing the 13 miles of state road leading from White Lake to South Lake, through Woodhall and North Lake, in Herkimer and Oneida counties. South Lake is situated on the direct road to Honnedaga Lake, the headquarters of the Adirondack League Club. G. W. Aldridge, Supt. Pub. Wks.

BROOKLYN, N. Y.—Timothy L. Woodruff, Park Comr., on Sept. 22, awarded contracts for the extension of the Eastern Parkway from Ralph Ave. to Ridgewood Park, as follows: The first section, from Ralph Ave. to Rockaway Ave., to Thomas F. Byrnes, $58,118. The distance is 3,000 ft. The second section, from Bushwick Ave. to Ridgewood Park, to Michael J. Dady, at $170,725. The distance is 3,500 ft., including a viaduct 200 ft. long, and considerable grading. The section between Rockaway and Bushwick Aves. will be let later, when specifications are completed.

BUFFALO, N. Y.—Bids are asked until Oct. 7 for repaving in two streets and grading, etc., in one other. R. G. Parsons, Secy.

OSWEGO, N. Y.—The council has directed that several streets be paved with brick or asphalt. H. D. McCaffrey, Pres. Bd. Pub. Wks.

JAMAICA, N. Y.—The trustees of the village have decided to call a special election to decide the question of appropriating $150,000 for macadamizing and general road improvements. John J. McLaughlin, Village Engr.

MOUNT VERNON, N. Y.—Bids are asked until Oct. 6 for macadamizing in Cottage Ave. G. M. Jenkins, Cy. Clk.

ROCHESTER, N. Y.—The West End Improvement Association is discussing the question of making West Ave. a boulevard. Another meeting to consider the subject will be held Oct. 7. D. M. Anthony and Wm. Cox, of the association are interested.——Whitmore, Rauber & Vicinus, of Rochester, were the lowest bidders, at $5,000, for paving in two streets. Edwin A. Fisher, Cy. Engr.

ROCHESTER, N Y.—Bids are asked until Oct. 2 for asphalt paving in Exchange Place and cement sidewalks in three streets. Thos. J. Neville, Clk. Executive Bd.——It is proposed to pave Mill St. with asphalt, at a cost of $21,000.

STAPLETON (S. I.), N. Y.—Bids are asked until Oct. 22 for improving certain roads, according to reports. Henry P. Morrison, Engr. County Roads.

JERSEY CITY, N. J.—Bids are asked until Sept. 29 for improving Highland Ave. The work will include 310 cu. yds. of earth and rock excavation, 675 sq. yds of paving, about 9,500 sq. ft. of flagging, etc. John C. Kaiser, Chn. Com.——It is proposed to pave Mercer St. with asphalt, at a cost of $60,000.

WILDWOOD, N. J.—At an election held Sept. 8 the question of issuing $50,000 in bonds for general improvements was voted upon.

WOODBURY, N. J.—It is stated that the Gloucester county board of freeholders, on Sept. 17, adopted a resolution to build a stone road between Paulsboro and Swedesboro, a distance of about six miles. John S. Jessup, County Solicitor.

ALLEGHENY, PA.—Bids are asked until Sept. 28 for grading, paving, etc., in four streets. Robt. McAfee, Dir. Pub. Wks.

NEWCASTLE, PA.—It is reported that $50,000 of 4% street and sewer bonds will be sold in November. Frank Tidball, Cy. Clk.; J. H. Miller, Cy. Engr.

PITTSBURG, PA.—Bids are asked until Sept. 26 for grading and asphalt paving in ten streets. Edward M. Bigelow, Dir. Pub. Wks.

MACON, GA.—Bids are asked until Oct. 13 for the purchase of $130,000 of 4½% paving bonds. Bridges Smith, Clk. Council; S. B. Price, Mayor.

TAMPA, FLA.—The question of paving West Fayette St. is being considered.

OWENSBORO, KY.—An election will be held Nov. 2 to vote on the question of issuing $25,000 in bonds for paving, and $25.000 for erecting an electric light plant. H. M. Talbott, Cy. Engr.

CINCINNATI, O.—Bids are asked by the board of administration until Oct. 8 for asphalt paving in two streets, and granite block paving in one street. Aug. Herrmann, Pres.; A. P. Butterfield, Clk.

CINCINNATI, O.—Bids are asked until Oct. 5 for brick paving in three streets and until Oct. 19 for brick paving in Carll St. Aug. Herrmann, Pres.——The council of St. Bernard has voted to construct cement sidewalks in Mitchell Ave.

CLEVELAND, O.—Bids are asked until Oct. 14 for grading about nine miles of the Brecksville road. Julius C. Dorn, Clk. County Comrs., Old Court House, Cleveland. ——The council has voted to pave two streets with brick. Frank A. Emerson, Pres. Council.

COLUMBUS, O.—The board of public works has directed the city clerk to advertise for bids for improving two streets. N. B. Abbott has been awarded the contract at $24,577 for improving Broad St. from High St. to the river. Josiah Kinnear, Cy. Engr.

NILES, O.—Bids are asked until Oct. 15 for about 5,000 sq. yds. of paving with asphalt blocks or brick, and until Oct. 17 for the purchase of $11,000 in 6% paving bonds, as stated in our advertising columns. Wm. Wilson, Engr.; John L. McDermott, Cy. Clk.

RICHMOND, IND.—Bids are asked until Oct. 12 for improving North D St., according to reports. J. H. Winder, Clk. Bd. Pub. Improvements; H. L. Weber, Cy. Engr.

BAY CITY, MICH.—The council is discussing the question of repaving Centre Ave., which was paved about four years ago with cedar blocks, at a cost of $40,000, but has proved a failure. Geo. Turner, Cy. Engr.

PORT HURON, MICH.—The council has directed the city engineer to advertise for bids for cedar block paving, on a sand foundation, in Pine Grove Ave.; estimated cost, $17,000. F. F. Rogers, Cy. Engr.

SAGINAW, MICH.—The street committee has recommended to the council the paving of four streets with asphalt and brick. H. E. Terry, Cy. Engr.

CHICAGO, ILL.—Bids are asked until Sept. 30 for laying cement sidewalks in about 30 streets. The sidewalks are to be from 14 to 6 ft. in width, and in many cases to be on both sides of the streets. Joseph Downey, Comr. Pub. Wks.

MILWAUKEE, WIS.—It has been decided to pave a portion of East Water St. with asphalt. L. L. Caufy, Alderman from the 7th Ward, can be addressed.

WAUKESHA, WIS.—The council is reported as again considering the question of issuing $16,000 in bonds for streets and sewers.

OMAHA, NEB.—The county commissioners have agreed to the proposed macadamizing of Centre St. for several miles beyond the city line. The city engineer has been instructed to draw plans and specifications for about 1½ miles of macadam road which will be built this fall. It is not known when the bids will be opened. Also for one mile of asphalt on South 16th St., which may be completed this fall. R. B. Howell, Cy. Engr.

BUTTE, MONT.—The county commissioners have decided to extend Park St. at a cost of about $4,000. Other improvements are also proposed.

DENVER, COLO.—The Colorado Paving Co., Pres., C. B. Rhodes, has been awarded the contract by the board of public works for grading and curbing district No. 1, on East Capitol Hill, at $120,000. T. J. Milner, Engr. Bd. Pub. Wks.

PORTLAND, ORE.—The committee has recommended that the contract be awarded to Hamilton & Sweeney at $5,347 for brick paving on a concrete foundation in Burnside St. T. M. Hurlburt, Cy. Engr.

MARTINEZ, CAL.—Bids are asked until Oct. 5 for building a road over a mile long. Elam C. Brown, County Surv., Martinez; F. L. Glass, County Clk.

SACRAMENTO, CAL.—The county surveyor has submitted estimates for constructing a road on the levee around the island. The work will include 200,000 cu. yds. of excavation.

SAN DIEGO, CAL.—The street committee has recommended to the council the paving of 5th St., at a cost of about $18,000. E. M. Capps, Cy. Engr.; F. W. Osburn, Supt. of Streets.

WINNIPEG, MAN.—The council has voted to improve the sidewalks in a number of streets at a cost of about $2,000. C. J. Brown, Cy. Clk.——The city engineer has been directed to make a number of improvements to the streets.

MANUFACTURING PLANTS.

HAZARDVILLE, CONN.—Four buildings of the Hazardville Powder Co. were recently destroyed; reported loss, $10,000.

OSWEGO, N. Y.—Fire destroyed the plants of the Silver Metal Co., and the Seliger-Toothill Novelty Co., on Sept. 20; reported loss, $100,000.

CLIFTON, N. J.—The Paterson "Guardian" announces that John W. Ferguson, of Paterson, has the contract for the construction of a three-story brick mill for Pitkin, Houldsworth & Co., woollen manufacturers, of Passaic, to be built at this place. The factory will be 275 × 60 ft., and the contract price is $36,500.

GARWOOD, N. J.—It is reported that A. J. Beckley, of Meriden, Conn., Pres. A. J. Beckley Steel & Iron Perforating Co., is arranging to erect a factory at this place. It is expected to have the building completed by Dec. 1.

ALIQUIPPA, PA.—The Victor Mfg. Co. will build a plant at this place. Chas. Bickel, of Pittsburg, is preparing plans.

BRADFORD, PA.—The Bradford Glass Works were destroyed by fire Sept. 18. The loss is estimated at $18,000; insurance, $10,000.

NORRISTOWN, PA.—The Norristown Wire Co. is building a plant at this place, and has already completed the foundation for the main building. Fred. M. Jaquith and J. H. Ruige, Jr., of Philadelphia, are interested.

NORRISTOWN, PA.—The Peerless Pipe Covering Co.'s buildings were destroyed by fire Sept. 22. The loss will reach about $15,000, with $5,000 insurance.

PHILADELPHIA, PA.—The "Record" states that the George W. Blabon Co. is going to put an additional story to its three-story oil cloth works, at Schuyler St. and the Philadelphia & Reading R. R. The additional story will be 10 ft. high, 50 × 153 ft.

PITTSBURG, PA.—The Iron City Brewery will build a new cooper shop, to cost $50,000. V. Wyss Thalman, Arch.

SHARON, PA.—It is stated that the Buhl Steel Co. has decided to increase its capital, for the erection of a steel mill, from $300,000 to $600,000. The company has already been chartered. with a capital stock of $300,000.

READING, PA.—It is understood that the Chantrell Tool Co. is to increase its plant to double its present capacity.

TROY, N. C.—The buildings for the Smitherman Cotton Mills are about completed, consisting of a main building 78 × 320 ft., engine and boiler room 35 × 60 ft. Space is provided for 5,000 spindles and 200 looms, but only about half of the amount will be put in at the present time.

PIQUA, O.—The plants of the Piqua Fabric Co. and the Piqua Hosiery Co. were burned Sept. 19. Reported loss, $60,000; insurance, $45,000.

MUSKEGON, MICH.—Wm. F. Wiselogels planing mill and furniture factory burned recently. Loss, $25,000; insurance, $10,000.

KANSAS CITY, MO.—The plant of the Marsh Oil Co. was recently totally destroyed by fire. Reported loss, $70,000; insurance, $60,000. It is stated that the company will rebuild.

ARDMORE, IND. TER.—The plant of the Chickasaw Asphalt Co., located at Woodford, Ind. Ter., was totally destroyed by fire Sept. 14. Loss, several thousand dollars.

MONCTON, N. B.—On Sept. 20 fire destroyed the Moncton sugar refinery, owned by the Acadia sugar combine; reported loss, $200,000.

LONDON, ONT.—It is stated that J. Mills, of Hamilton, has the contract to erect car shops for the Grand Trunk Ry. and work will soon commence.

MISCELLANEOUS CONTRACTS.

STONE CRUSHER.—Shawano, Wis.—It is reported that the council has voted to purchase a stone crusher.

STEAM ROAD ROLLER.—Franklin, N. H.—It is stated that this place has voted to purchase a steam road roller.

STREET SWEEPER.—Santa Ana, Cal.—It is stated that the city clerk has been directed to advertise for bids for a street sweeper.

NATURAL GAS PLANT.—Wheeling, W. Va.—The Wheeling Natural Gas Co. is reported as about to lay mains in this city.

DREDGING.—Philadelphia, Pa.—Bids are asked until Oct. 17 for dredging in the Schuylkill River, Pa. Maj. C. W. Raymond, U. S. Engr., 1428 Arch St.

JETTY WORK. —San Diego, Cal.—It is stated that bids will soon be asked for constructing another section of the jetty in the harbor, for which $50,000 is now available.

DREDGING.—Wilmington, Del.—Bids are asked until Oct. 8 for dredging in Christiana River, Del., as stated in our advertising columns. Maj. Wm. F. Smith, U. S. Agt.

REMOVAL OF WRECKS.—Wilmington, Del.—Bids are asked until Sept. 28 for removing the wrecks of two barges in Upper Christiana River, Del. Wm. F. Smith, U. S. Agent.

DIKES.—Portland, Ore.—Bids are asked until Oct. 8 for constructing dikes, etc., in Tillamook Bay, Ore., as stated in our advertising columns. Capt. W. L. Fisk, U. S. Engrs.

LEVEE WORK.—Arkansas City, Ark.—Bids are asked until Oct. 12 for enlarging the railway levee south of this city, according to reports. C. P. Balfour, Pres. Bd. Levee Comrs., Bayville, La.

ENGINE.—Grant's Pass, Ore.—A local paper states that Major C. Newell proposes to put in a 120-HP. engine at his hydraulic mines on the river above town, for the purpose of hoisting water.

DITCH EXCAVATION.—Winnipeg, Man.—Bids are asked until Sept. 26 for the excavation of a ditch five miles long, about 30,000 cu. yds. of earthwork. Robt. Watson, Minister Pub. Wks.

RIPRAP EMBANKMENTS.—Duluth, Minn.—Bids are asked until Oct. 20 for riprap embankments at Agate Bay, Minn., as stated in our advertising columns. Maj. Clinton B. Sears, U. S. Engrs.

QUARRY MACHINERY.—Rockland, Me.—A cave-in at the lime quarry of the Cobb Lime Co. last week resulted in the destruction of derricks, pump house, engines, etc.; reported loss, 5,000 to $15,000

PIERS.—Brooklyn, N. Y.—The commissioner of city works is considering the question of constructing two piers and bulkheads at Wallabout Market. W. E. Belknap, Asst. Engr. Dept. Cy. Wks.

FEED PUMPS.—Chicago, Ill.—Bids are asked until Sept. 28 for three duplex feed pumps for the Chicago public library building. Shepley, Rutan & Coolidge, Archs., Venetian Bldg.; W. B. Wickersham, Secy., City Hall.

DREDGING.—New York, N. Y.—Bids are asked until Oct. 17 for dredging in Lemon Creek, Staten Island, N. Y., and until Oct. 19 for dredging in South River, N. J., as stated in our advertising columns. Maj. H. M. Adams, U. S. Engrs., 39 Whitehall St.

COAL CONVEYOR.—Chicago, Ill.—Bids are asked until Sept. 28 for the apparatus and machinery for receiving, conveying and storing the daily coal supply for the public library building on Dearborn Park. W. B. Wickersham, Secy., City Hall.

REPAIRING DAMS.—Albany, N. Y.—Bids are asked until Sept. 28 for repairing steel dam over the Mohawk River at Cohoes, on the Champlain Canal, and the dam across the Mohawk River at Rexford Flats. Thos. Wheeler, Asst. Supt. Pub. Wks., Syracuse; R. G. Lay, Asst. Supt., Rochester; Geo. W. Aldridge, Supt., Albany.

OIL WELLS.—Indianapolis, Ind.—It is stated that the Keystone Oil Co. has had plans prepared for sinking a well on the Wm. Bradley farm; also that in a few weeks about 20 more wells will be started on this farm and on the Hessong farm, in which R. C. Fry is interested. Wm. Murphy and Alex. McKnight are interested in the Keystone Oil Co.

PIERS.—Baltimore, Md.—It is stated that Benjamin Glen has contracted to build for Wolf Bros., at Rose Bank fishing shore, Back River, a promenade and boat pier 120 ft. long and 12 ft. wide. At the end will be a walk 20 × 30 ft. Mr. Glen will also build on his own fishing shore, opposite Rose Bank, a platform pier 120 ft. long and 8 ft. wide.

BRICK CONDUIT.—Boston, Mass.—Bids are asked until Sept. 25 for building Section 5, Columbus Ave., Roxbury, of the brick conduit for Stony Brook. The conduit is to be 15½ × 17 ft. The work will include 20,540 cu. yds. of earth excavation, 7,150 cu. yds. of rock excavation, 1,240 cu. yds. of concrete, 2,877 cu. yds. of brick masonry and 10,500 ft. B. M. of spruce lumber. Benj. W. Wells, Supt. of Streets.

PARK WORK.—Boston, Mass.—The park commissioners have awarded to Perkins & White, at $23,000, the contract for the construction of the North End Pleasure Ground, at Copp's Hill. The park will be 235 × 188 × 158 × 117 ft. The other bidders were: Metropolitan Construction Co., $25,500; Trumbull & Ryan, $35,498; H. P. Nawn, $29,648; L. D. Wullen & Co., $38,750; John Shay, W. P. Chapman and S. L. McCallam, $23,740.

BONDS.—Cleveland, O.—No bids were received for $250,000 of 4% Cleveland park bonds which were offered for sale on Sept. 16, and the bids opened on the same day for $300,000 of 4% water bonds were rejected. The park bonds will draw interest from July 1, 1896, and will mature April 1, 1927, and the water bonds will draw interest from Oct. 1, 1896, and will mature Oct. 1, 1926. Principal and interest of both loans will be payable at the American Exchange National Bank of New York.

GRAIN ELEVATORS.—St. Paul, Minn.—It is stated that the Chicago Great Western Ry. Co. has secured about $5,000,000 from European investors for improvements to the road, which include the erection of grain elevators in Kansas City (now under construction at a cost of $200,000); St. Joseph, Mo.; Omaha, Neb.; Leavenworth, Kan.; Topeka, Kan.; Minneapolis and St. Paul, Minn.; Buffalo, N. Y.; and probably one in Liverpool, Eng. Pres., A. B. Stickney; Vice-Pres., Ansel Oppenheim, Metropolitan Opera House Block, St. Paul.

CANAL WORK.—Albany, N. Y.—It is stated that the state canal board has approved additional plans and specifications for canal work under the $9,000,000 improvement scheme to cost $252,154. This work is divided as follows: Eastern Division, Erie Canal, $126,600, to include $86,000 for deepening the canal from Rexford Flats, Aqueduct, to Schenectady; Middle Division, $115,266, to include an item for lengthening and improving lock 18 on the Oswego Canal, the last lock before entering Lake Ontario, and Western Division, $10,287. This work will be advertised soon by Geo. W. Aldridge, Supt. Pub. Wks., Albany.

SEA WALL.—Boston, Mass.—Application has been made by the city engineering department for a permit from the Harbor and Land Commissioners to erect the sea-wall which is to mark the outer edge of the new Dorchester Ave. in the vicinity of the new Union Station. When this is granted, as it will undoubtedly be in a few days, another application will be made and drawings submitted for the construction of 200 ft. of wall on Fort Point Channel, adjoining the yards of the New York & New England. This will be the beginning of work on the part of the city. The work on Summer St. extension will come later, as the Boston Terminal Co. is not yet ready to turn over to the city the land needed.

HARBOR IMPROVEMENT.—Aransas Pass, Tex.—Press reports state as follows: At a meeting in Baltimore, Sept. 12, the bondholders of the Aransas Pass Harbor Co. accepted a proposition, made by Col. Goodyear, a New York contractor, to secure and maintain 20 ft. of water over Aransas bar. Charles Clarke & Co., the contractors who built the breakwater, offered to secure and maintain for five years a depth of 20 ft. for $650,000 and a bonus of $40,000 for each additional foot up to 25 ft. Col. Goodyear will secure 20 ft. for $500,000 and the engineers are confident that when the current is guided through a channel 20 ft. deep it will soon scour to the clay bottom at a depth of over 30 ft. At present the distance across the bar between 20-ft. contours is only about 3,700 ft. It is not expected that the work of dredging a 20-ft. channel for that distance will occupy many weeks, especially as the ebb tide has a velocity of over two miles an hour.

GAS WORKS.—Indianapolis, Ind.—Local papers state that the two natural gas companies which supply this city with fuel are making preparations for more gas this winter. The Indianapolis Gas Co.'s pumping station is almost ready for operation. About 35 new wells will be completed by the time the pumping station is in action and the supply of gas that reaches the city is promised to be larger and of stronger pressure than ever before. The Consumers' Gas Trust Co. will expend $300,000 in extending and bettering its plant. A pumping station will be constructed at the edge of Hamilton county, and the company will draw from a largely increased territory and at least 30 more wells. A new main will be built from the field connecting with the 16-in. main which extends into the city from a point about 12 miles out. About 45 miles of small pipe will be laid in the field connecting with the new main. The company expects to almost double the amount of gas which reaches the city.

PIER.—Philadelphia, Pa.—Armstrong & Prentzenhoff have been awarded the contract for extending pier No. 18, South Wharves, to the new Port Warden's line. Work was begun Sept. 21. The extension of this pier means practically the construction of an entire new wharf. The contract was awarded by the Charles P. Beck estate, the owners of the present small pier at that point. This is to be entirely removed, and in its place will be erected a substantial covered wharf. Its dimensions will be: Length, 593 ft.; width, 65 ft. The shed which will cover it will be 587 ft. long and 63 ft. wide. This shed will have a wooden frame with corrugated iron sides, the whole to be covered with a slag roof. At the Delaware Avenue end of the pier, offices will be constructed. All the latest appliances for the expeditious handling of freight will be introduced, and eight wharf drops will be built. The contract calls for the pier's completion by Jan. 1, 1897. When finished the Ocean Steamship Co., which now occupies piers Nos. 35 and 39, South Wharves, will take possession of it.

CONTRACT PRICES.

CEDAR BLOCK PAVING.—Milwaukee, Wis.—Three contracts for paving with cedar blocks were awarded Sept. 10 to E. E. Naugle, of Chicago, at 85 cts., 93 cts. and $1.02 a sq. yd. for paving, and 30 cts. and 33 cts. a lin. ft. for curbing; Wm. Forrestal received one contract at 97 cts. for paving and 45 cts. for curbing.

SEWERS.—Latrobe, Pa.—L. W. Fogg, Engr., informs us that the contracts for constructing sewers, as advertised in Engineering News, has been awarded to Thos. Pottinger, the bids being as follows:

Quantities.		T. Pottinger, Latrobe, Pa.	Jno. Herrmann, Latrobe, Pa.	Caleb & Conture, Bridgeport, O.	Wm. Chisholm, E. Liverpool, O
12-in. pipe........	1,970 ft......	$0.41½	$0.51	$0.42	$0.81
24-in. "	2,000 "	.88¾	.99	1.08	1.64
Rock excavation...	250 cu. yds.	.35	.08	2.00	1.00
Brick masonry.....	12 " "	7.00	8.00	9.00	10.00
Manholes.....	40 vert. ft.	3.25	3.00	2.25	....
Iron castings.......	5 tons...	29.00	37.00	45.00	35.00

ROCK EXCAVATION.—Fostoria, O.—The contract for excavating rock for reservoir, screen chamber and sewage well for the sewage disposal plant has been awarded to Fred. Kleinman, of Findlay, O., at 70 cts. a cu. yd.; bond, $5,000.

SEWERS.—Bluffton, Ind.—Phillips & Goss, Consult. Engrs., Martinsville, Ind., inform us that the contract for constructing a sanitary sewer system 16 miles in length, bids received Sept. 5, has been awarded to Derheimer & Shanklin, and that for a system of storm sewers, bids received Sept. 14, to J. W. Wilding & Co., the bids being as follows:

Bids for Constructing Storm Sewers:

Quantities.		Derheimer & Shanklin, Fort Wayne, Ind.	J. W. Wilding & Co., Fort Wayne, Ind.	Weicking & Mason, Bluffton. Ind.
15-in. pipe sewer	374 ft.	$0.65	$0.42	$0.70
18-in. " "	9,460 "	.73	.48	.76
20-in. " "	350 "	.90	.64	1.10
24-in. " "	11,265 "	1.02	.83	1.36
30-in. " "	1,075 "	2.56	2.04	....
36-in. brick sewer	4,020 "	2.75	1.99	1.93
48-in. " "	2,020 "	3.72	2.65	5.00
24-in. c. i. pipe sewer..	180 "	3.00	3.25	....
Manholes	74...	18.00	25.00	19.50
Catch basins	62...	22.00	26.00	30.75

Bids Received at Bluffton, Ind., Sept. 5, for Constructing Sanitary Sewer System.

Bidder.	8-in. pipe, 72,639 ft.	10-in. pipe, 3,950 ft.	12-in. pipe, 3,055 ft.	15-in. pipe, 1,000 ft.	16-in. pipe, 750 ft.	8-in. c.i. pipe, 1,040 ft.	10-in. c.i. pipe, 240 ft.	Manholes, 59.	Lampholes, 72.	Miller flush-tanks, 36.
J. A. Wilding & Co., Fort Wayne, Ind.	$0.31	$0.416	$0.57	$0.70	$0.60	$1.30	$1.60	$26.00	$6.25	$49.00
Derheimer & Shanklin, Fort Wayne, Ind.	.29¾	.38	.50	.70½	.76½	1.10	1.10	18.00	6.00	[1]63.25
Savage & Sinclair, Chicago, Ill.	.28½	.39	.39	.68	.62	....	.62	24.00	5.00	[2]36.00
Fisher, Keefer & Bailey, Huntington, Ind.......	.33¾	.48	.55¾	.69½	.69	1.00	1.25	25.00	3.54	54.30
C. A. Paul, Fort Wayne, Ind.	.51	.60	.69	1.15	.85	....	2.47	25.00	11.50	63.00
Kerlin Bros. & Co., Pittsburg, Pa.	44½	.49	.55	.64	.70	.60	.80	37.00	8.50	60.00
T. J. Driscoll, Bluffton, Ind.	.42	.45	.52	.62	.65	.59	.82	36.00	8.50	55.00
George Plunkett, Toledo, O.	.38	.43	.49	.59	.65	.59	.78	35.00	8.50	57.00

[1] Rhodes-Williams flushtanks, $58.25; Van Vranken, $59.75. [2] All kinds at same price.

BRICK PAVING.—Milwaukee, Wis.—The contract for paving the hill in Biddle St., from Market St. to Broadway, was awarded Sept. 18 to Wm. Forrestal at $1.89 a sq. yd.; Geo. J. Markey bid $1.98; Jas. O'Donnell, $2; Vogt Fuel & Construction Co., $2.03.

DREDGNIG.—Milwaukee, Wis.—The following bids were received by Capt. Geo. A. Zinn, U. S. Engrs., Sept. 16, for 122,000 cu. yds. of dredging in Waukegan Harbor, Ill.:

	Per cu. yd.	
Green's Dredging Co., Chicago, Ill............	9	cts.
Charles Berner, Green Bay, Wis......	10.5	"
William A. Starke, Milwaukee, Wis....	9	"
Racine Dredge Co., Racine, Wis.............	9.5	"
Illinois Dredging Co., Chicago, Ill......	8	"
Arthur H. Vogel, Milwaukee, Wis.....	8.6	"

JETTY WORK.—Newport, R. I.—Maj. D. W. Lockwood, U. S. Engrs., has recommended that the contract for furnishing and placing stone in jetty at entrance to Great Salt Pond. Block Island, as advertised in Engineering News, be awarded to S. & E. S. Belden, Hartford, Conn., at $1.33 a ton; bids opened Sept. 21; appropriation available, $35,000.

CHANNEL EXCAVATION.—Boston, Mass.—The Metropolitan water board has awarded the contract for section No. 11 Nashua aqueduct to Moulton & O'Mahoney, the bids being as follows:

Bids for Section No. 11, Nashua Aqueduct (Open Channel), Boston, Mass., Sept. 15, 1896.

Bidder.	Excavation, Earth, 290,000 cu. yds.	Rock, 300 cu. yds.	Rip-rap, small stone, 1,000 cu. yds.	Rip-rap, large stones, 1,300 cu. yds.	Masonry: Cement concrete, 1,070 cu. yds.	Rubble-stone, in mortar, 660 cu. yds.	Split-stone, in mortar, 920 cu. yds.	Dim. stone, in mortar, 150 cu. yds.	Face dress'g, point'd wrk, 2,600 sq. ft.	Face dress'g, six-cut wrk, 350 sq. ft.	Lumber, in foundation, 5 M. ft.	Total.
Maney & Flaherty, Somerville, Mass....	$0.21	$1.25	$3.50	$3.50	$4.00	$4.00	$8.00	$15.00	$0.30	$0.50	$30.00	$86,960
Moulton & O'Mahoney, Boston, Mass...	.18	2.00	1.25	2.00	5.00	6.00	18.00	30.00	.75	1.00	30.00	89,470
Joseph D. Gennaro, Boston, Mass......	.22⅞	1.75	1.25	1.75	4.50	4.75	9.00	14.00	.40	.60	30.00	90,117
Shea, Chapman & McCalla, New York..	.22	1.25	.90	1.25	5.50	6.00	14.00	24.00	.35	.75	35.00	94,372
Perkins, White & Co., Charlestown	.24	3.00	2.50	3.00	5.00	6.25	8.00	16.50	.24	.50	30.00	97,159
McArthur Bros. & Co., Chicago, Ill.....	.256	1.50	.75	1.45	3.70	5.50	10.00	17.00	.20	.50	30.00	97,509
Thos. Nevins & Son, Orange, N J......	.235	3.00	2.00	3.00	5.00	8.00	11.00	35.00	.75	1.20	35.00	103,495
T. W. Kinser & Sons, Waltham, Mass..	.29	1.40	1.50	1.50	4.50	6.00	15.00	20.00	.40	.60	25.00	114,920
Gahan & Byrne, Chicago, Ill.	.329	1.30	1.25	2.00	4.00	3.50	10.00	18.00	.25	.50	30.00	119,115
C. Barton and Connors Bros., Lowell..	.32	2.00	2.00	2.25	5.00	5.50	10.00	18.00	.25	.50	40.00	120,230
C. E. Brodhead & Bro., Easton, Pa....	.30	2.00	1.50	2.50	6.50	6.50	11.00	31.00	.60	.75	35.00	120,362
H. P. Nawn, Boston, Mass.	.30	2.00	1.15	1.90	5.50	5.75	16.00	30.00	.50	.75	40.00	121,882
James McGraw, Fayville, Mass........	.35	2.00	1.00	1.25	4.75	5.75	9.00	15.00	.50	1.00	30.00	125,932
William T. Ross, Hampton, N. H.	.33	4.00	2.00	2.73	5.97	5.87	8.37	55.00	.40	.60	33.00	130,076
Winston & Co., Willow Springs, Ill...	.35	2.00	1.75	2.50	4.50	4.50	15.00	25.00	.70	1.00	28.00	134,745
William H. Ward, Lowell, Mass.......	.39	2.00	1.25	3.00	8.00	6.00	13.00	15.00	.30	.50	25.00	146,660
J. Wilder & Howe, Cambridge, Mass...	.39½	2.00	2.00	3.00	5.00	5.00	15.00	30.00	.50	1.00	40.00	149,850
Frank S. Robbins, Worcester, Mass...	.46	2,65	2.25	2.35	6.00	4.85	15.00	22.00	2.00	3.00	35.00	172,646
David Hall, Boston, Mass.	.49	1.75	3.00	3.00	6.00	7.00	11.50	23.00	.15	.25	20.00	175,172
Rexford Bros., New York, N. Y.......	.66	2.25	1.50	2.25	5.50	6.50	16.00	38.00	.50	.75	36.00	228,837
Collins & Ham, So. Boston, Mass.....	1.30	1.50	.90	2.75	5.50	5.50	6.00	15.00	.60	.90	38.00	401,275

QUAY WALLS.—Brooklyn, N. Y.—The following bids were received at Washington, Sept. 16, for constructing quay walls at the Brooklyn Navy Yard, as advertised in Engineering News; price is per lin. ft.:

	At coal wharf.	Inside Whitney Basin.
T. A. Walsh, 96 Water St., N. Y......	———	$123.00
Benner & Opdyke, Philadelphia........	$111.80	96.80
Thos. Dwyer, New York....	119.00	109.00
*P. Sanford Ross, Jersey City....	84.50	107.00

*Telegram requested that each of the two sealed bids be reduced $6 a lin. ft.

RETAINING WALL, ETC.—Rutland, Vt.—Sidney Smith, Cy. Engr., writes us that the contract for building concrete retaining wall and making excavations for channel for East Creek, at the water-works, as advertised in Engineering News, was awarded Sept. 16, to Willis, Young & Creed, of Rutland, at $2,544, as follows: Trench for wall, 150 ft., $1.33 a lin. ft.; channel excavation, 410 cu. yds., 95 cts. a cu. yd.; American concrete masonry, 40 cu. yds., $4.87; Portland concrete masonry, 270 cu. yds., $6.33.

ASPHALT PAVING.—Milwaukee, Wis.—The contract for paving Third St., from the Union depot to the Second Ward bank, 11,385 sq. yds. with asphalt on a concrete foundation, has been awarded to the Western Paving & Supply Co., at $2.29½ a sq. yd.; the Warren-Scharf Asphalt Paving Co. bid $2.33.

STEEL.—Boston, Mass.—The Boston Transit Commission has awarded the contract for furnishing steel for Section 8 of the subway to A. & P. Roberts Co., of Philadelphia, at $41.98 a ton; New Jersey Steel & Iron Co., bid $49.80; Boston Bridge Works, $59.90; Carnegie Steel Co., $44.80; Pennsylvania Steel Co., $44.80.

BRICK PAVING.—Marion, O.—The contract for paving North Main St. with brick has been awarded to P. Kelly & Co. ,of Marion, prices being given in a local paper as follows: Bolen brown granite blocks, 91½ cts. a sq. yd.; grading, 25 cts. a cu. yd.; circular curbing, 37½ cts. a lin. ft.; curbing, 37½ cts.; corner blocks, $3; redressing and resetting old curbing, 7 cts. a lin. ft.; redressing and resetting old corner blocks, $1.07; catch basins, $15; rebuilding and resetting old catch basins, $5; iron platforms 6 cts. a lb.; coal tar filler No. 6, 12 cts.; retarring stone, 15 cts. a ft.; concrete, $3.50 a cu. yd. James Williams, Cy. Clk.

TORPEDO BOATS.—Washington, D. C.—Bids were opened Sept. 18 for 13 torpedo boats to cost not more than $1,300,000, authorized by the last session of Congress; 3 to have a speed of 30 knots, the cost being limited to $800,000, and for the remaining 10 a total of $500,000 is allowed. It is stipulated that not more than three of the boats are to be constructed in one yard or by one party. If possible, at least one boat is to be built on the Mississippi, one on the Gulf of Mexico and one on the Missouri River. For the 10 smaller vessels the department asked for bids for two separate types, involving approximately 105 ft. length, 12½ ft. beam, 4½ ft. mean draft, 68 tons displacement. 850 HP. and 20 knots speed, armed with two single deck torpedo guns and one one-pounder rapid-fire rifle; no premium to be paid, but a deduction at the rate of $10,000 per knot to be exacted below 20 knots. On plans of their own builders were invited to propose 22½-knot boats, about 140 ft. long, 150 tons displacement and 1,700 HP. The bids are reported as follows: For the 30-knot boats the Union Iron Works, San Francisco, bid for one at $227,500; Bath Iron Works, Bath, Me., for two at $194,000 each, and for three at $189,000 each, and submitted another proposition for two at $235,000 each; Herreshoff Co., for one at $218,000 and for three at $206,000 each, and John H. Dialogue & Son, of Camden, N. J., for one at $260,000 or two at $255,000 each; the Columbian Iron Works, of Baltimore, offered one, two or three 20-knot boats for $49,000 each on the department plans, and on its own design for the same speed at $45,000 each; the same company asked $79,100 for 22½-knot vessels; Moran Bros. & Co., of Seattle, Wash., bid $59,840 for one 20-knot boat and $56,928 each for three of them; also three of the 22½-raters at $94,255 each; Bath company bid $80,000 each for three of the 22½ boats and $123,580 each for three special 25-knot vessels; all the Bath bids were accompanied by a proposition to use bronze in the construction of the vessels for a slight increase; Herreshoff company offered three of the 20-knot boats for $37,000 each, or one for $40,000, and also bids for the 22½-knot vessels as low as $80,000 each; the 22½-knot design, the exact duplicate of the "Cushing" was offered for $92,500 each, and with certain modifications for $78,500 each; Wolff & Zwicker, of Portland, Ore., offered to build 20-knot boats at $45,000 each for three, and 22½-knot boats for $75,100 each; Providence Steam Engine Co., of Rhode Island, bid $51,000 each for two of the department's 20-knot plans and $48,650 each for three of them; Lewis Nixon, of Elizabeth, N. J., has his own design for the little boats, and asked $69,000 for one, or $68,000 each for two; Charles Hillman Ship & Engine Co., of Philadelphia, asked $48,000 each for two on the department's plans, and John Dialogue asked $68,500 each for the same; George Lawley & Son, of South Boston, submitted their own designs for the 20-knot boats, asking $56,835 for each, if three were awarded them, or $61,500 for one. They offered 22½ knots as low as $78,800 each for three, or $83,500 for one. There was an irregular bid from Alexandria, Va., for an electric boat to run 35 knots, for which $530,000 was asked. Many of the companies made combination bids for two of one class and one of another, and some bidders furnished various designs, which will have to be carefully examined by the bureau of engineers before any award is made.

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INDUSTRIAL NOTES.

THE ELLIOT CAR WORKS, Gadsen, Ala., has received an order from the Florida East Coast Ry. for 50 flat and 300 ventilated box cars.

THE MICHIGAN PENINSULAR CAR CO., Detroit, Mich., is at work on an order for 400 coal cars for the Chicago, Rock Island & Pacific R. R.

THE NEW CASTLE STREET CAR MFG. CO., New Castle, Pa., has received the contract to furnish the New Castle Electric Co. with ten cars.

THE KENSINGTON ENGINE WORKS, Philadelphia, Pa., has the contract for a disinfecting plant for the Municipal Hospital, Pittsburg, to cost $3,099.

THE UNION CAR CO., Depew, N. Y., is building 1,000 gondola cars for the Philadelphia & Reading R. R. Co., and 250 of various kinds for the West Shore R. R. Co.

THE TERRE HAUTE CAR WORKS, Terre Haute, Ind., has the contract for 200 tank cars for the Indiana Pipe Line & Repairing Co., and for 150 refrigerator cars for the Vandalia Ry.

THE FORT PITT BRIDGE WORKS, Canonsburg, Pa., has been awarded the contract by the United States government for the iron for the movable dams on the Monongahela River.

THE ST. CHARLES CAR CO., St. Charles, Mo., has finished several new passenger cars for the Union Pacific, Denver & Gulf Ry. The company is also building 30 furniture cars for the same railway.

MR. W. W. CURTIS, 1108 Monadnock Block, Chicago, has the contract for the erection of two steel buildings and 855 ft. of steel viaduct for the Homestake Mining Co., Lead, S. Dak.; the buildings will be a boiler house, 50 × 50 ft., and a shaft house, 90 × 150 ft.

STANLEY G. FLAGG & CO., Philadelphia, Pa., writes us that they have for some time been making steel fittings for ice machines. The company supplies the fittings, flanged or screwed, and tested in sizes from ¼-in. to 4 ins. and larger by special order.

THE MARIETTA BOILER WORKS, Marietta, O., has finished its new plant and has begun operations. The plant has a capacity for the employment of 300 men. The company is capitalized at $100,000. Among its officers are J. J. Leidecker and Hughes Bros., of Butler, Pa.

THE PULLMAN CAR CO., Chicago, Ill., it is said, will shut down the freight car department indefinitely. This will throw 300 men out of work. The cause is lack of orders. The company is just finishing the last 1,000 of an order for 5,000 freight cars for the Baltimore & Ohio.

THE BIRMINGHAM CAR WHEEL WORKS, Birmingham, Ala., has added new machinery for the manufacture of tram car wheels. Heretofore the plant has only made large wheels. The company employs about 100 men and has been constantly at work since it started in the spring.

THE WESTINGHOUSE AIR BRAKE CO., Pittsburg, Pa., is reported to have been awarded the contract for furnishing the Pennsylvania R. R. with 30,000 sets of air brakes. The order will keep the company's plant in steady operation until March 1, 1897, and give employment to 1,500 men.

THE RAND DRILL CO., of New York city, has recently received an order from the Michigan Central R. R. for three air compressors for its shops in Detroit, Mich., Jackson, Mich., and St. Thomas, Canada. It has also an order from the Missouri Car & Foundry Co., of St. Louis, Mo., for two air compressors.

THE BROWN & SHARPE MFG. CO., Providence, R. I., announces that owing to the increased demand upon its hardening and annealing department, it has recently erected a building which will be entirely devoted to this branch of its business. The building is fitted with all modern improvements as well as many tools and appliances which are the outgrowth of twenty years' experience in this line of work.

THE BAGNALL & LOUD BLOCK CO., Boston, Mass., writes us that it is in receipt of a diploma, accompanied by a bronze medal, which were awarded for its exhibit at the Columbian Exposition. The award reads: "For a complete collection of wooden and steel frame blocks, embodying improvements of importance for better service in manila and wire rope systems for hoisting and transferring; also, for development in design of special sheaves of wood and metal, and adjustable bushings for same."

THE PENNSYLVANIA ASPHALT CO., Pittsburg, Pa., is building a plant in East Liberty, Pa. The company lately completed a like plant on South Ave., Allegheny. A. W. Sewall, Secy., is quoted as saying that the East Liberty plant would be ready to start in a couple of weeks. It will be used exclusively for mixing Trinidad Lake asphalt. The one in Allegheny will prepare for use the Bermudez asphalt. The company has recently been awarded street paving contracts in both cities.

THE BOSTON & LOCKPORT BLOCK CO., Lockport, N. Y., at a recent meeting of the directors elected Hon. Albert D. Bosson, of Boston, president to fill the vacancy caused by the death of the late President Beverly. Mr. Bosson is president of the Winnisimmet Savings Bank and formerly vice-president of the company. Mr. Frank Gebbie, Mgr. of the Mohawk Condensed Milk Co., St. Johnsville, was elected vice-president and A. C. Beverly, director. The treasurer reported the factories both at Lockport and Boston as running as usual, but with a lager assorted stock of goods on hand than ever carried before; he also reported a good number of orders received but usually small in amount, indicating that the trade is buying from "hand to mouth," which necessitates carrying a much larger stock in the factories than formerly.

THE ST. LOUIS IRON & MACHINE WORKS, St. Louis, Mo., has just completed the steam plant for the Maryville Electric Light & Power Co., Maryville, Mo., and the new plant is now in operation furnishing the entire city with lights, the equipment consisting of a boiler plant of 250 HP., a St. Louis Corliss engine of 250 HP., a Thomson-Houston arc dynamo of 40 lights capacity, a 50 K-W. General Electric alternator, and a 75 K-W. Fort Wayne alternator. This company is also furnishing the new power plant for the Trenton Thomson-Houston Electric Light & Power Co., Trenton, Mo., and will install a St. Louis Corliss engine of 125 HP. capacity, with line shafting, belting, etc. When the new machinery is installed and in operation the old plant will be abandoned. New dynamos will be purchased. It is also furnishing the entire steam plant for the new lighting station of the Bement Electric Light & Power Co., Bement, Ill.; this plant will have two horizontal steel boilers and one St. Louis Corliss engine of 125 HP.

Contract Work Should Always be Advertised in a Paper Read by Contractors.

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PERSONALS.

Mr. James Duncan, contractor, of New Castle, Pa., died Oct. 2, aged 77.

Mr. Homer A. Collar, City Engineer, of Grand Rapids, Mich., has resigned.

Mr. George F. Crandall, marine architect, of Newport, R. I., died Oct. 1, aged 65.

Mr. William L. Bull, President of the Minneapolis & St. Louis R. R., has resigned.

Mr. Frederick J. Starin, railway contractor, of Whitewater, Wis., died Oct. 3, aged 76.

Mr. W. H. Ferguson, Superintendent of the Dayton Coal & Iron Co., Dayton, Tenn., has resigned.

Mr. Charles S. Barintz has been appointed Receiver for the Middletown Gas Co., of Middletown, O.

Mr. F. C. Cleaver has been appointed Master Mechanic of the Louisville, Evansville & St. Louis R. R.

Mr. Charles E. Levy, President of the New Orleans & Western R. R., has resigned on account of ill health.

Mr. William L. Bull, President of the Minneapolis & St. Louis R. R., with headquarters in New York city, has resigned.

Mr. Henry Fink, Receiver for the Norfolk & Western R. R. Co., has been made President of the reorganized company.

Mr. W. H. Stark, Master Car Builder of the Wheeling & Lake Erie Ry., with headquarters at East Toledo, O., has resigned.

Mr. Sylvanus D. Locke, civil engineer, of Hoosick Falls, N. Y., died Sept. 27. He was at one time City Engineer of Janesville, Wis.

Mr. W. H. McDoel, Vice-President and General Manager of the Louisville, New Albany & Chicago Ry., has been appointed Receiver.

Mr. G. O. Viebahn, City Engineer, of Watertown, Wis., has resigned and will begin the study of law this fall, according to report.

Mr. O. E. Weller, of Boston, Mass., has been appointed Receiver for the Citizens Gaslight Co., of Reading, South Reading and Stoneham.

Mr. A. H. Kimball, Superintendent of the Fitchburg (Mass.) Gas & Electric Light Co., was married to Miss Carrie J. Bordwin, Oct. 1.

Mr. Frank J. Sarnan, Master Mechanic of the Manitou Beach R. R., has been appointed Superintendent, to succeed Mr. George C. Mills.

Mr. Charles D. Marvin, architect, of Brooklyn, N. Y., died Oct. 2, aged 38. He was a graduate of Cornell University in the class of 1878.

Mr. J. F. Sechler, Master Mechanic of the Louisville, Evansville & St. Louis R. R., with headquarters at Princeton, Ind., has resigned.

Mr. D. R. Murphy has been appointed Superintendent of the Duluth, Mississippi River & Northern Ry., to succeed Mr. H. O. Halsted, resigned.

Mr. W. Mason Smith, Vice-President of the New Orleans & Western R. R., has been elected President, to succeed Mr. Chas. E. Levy, resigned.

Mr. Edward C. Coggeshall, builder, of New York city, died Oct. 4, aged 67. He was born in Providence, R. I., and came to New York 29 years ago.

Mr. J. H. McGill has been appointed Master Mechanic of the New Orleans & Northwestern Ry., in charge of the locomotive and car departments and the water supply.

Mr. William C. Hoge, civil engineer, committed suicide at Santiago, Chili, Aug. 19. He was 65 years of age, a native of Kentucky and lived for several years in Monterey, Cal.

Mr. H. U. Wallace has been appointed Roadmaster of the First Division of the Illinois Central R. R., with headquarters at Chicago, Ill., to succeed Mr. A. Philbrick, transferred.

Mr. F. G. Patterson, President and General Manager of the Altoona, Clearfield & Northern R. R., with offices at Altoona, Pa., has been appointed Receiver on petition of its officers.

Mr. James Gaston has been appointed Master Car Builder of the Louisville, Evansville & St. Louis R. R., with headquarters at Princeton, Ind., to succeed Mr. W. E. Looney, resigned.

Mr. R. P. C. Sanderson, Division Superintendent of Motive Power of the Norfolk & Western R. R., with headquarters at Roanoke, Va., has resigned and the office has been abolished.

Mr. H. H. Havill has been appointed Engineer of Sewage Purification in the Twenty-sixth Ward Purification Works of Brooklyn, N. Y., by Commissioner Willis, of the Department of City Works.

Mr. John H. Winder, of Raliegh, N. C., until recently General Manager of the Seaboard Air Line, has formed a business connection with the banking firm of Sharp & Bryan, of New York city.

Mr. Francis Stokes, one of the two Receivers for the Susquehanna Water Power & Paper Co., of Harford county, Md., has resigned, and Mr. D. C. W. Smith has been appointed sole Receiver.

Mr. Jacob Bushong, of the firm of Bushong Bros., of Reading, Pa., died Sept. 24, aged 72. He was for a time engaged in metallurgical work, and built a large part of the present Schuylkill & Lehigh R. R.

Mr. J. A. Atwood, Principal Assistant Engineer of the Pittsburg & Lake Erie R. R., has been appointed Chief Engineer, to succeed Mr. F. E. House, now holding a similar position with the Butler & Pittsburg Ry.

Prof. C. M. Strahan and Mr. O. H. Sheffield, Assistant, of the Engineering Department of the University of Georgia, Athens, Ga., have formed a partnership as architects under the firm name of Strahan & Sheffield.

Mr. Frederic Harrison, Vice-President of the London & Northwestern Ry., of England, and Mr. Robert Turnbull, Superintendent of the same, are in Chicago, Ill., inspecting the operations of the roads centering at that city.

Mr. A. G. Wright, Roadmaster of the Louisville, New Albany & Chicago Ry., at Monon, Ind., has been appointed Division Master Mechanic of the Chicago, St. Paul, Minneapolis & Omaha Ry., with headquarters at Altoona, Wis.

Mr. Charles Worthington has resigned his position in the Department of Maintenance of Way of the Pennsylvania R. R., and is now engaged as estimating and designing engineer with the Pennsylvania Steel Co., Steelton, Pa.

Mr. John M. Perham, C. E., with the E. & T. Fairbanks Scale Co., St. Johnsbury, Vt., was married on Oct. 7 to Miss Mary A. Sheldon, of Burlington, Vt. Mr. Perham graduated from the University of Vermont in the class of 1890.

Mr. C. G. Sholes, Assistant Superintendent of Telegraph of the Atchison, Topeka & Santa Fe Ry., has been appointed Superintendent of Telegraph to succeed Mr. R. B. Gemmel, whose death was announced in our issue of Sept. 24.

Mr. William S. Wright, contractor and builder, of Brooklyn, N. Y., was run over in that city by a runaway horse attached to an express wagon, Oct. 5, and died two hours later in the Homeopathic Hospital, of which he was the builder.

Mr. Alexander Galloway, Superintendent of the Cincinnati, Hamilton & Indianapolis Division of the Cincinnati, Hamilton & Dayton R. R., has been appointed Superintendent of the Cincinnati Division to succeed Mr. F. A. Husted, resigned.

Mr. Thomas A. Lawson, Assistant Superintendent of the Wisconsin Division of the Chicago & Northwestern Ry., has been appointed Superintendent of the same division, to succeed Mr. W. A. Gardner, promoted, with headquarters at Chicago, Ill.

Mr. Henry S. Douglas, Assistant U. S. Engineer at Natchez, Miss., in charge of the levees from Warrenton to the mouth of the Red River, has been transferred to New Orleans, La., and will have charge of the harbor work near that city.

Mr. W. A. Scott, General Superintendent of the Chicago, St. Paul, Minneapolis & Omaha Ry., with headquarters at St. Paul, Minn., has been appointed General Manager, to succeed Mr. Horace G. Burt, promoted, and the former office will be abolished.

Mr. C. Kadono, who was formerly on the engineering staff of the Pennsylvania R. R., and who recently returned to Japan, has been appointed Assistant to the Chief Engineer and Engineer of Construction of the Sanyo Ry., with headquarters at Hiroshima.

Mr. Thomas J. English, Trainmaster of the Cleveland, Cincinnati, Chicago & St. Louis Ry., has been appointed Superintendent of the Sandusky Division, with headquarters at Springfield, O., to succeed Mr. William Gibson, whose resignation was noted last week.

Mr. Palmer H. Baermann, formerly City Engineer of Troy, N. Y., has been declared insane, and will be removed to an asylum. He is a graduate of the Rensselaer Polytechnic Institute and was for a time engineer of the Public Improvement Commission.

Mr. A. Sterle, Assistant Engineer in the office of Maj. William F. Smith, Corps of Engineers, U. S. Army, in charge of river and harbor work with headquarters at Wilmington, Del., has resigned to accept a position with the Light House Board at Tompkinsville, Staten Island.

Mr. Horace G. Burt, whose appointment to the office of General Manager of the Chicago, St. Paul, Minneapolis & Omaha Ry. we announced in our issue of July 2, has been appointed Third Vice-President of the Chicago & Northwestern Ry., to succeed Mr. W. H. Newman, whose resignation was noted in our issue of Sept. 24. Mr. Burt has also been promoted to be Assistant to the President of the former road.

Mr. Loewenherz, mechanical engineer, formerly of the Engineering Department of the Metropolitan Telephone & Telegraph Co, of New York city, is engaged upon the work now under execution by the recently incorporated New York Telephone & Telegraph Construction Co., for the Newark & Hudson Telephone Co., operating in Newark and Jersey City.

Capt. Harry Pollitt, of Gorton, England, Chief Locomotive and Marine Engineer of the Manchester, Sheffield & Lincolnshire Ry., and Mr. W. G. Percy Maclure, Assistant Engineer of the same, are visiting this country on a tour of inspection of some of the leading railways with a view of gaining practical knowledge of the best American methods in the mechanical departments.

Mr. Yen Nien, special commissioner of the Emperor of China, is in New York city on a tour of inspection of American manufactories, transportation methods and systems of municipal government. He is said to be an experienced mechanic, and one of the principal objects of his visit is to report on the latest improvements in machinery, particularly in weaving, shoemaking and similar industries. He will return to China by way of London, France and the Suez Canal.

Dr. T. M. Downe, President of Lehigh University, Bethlehem, Pa., and formerly Professor of Chemistry in the Massachusetts Institute of Technology, Boston, Mass., has been retained by City Engineer McClure, of Worcester, Mass., as an expert to study the sewage disposal problem in that city and decide upon the best means of meeting the present difficulty. Mr. Samuel M. Gray, engineer, of Providence, R. I., will be associated with him in his investigations.

Messrs. R. Ulrich and Chas. W. Leavitt, Jr., have opened an office at 15 Cortlandt St., New York city, for the practice of landscape architecture and engineering. Mr. Leavitt was formerly assistant engineer of the East Jersey Water Co., and Mr. Ulrich was at one time superintendent of the Hotel del Monte Park, Monterey, Cal., and for two years superintendent of Public Parks of Brooklyn, N. Y. He also had charge of landscape work at the World's Columbian Exposition, at Chicago, for Messrs. Olmstead & Elliott, consulting engineers.

Mr. Ernest S. Cronise, consulting mechanical engineer, of 37 Broad St., New York city, died at Ridgewood, N. J., Sept. 14, aged 35. He graduated from Stevens Institute, Hoboken, N. J., in June, 1881, and entered the employ of the Pennsylvania R. R. Co. the following spring. Later he became Assistant Superintendent of Car Construction of the West Shore R. R., at Pullman, Ill., and in 1885 entered the employ of Mr. Henry R. Worthington. He superintended the erection of various pumping engines, among them those of the Cincinnati (O.) Water-Works of 25,000,000 gallons capacity. In 1894 he opened an office in New York city as a consulting engineer, and made a commendable reputation as a railway expert.

Mr. Rokuro Oshima, Chief Mining Engineer of the Hokkaido Colliery & Ry. Co., of Sapporo, Japan, and Mr. M. Suzuki, General Manager of the Sumitomo Co., of Osaka, Japan, arrived in Tacoma, Wash., Sept. 28. The former is here on a tour of examination of the largest mining localities in this country, and will visit the mines of Washington, California, Colorado, Pennsylvania, Virginia and Alabama. He is interested in the mines in Hokkaido Island, about 800 miles from Tokio, the largest of which four, produces 300,000 tons of coal annually. It is his purpose to especially study the working of mines with electrical power and will probably have it introduced in his mines in Japan upon his return. Mr. Suzuki will accompany him on his trip eastward.

Mr. Robert Lewis Harris, M. Am. Soc. C. E., M. Inst. C. E., died of apoplexy, on Sept. 29, at Kearsarge Village, N. H., where he had been spending the summer. Mr. Harris was born about 62 years ago, and commenced his engineering career as a student with Ezra Lincoln, C. E., of Boston, Mass. After spending three years in Mr. Lincoln's office, he was, in 1852, made leveler and chief draughtsman on the Cleveland & St. Louis Air-Line Ry., under Chief Engineer E. G. Goddard. In 1854-55 he was assistant engineer on the Delaware Ry., under E. Q. Sewall, Jr.; in 1856 he was engaged on the Racine & Mississippi Ry., and in 1857 was resident engineer on the Milwaukee & Beloit Ry. He went to Honduras in the latter part of 1857, with the late John C. Trautwine, and spent a year there as resident engineer on the Inter-Oceanic Ry.; but he returned in 1858 and became a resident engineer on the Minnesota & Pacific Ry., the first railway west from St. Paul. In 1859-1860 he opened an office in Boston for general work, and then made an accurate survey of Portsmouth, N. H. From 1860 to 1871 Mr. Harris had an office in San Francisco, Cal., and was chief engineer of the Napa Valley, San Francisco & Oakland, Alameda, Valley, California Pacific and a number of other railways projected or built. In 1865 he located about 45 miles of the Central Pacific Ry., east of the summit of the Sierra Nevada Mountains. In 1871-1872 he was chief engineer of the Northwestern Construction Co., which built 225 miles of the Northern Pacific Ry. across Minnesota; from 1872 to 1874 Mr. Harris was chief engineer of the Chicago & Canada Southern Ry., and in 1875-1876 he held the same position on the Canada Central Extension, now a part of the Canadian Pacific Ry. From this time to 1883 he was engaged in various railway enterprises, chiefly in the Southern states, and from 1883 to 1891 he practiced as a consulting engineer in New York city. In 1893 he was chief engineer of the Wilkes Barre & Hudson River Improvement Co. Mr. Harris was made a Member of the American Society of Civil Engineers May 3, 1876, and a Member of the Institution of Civil Engineers, of Great Britain, on March 3, 1891. He contributed several papers to both the American and English societies. Mr. Harris has of late made his home at Portsmouth, N. H., and a widow and two daughters survive him.

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ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF KANSAS CITY.
Oct. 12. Secy., F. W. Tuttle, Baird Bldg.

DENVER SOCIETY OF CIVIL ENGINEERS.
Oct. 13. Secy., Walter Pearl, 36 Jacobson Bldg.

NORTHWEST RAILWAY CLUB.
Oct. 13. Secy., T. A. Foque, Soo Line, Minneapolis, Minn.

NORTHWESTERN SOCIETY OF ENGINEERS.
Oct. 13. Secy. D. W. McMorris, 635 Burke Block, Seattle, Wash.

WISCONSIN POLYTECHNIC SOCIETY.
Oct. 13. Secy., W. K. Means, Loan and Trust Bldg., Milwaukee, Wis.

NEW ENGLAND RAILROAD CLUB.
Oct. 14. Secy., Edw. L. Jones, P. O. box 1158, Boston.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS.
Oct. 14-16. Secy., D. L. Fulton, Allegheny, Pa.

ENGINEERS' CLUB OF CINCINNATI.
Oct. 15. Secy., J. F. Wilson, P. O. box 333.

NEW YORK RAILROAD CLUB.
Oct. 15. Secy., W. W. Wheatley, 168 Montague St., Brooklyn, N. Y.

TACOMA SOCIETY OF CIVIL ENGINEERS AND ARCHITECTS.
Oct. 16. Secy., 201 Washington Bldg., Tacoma, Wash.

ENGINEERS' CLUB OF COLUMBUS.
Oct. 17. Secy., M. S. Hopkins, Columbus, O.

ENGINEERS CLUB OF PHILADELPHIA.
Oct. 17. "Electricity in Gold Milling," by H. M. Chance. Secy., L. F. Rondinella, 1122 Girard St.

ENGINEERS' CLUB OF MINNEAPOLIS.
Oct. 19. Secy., Elbert Nexsen, 1620 S. E. 4th St., Minneapolis, Minn.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.
Oct. 20. Annual meeting, at Chicago. Secy., S. F. Patterson, Concord, N. H.

ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
Oct. 20. Secy., Daniel Carhart, 410 Penn Ave., Pittsburg.

WESTERN RAILWAY CLUB.
Oct. 20. Secy., W. D. Crossman, The Rookery, Chicago.

COLUMBIAN ENGINEERING SOCIETY.
Oct. 20. Secy., F. W. Hart, 15th and H Sts., N. W., Washington, D. C.

AMERICAN INSTITUTE OF ARCHITECTS.
Oct. 20, 21, 22. Annual meeting to be held at Nashville, Tenn. Secy., Alfred Stone, Providence, R. I.

AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 20-23. Annual convention, at St. Louis. Secy., T. C. Penington, 2020 State St., Chicago.

ENGINEERS' AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Oct. 21. Secy., F. Van Vleck, Los Angeles.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Oct. 21. Secy., J. A. Pilcher, Roanoke, Va.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Oct. 21. Secy., S. E. Tinkham, City Hall.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Oct. 21. Secy., R. W. Pope, 26 Cortlandt St., New York city.

WESTERN FOUNDRYMEN'S ASSOCIATION.
Oct. 21. Secy., A. Sorge, Marquette Bldg., Chicago.

ENGINEERS' CLUB OF ST. LOUIS.
Oct. 21. "Boiler Efficiency with Low Grade Fuels," by Wm. H. Bryan. Secy., Wm. J. Bryan, Turner Bldg.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Oct. 21. "Suspension Bridges—A Study," by Geo. S. Morison. Secy., C. W. Hunt, 127 E. 23d St., New York.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Oct. 22. Secy., C. H. McLeod, Montreal, Can.

ENGINEERING ASSOCIATION OF THE SOUTH.
Oct. 23. Secy., L. P. Brown, Nashville, Tenn.

INDIANAPOLIS ENGINEERING CLUB.
Oct. 24. Secy., C. C. Brown, Indianapolis, Ind.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
Oct. 27. "Gas Producers and the Mechanical Handling of Fuel for Same," C. L. Saunders. Secy., F. A. Colburn, Case Library Bldg.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Nov. 2. Secy., C. L. Annan, City Engineer's Office.

ENGINEERS' SOCIETY OF WESTERN NEW YORK.
Nov. 2. Secy., Carleton Greene, Library Bldg., Buffalo.

WESTERN SOCIETY OF ENGINEERS.
Nov. 4. Secy., N. L. Litton, Monadnock Block, Chicago.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Nov. 6. Secy., O. Von Geldern, 819 Market St., San Francisco, Cal.

RAILWAY SIGNALLING CLUB.
Nov. 10. Secy., Geo. M. Bashford, The Rookery Bldg., Chicago.

ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Nov. 12. Secy., James K. Zollinger, Norton Bldg., Louisville, Ky.

CENTRAL RAILWAY CLUB.
Nov. 13. Secy., H. D. Vought, Buffalo "Courier," Buffalo, N. Y.

MONTANA SOCIETY OF ENGINEERS.
Nov. 14. Secy., Forrest J. Smith, Denver Block, Helena.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 19. Kimball House, Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 1, 2, 3, 4. Meeting to be held at the Society House, New York city. Secy., F. R. Hutton, 12 W. 31st St., New York city.

NORTHWESTERN TRACK AND BRIDGE ASSOC.
Dec. 11. Secy., D. W. Meeker, St. Paul, Minn.

AMERICAN SOCIETY OF IRRIGATION ENGINEERS.
Dec. 11 and 12. Annual meeting to be held in Denver, Colo. Secy., John S. Titcomb, Room 36, Jacobson Bldg., Denver, Colo.

NATIONAL IRRIGATION CONGRESS.
Dec. 15, 16 and 17. Annual meeting to be held in Phoenix, Ariz. Secy., C. M. Heintz, Los Angeles, Cal.

NEW PUBLICATIONS.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—Report of the Proceedings of the Twenty-ninth Annual Convention, Held at Saratoga, N. Y., June 22, 23 and 24, 1896. Published by the Association; John W. Cloud, Secretary, Chicago, Ill. Cloth; 8vo.; pp. 365; plates 16.

This contains the constitution, list of members, reports of committees and full discussions of the subjects presented at the convention, the proceedings of which were reported in our issues of June 25 and July 2, 1896. It is well printed on good paper, and is well illustrated, most of the cuts being inserted in the text, but some of the illustrations on the folding plates might have been reduced to a smaller scale and put on the pages. This is the first year that the report has been issued in cloth binding.

MASTER CAR BUILDERS' ASSOCIATION.—Report of the Thirtieth Annual Convention, held at Saratoga, N. Y., June 17, 18 and 19, 1896. Published by the Association; John W. Cloud, Secretary, Rookery Building, Chicago, Ill. Cloth; 8vo.; pp. 531; plates, 33.

This volume contains the full reports, discussions and illustrations of the various subjects under discussion at the convention, the proceedings of which were reported in our issue of June 25. It is the best style of volume of the M. C. B. reports which has yet appeared, and it is well printed on good paper. The arrangement of the plates is defective in that they are all folding plates, folded so closely that the loose edge is close against the binding, making it very liable to crease and bend the plate in closing the volume. This is the more objectionable in that the lack of visible title on the folded plates makes it necessary to partly unfold each plate in looking for any particular one. The illustrations on single pages are much more convenient.

STANDARD TABLES.—The Carnegie Steel Co., Limited, 1896. Pittsburg, Pa. 8 sheets; 7¾ × 11¾ ins.

Mr. F. H. Kindl, Structural Engineer of the Carnegie Steel Co, sends us a set of these tables which have been compiled by him for use in preparing shop details for structural work. By their use it is hoped to avoid the complications which arise from different individual practice. They include tables of lengths of shop-driven rivets for punched work, clearance for driving, draftsman's signs for countersinking, distance from center of beams and from back of channels to end of framed beams, channels and angles, center distance of holes for connecting angles, sizes of wall anchors, size and weight of connection angles, details of connections of I-beams to Z-bar columns and to cast-iron columns, etc. The tables will undoubtedly be of value to structural engineers, but it is to be regretted that they have not been printed in a better form. The sheets are very poor photo-reproductions from the draftsman's originals. It would have been much better if the tables had been set up in type, and if the illustrations had been engraved from well-executed drawings, and then the whole printed either in such shape that it could have been inserted into the Carnegie Pocketbook, or else in the standard circular size of 6 × 9 ins.

LITERARY MAGAZINES.—In the "Nineteenth Century," for September, we find a paper by Mrs. Percy Frankland with the prosaic title "Boiling Milk," Our readers will recall Mrs. Frankland's contributions to the columns of Engineering News on sanitary subjects. Her present paper is an excellent summary of the reasons why milk which has been sterilized by boiling should be used not only for infants and children but for all purposes. In "The Contemporary Review," Mr. W. R. Lawson writes on "American Currency Cranks," and pokes fun at the efforts of political speakers to make out that English monetary institutions are the enemies of the United States. We venture to quote the following:

> In the rabid fancy of the Silverite and the Populist, Lombard Street is a golden-clawed vampire sucking the life blood of American industry.
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> But our base designs have been seen through at last, and, in the proud language of Mr. Shackelford, of the Eleventh Ward, Cook County, Illinois, "the Democrats mean, and the American people mean, to throw defiance in the face of England." Alas, England has hitherto remained in happy ignorance of the danger that threatens her. Reuter's telegrams, too fully occupied with less important affairs, have not furnished her with a single sample of the thunder-bolts which, during the Convention, Chicago hurled at her devoted head. She little recks the fate that hangs over Lombard Street; little dreams that her gold standard and her "monetary despotism" are marked out for a common doom. Perhaps not a dozen persons in England have read these Chicago speeches at length, or bestowed a thought on the mischief they may do to Americans themselves should they pass unchallenged. The present writer has studied them professionally as well as theoretically, and, knowing something of the real Lombard Street, he believes that impartial, unbiased Americans will be glad to know how widely it differs from its Chicago caricature.
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> The Lombard Street of stump oratory is the headquarters of the gold monopolists, the temple of dear money and low prices, the happy hunting-ground of creditors, mortgagees, landlords, financiers, and the whole of the "predatory and piratical element" which, in the elegant language of a Kansas delegate, "loots the Treasury, stifles commerce, paralyzes industry and plunders the world." Lombard Street is the universal enemy against which a holy war is to be proclaimed by all the bona fide producers, with the tramps and demagogues at their head. Possibly not a single orator who helped to draw this fancy picture and to pile lurid colors on it has ever seen Lombard Street or read a plain account of its actual business. If they had to spend a day in it they might be surprised to find that it is not paved with gold, and that there is less show of metallic money in it than in Chicago itself. It might astonish them further to discover that its fabled monopoly is the very freest of free trade; that its alleged tyranny over silver-using countries is in the nature of things an utter impossibility; and that its blood-sucking propensities are restrained by a glut of money which makes lenders there thankful to earn as much interest in a year as they would get in a month or even in a week in the Western States.
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> The real Lombard Street deals in money of all kinds and qualities; not gold money alone, or silver money, or paper, but any form of monetary material. It deals honestly all round, and, by so doing, it has become the monetary center of the world. It undertakes to convert at sight the currency of any country into that of any other country. In the process it uses very little gold, and can turn over millions sterling with less handling of coin than takes place every day in a second-rate California city. Gold as such has had little to do with the prosperity or the power of Lombard Street. Silver might have served equally well if it had been adhered to with equal persistence and had its market value been as jealously safeguarded. It was not the yellow metal, but the standard and its strict maintenance that possessed the magical virtue. * * * * * *
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> If there be a class of producers who above all others have benefited by the facilities that Lombard Street has provided for turning their produce into sound money it is the Grangers and Populists, who at Chicago screeched about "the monetary despotism of the same old stepmother." Fifty-cent wheat, twenty-cent corn, and seven-cent cotton are calamities without doubt, and for the sake of the British as well as the American farmer a remedy for them would be highly desirable. But what has Lombard Street had to do with them? Without Lombard Street they might have been very considerably worse; nay, it is certain they would have been. Suppose that British ports had been barred against American produce, as French and German ports have been, how much less would the Western farmer be getting for his crop than the slender pittance which, in order to complete his ruin, he now seems anxious to receive in silver instead of gold?
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> The South and West are both under deep obligations to the much-abused Lombard Street for throwing open to them the best and most profitable foreign markets they possess. If, as we believe, they get better returns for their exports to England than to any other country, they have Lombard Street and its unrivaled exchange facilities to thank for it. But they have got it into their heads that Lombard Street is the Juggernaut that has crushed silver. It is on a gold basis certainly, but it has never raised a finger to hurt silver or to discourage the use of it by countries that prefer it. Lombard Street has always said in such cases, "Have a silver standard by all means, and make the best you can of it, so long as you let those who prefer a gold standard also do the best they can with theirs."

Along with this discussion, Mr. Lawson explains in detail just what business is done in Lombard St., and just what its relations are to the financial and mercantile world. He also frankly confesses the weaknesses and limitations of the gold standard and expresses the opinion that it may yet become necessary to suspend the free coinage of gold. The paper is one which will interest every student of the currency question. The editorial review on "Money and Investments" in the same magazine discusses American financial affairs in considerable detail, and is of especial interest as showing how the British investor is coming to regard the American securities which he is asked to purchase.

The leading article in the "Popular Science Monthly" is a paper on "The Metric System," by Dr. T. C. Mendenhall, which is written as an answer (and a very excellent and pointed one it is) to the attack on the metric system by Mr. Herbert Spencer, which was published in a recent number of the same magazine. We advise any who are interested in the question to read the two articles. Even those not interested in the subject will relish immensely the keen wit with which the American demolishes the ponderous logic of the distinguished Englishman. In the same magazine Mr. Chas. Howard Shinn tells in an interesting manner the history of Nevada silver mining, a romantic story and one with much of especial interest to engineers. There is a short article on "Acetylene," which would have been timely once but is an old story now.

"The North American Review" is chiefly devoted to politics this month. Under the title "A Hindrance to Our Foreign Trade," the Consul-General of the United States in China explains how impossible it is for our consuls to do efficient work when their tenure of office is interrupted by changes in the Administration. We have nowhere seen a better description of the difficulties which lie in the way of making our consular service the aid to the extension of our commerce that it should be than is given in this article. The writer also explains what an enormous market for American manufactures China is destined to become, if only we are successful in securing our share of its trade. Another paper in the same magazine deserving mention here is "Our Neglected Shipping," by Mr. Alex. R. Smith, Secretary of the American Merchant Marine Association.

"Harper's" this month has a long paper with the rather broad title "Electricity," by Mr. R. R. Bowker, the managing Vice-President of the Edison Electric Illuminating Co., of New York city. The paper is an excellent summary in a brief space of what has been accomplished to the present time in the various fields in which electricity has been applied, and its non-technical description of many matters may clear up clouds in the minds of some engineers as well as laymen. In the "Editor's Study," Mr. Charles Dudley Warner has an interesting discussion of the forestry question and of the steps now being taken looking to the preservation of the forests on the public lands.

"The Review of Reviews" is political in its contents entirely this month, but is none the less of interest for that. Both in its editorial and in its contributed articles it gives a broader and more enlightened view of the campaign and of the questions which are being fought over than we have found in any other periodical.

In "Scribner's," Mr. Francis V. Greene writes on "The Government of the Greater New York," and discusses principles of municipal government so ably that his paper will interest many who do not reside in the future metropcIis. There is also an entertaining account of the cruise of the "Almeria," the United States supply vessel which makes an annual visit to every lighthouse and beacon on the Atlantic and Gulf coasts.

TRADE PUBLICATIONS.

RAILWAY EQUIPMENT.—M. Mitshkun & Co., Detroit, Mich. Pamph.; 4 × 6 ins.; pp. 32; illustrated.

This is a catalogue of second-hand locomotives, cars, relaying rails, track supplies, logging railway equipment, etc., on hand and for sale by the above named company.

THE TAYLOR GAS PRODUCER.—R. D. Wood & Co., 400 Chestnut St., Philadelphia, sole makers. Pamph.; 6 × 9 ins; pp. 56.

This pamphlet describes the well-known Taylor gas producer in its different forms, and contains a brief treatise on gas fuel and its application to manufacturing purposes.

WATER-TUBE MARINE BOILERS.—J. I. Thornycroft & Co., London. John Platt & Co., 97 Cedar St., New York, agents for the United States. Pamph.; 7½ × 9¾ ins.; pp. 8.

This pamphlet briefly describes three forms of the Thornycroft marine boiler which is now extensively used in Great Britain on yachts, torpedo boats, etc. It is claimed that 200,000 HP. are already in use.

MECHANICAL STOKERS.—The Playford Stoker Co., Cleveland, O. Pamph.; 6 × 9 ins.; pp. 11.

This pamphlet illustrates the Playford mechanical stoker and smokeless furnace, used especially for bituminous coal. The stoker is of the chain grate type, with a fire brick arch over a portion of the grate in front of the coal hopper.

LONG BURNING ARC LAMPS.—General Electric Co., Schenectady, N. Y. Paper; 4¼ × 6⅝ ins.; pp. 12; illustrated.

These are 100-hour and 150-hour arc lamps for use on direct current incandescent circuits. They require trimming and new carbons only about eight times in a year. The arc is entirely enclosed by an inner globe, and the latter is surrounded by an outer globe.

BELT CONVEYORS.—Robins' Conveying Belt Co., 64 Cortlandt St., New York. Pamph.; 6 × 9 ins.; pp. 12.

This circular contains photographs and descriptions of the operation of the Robins' system of belt conveyors. One of the cuts shows a belt conveying 100 tons of coarsely-broken iron ore per hour up an incline of 25½°, elevating it about 40 ft. This system of conveying and elevating seems likely to come extensively into use.

THE ARTIFICIAL PRESERVATION OF TIMBER.—Otis Allen & Son, Lowell, Mass. Pamph.; 7 × 11 ins.; pp. 27.

This pamphlet contains an interesting account of the "kyanizing" of timber, by impregnation with bichloride of mercury or corrosive sublimate. The process has been in use more or less since 1832. Numerous photographs of sticks of timber which have been kyanized and buried underground used as railway ties, or exposed in fences, bridges, etc., for long periods, in some cases over 40 years, without decaying, are shown. The kyanizing works of Otis Allen & Son contain tanks having a capacity of 150,000 ft. of lumber. The present price of kyanizing is $8 per 1,000 ft., board measure, and $1 per 1,000 for shingles.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work. Place.	See Eng. News.
Oct. 8.	Bridge, San Jose, Cal.	Oct. 1
Oct. 8.	Repairs to hospital building, New York.	Oct. 1
Oct. 8.	Grading, Scranton, Pa.	Oct. 1
Oct. 8.	Railway repairs, etc., San Francisco, Cal.	Oct. 1
Oct. 8.	Steam fire engine, Cleveland, O.	Oct. 1
Oct. 8.	Dredging in Christiana River, Del. Advertised, Eng. News, Sept. 24 and Oct. 1.	Sept. 24
Oct. 8.	Plumbing, heating, etc., Toronto, Ont.	Sept. 24
Oct. 8.	Iron and steel bridge, Big Timber, Mont.	Sept. 24
Oct. 8.	Dikes, etc., Portland, Ore. Advertised, Eng. News, Sept. 24 and Oct. 1.	Sept. 24
Oct. 8.	Asphalt and granite paving, Cincinnati, O.	Sept. 24
Oct. 9.	U. S. building work, Martinsburg, W.Va. Advertised, Eng. News, Sept. 24 and Oct. 1.	Sept. 24
Oct. 9.	Masonry bridge piers (5), Portland, Me. Advertised, Engineering News, Sept. 24.	Sept. 24
Oct. 9.	Electric light plant, Bryon, O.	Sept. 24
Oct. 9.	Sewer bonds, etc., Niagara Falls, Ont.	Oct. 1
Oct. 9.	Stone (200 cords), Arcadia, Wis.	Oct. 1
Oct. 9.	**School building, Kilbuck, O.**	**Oct. 1**
Oct. 9.	Electric light plant, Ogdensburg, N. Y.	Oct. 8
Oct. 9.	Smokestack, St. Paul, Minn.	Oct. 8
Oct. 10.	School building, Tulare, Cal.	Oct. 8
Oct. 10.	Repairing bridge, Auburn Cal.	Oct. 8
Oct. 10.	Brick store, Blair, Neb.	Oct. 8
Oct. 10.	Warehouse, St. John, N. B.	Oct. 8
Oct. 10.	Sewer, St. Paul, Minn.	Oct. 8
Oct. 10.	**Sewers, Washington, D. C.**	**Oct. 1**
Oct. 10.	Repairs to post office, Macon, Ga.	Oct. 1
Oct. 10.	Earth excav. (10,000 yds.), Slatington, Pa.	Oct. 1
Oct. 10.	County court house, Wise, Va.	Sept. 17
Oct. 12.	Officers' quarters, Fort Ethan Allen, Vt.	Sept. 24
Oct. 12.	Extending levee, Arkansas City, Ark.	Sept. 24
Oct. 12.	Bridge, Houston, Tex.	Sept. 24
Oct. 12.	**School building, Pittsburg, Pa.**	**Oct. 1**
Oct. 12.	**Steel bridge, Oakland, Cal.**	**Oct. 1**
Oct. 12.	Hook and ladder truck, Los Angeles, Cal.	Oct. 1
Oct. 12.	Paving (11,500 sq. yds.), Jersey City, N.J.	Oct. 8
Oct. 12.	Grading, St. Paul, Minn.	Oct. 8
Oct. 12.	Hospital buildings, etc. (5), New York.	Oct. 8
Oct. 12.	Bridge substructure, Indianapolis, Ind.	Oct. 8
Oct. 12.	Bridge, Los Angeles, Cal.	Oct. 8
Oct. 12.	Sewers, Chicago, Ill.	Oct. 8
Oct. 12.	Water service pipes (8 sts.), Chicago, Ill.	Oct. 8
Oct. 12.	Grading and sewers, New York, N. Y.	Oct. 8
Oct. 12.	Grading 50 acres at Sandy Hook, N. J.	Oct. 8
Oct. 12.	Brick stable, Philadelphia, Pa.	Oct. 8
Oct. 12.	Ventilating, etc., Pittsburg, Pa.	Oct. 8
Oct. 12.	Iron and wood bridge, Fresno, Cal.	Oct. 8
Oct. 13.	Grading, etc., Kearney, N. J.	Oct. 8
Oct. 13.	**Asphalt paving, Brooklyn, N. Y.**	**Oct. 8**
Oct. 13.	Improving streets, Peru, Ind.	Oct. 8
Oct. 13.	Pier work, New York, N. Y.	Oct. 8
Oct. 13.	Belt power elevators, etc., Wash. navy yard. Advertised Engineering News, Oct. 8.	Oct. 8
Oct. 13.	Remodeling elevator, Washington, D. C.	Oct. 8
Oct. 13.	Tin roof for U. S. building, Baltimore, Md.	Oct. 8
Oct. 13.	Brick sewers, Boston, Mass.	Oct. 8
Oct. 13.	Macadamizing, Hammond, Ind	Oct. 1
Oct. 13.	Paving bonds ($130,000), Macon, Ga.	Sept. 24
Oct. 13.	Water and light bonds, Anaheim, Cal.	Sept. 17
Oct. 14.	School building, Hoboken, N. J.	Sept. 24
Oct. 14.	Grading (9 miles), Cleveland, O.	Sept. 24
Oct. 14.	Improving bayou, New Orleans, La.	Oct. 1
Oct. 14.	Cement sidewalks, etc., Indianapolis, Ind.	Oct. 8
Oct. 14.	Electric light fixtures, etc., New York, N.Y.	Oct. 8
Oct. 14.	Elec. l't plnt and bonds, Grand Haven, Mich.	Oct. 8
Oct. 14.	Bridge abutments, Redlands, Cal.	Oct. 8
Oct. 14.	Wharf, Boston, Mass.	Oct. 8
Oct. 14.	Bridge girders, Indianapolis, Ind.	Oct. 8
Oct. 14.	Brick and pipe sewers, Indianapolis, Ind.	Oct. 8
Oct. 14.	Filling in wharf, Brooklyn, N. Y.	Oct. 8
Oct. 15.	Lighthouse work, Brazos River, Tex.	Oct. 8
Oct. 15.	Repairing r'y bridges, etc., San Francisco.	Oct. 8
Oct. 15.	Rebuilding flume, Cleveland, O.	Oct. 8
Oct. 15.	Masonry, abutments, etc., Buffalo, N. Y.	Oct. 8
Oct. 15.	Church building, Raleigh, N. C.	Oct. 1
Oct. 15.	River bank protection, Evansville, Ind. Advertised, Engineering News, Oct. 1.	Oct. 1
Oct. 15.	Bridges (2), Elk Point, S. Dak.	Sept. 24
Oct. 15.	Asphalt paving (5,000 sq. yds.), Niles, O. Advertised, Engineering News, Sept. 24.	Sept. 24
Oct. 15.	Electric lighting, Manistee, Mich.	Sept. 24
Oct. 15.	Pipe (1,215 tons, 30-in.), Evansville, Ind. Advertised, Engineering News, Sept. 24.	Sept. 24
Oct. 15.	County court house, South Bend, Ind.	Sept. 10
Oct. 16.	Railway bridge, Rumford Falls, Me. Advertised, Eng. News, Oct. 1 and 8.	Oct. 1
Oct. 16.	Water pipe (48 and 42-in.), Boston, Mass. Advertised, Engineering News, Oct. 8.	Oct. 8
Oct. 16.	Bridge, Indianapolis, Ind.	Oct. 8
Oct. 16.	Sewer, Richmond, Ind.	Oct. 8
Oct. 17.	Water main, East Cleveland, O.	Oct. 8
Oct. 17.	Well, Eagle Bend, Minn.	Oct. 8
Oct. 17.	School building, Whittier, Cal.	Oct. 8
Oct. 17.	Pumping engine, Kansas City, Mo. Advertised, Eng. News, Sept. 17 and 24.	Sept. 17
Oct. 17.	Dredging, Philadelphia, Pa.	Sept. 24
Oct. 17.	Dredging in Lemon Creek, N. Y. Advertised, Eng. News, Sept. 24 to Oct. 15.	Sept. 24
Oct. 17.	Increased water supply, Watervliet, N. Y.	Sept. 24
Oct. 17.	Paving bonds ($17,000), Niles, O. Advertised, Engineering News, Sept. 24.	Sept. 24
Oct. 17.	Brick arch (60 ft.), Mansfield, O.	Oct. 1
Oct. 19.	Pipe sewer, Fresno, Cal.	Oct. 1
Oct. 19.	Dredging in South River, N. J. Advertised, Eng. News, Sept. 24 to Oct. 15.	Sept. 24
Oct. 19.	Brick paving, Cincinnati, O.	Sept. 24
Oct. 19.	**Paving, Toledo, O.**	**Oct. 1**
Oct. 19.	Water main, Blue Island, Ill.	Oct. 8
Oct. 19.	Survey and maps, Sea Cliff, L. I. Advertised, Enginering News, Oct. 8.	Oct. 8
Oct. 20.	Hospital building, Verona, N. J.	Oct. 8
Oct. 20.	Bank building, Camden, N. J.	Oct. 8
Oct. 20.	Heating and ventilating, Allegheny, Pa.	Oct. 1
Oct. 20.	Sewer bonds ($212,000), Cleveland, O.	Oct. 1
Oct. 20.	Water-works, Blanchester, O.	Oct. 1
Oct. 20.	Water extensions, Pueblo, Colo.	Oct. 1
Oct. 20.	Drainage channel, Peoria, Ill. Advertised, Eng. News, Sept. 17 to Oct. 1.	Sept. 17
Oct. 20.	Rip-rap embankment at Agate Bay, Minn. Advertised, Eng. News, Sept. 24 to Oct. 15.	Sept. 24
Oct. 20.	**Electric light plant, Blanchester, O.**	**Oct. 1**
Oct. 20.	**Plumbing, heating, etc., Buffalo, N. Y.**	**Oct. 1**
Oct. 21.	Dredging harbor at Newport, R. I. Advertised, Eng. News, Oct. 1 to 15.	Oct. 1
Oct. 22.	Barracks, stable, etc., Fort Riley, Kan.	Oct. 1
Oct. 22.	Repairing sidewalks, Cincinnati, O.	Oct. 1
Oct. 22.	Jetty and levee work at San Diego, Cal.	Oct. 1
Oct. 22.	Improving roads, Stapleton, N. Y.	Sept. 24
Oct. 23.	Heating, ventilating, New Berne, N. C.	Oct. 8
Oct. 23.	Laying 60-in. intake pipe, Duluth, Minn.	Oct. 8
Oct. 23.	Water gates, valves, etc., Duluth, Minn.	Oct. 8
Oct. 24.	Macadamizing, etc., Pleasant Ridge, O.	Oct. 8
Oct. 24.	Dredging in Chicago River, 1,300,000 yds. Advertised, Eng. News, Oct. 1 to 22.	Oct. 1
Oct. 26.	**Dredging** Elizabeth River, Va. Advertised, Eng. News, Oct. 1 and 15.	Oct. 1
Oct. 26.	Brick paving, Marietta, O.	Oct. 8
Oct. 27.	Ditch at U. S. bldg., Omaha, Neb. Advertised, Eng. News, Oct. 8 and 15.	Oct. 8
Oct. 27.	Reservoir, dam, etc., New York, N. Y.	Oct. 8
Oct. 28.	Interior building work, Washington, D. C.	Oct. 8
Oct. 28.	Sewer, Hoboken, N. J.	Oct. 8
Oct. 28.	Breakwaters, New London, Conn. Advertised, Eng. News, Oct. 1 to 22.	Oct. 1
Oct. 29.	**Sand, Philadelphia, Pa.**	**Oct. 1**
Oct. 29.	U. S. bldg. work, New York, N. Y.	Oct. 8
Oct. 29.	Rock for jetty, Coos Bay, Ore. Advertised, Eng. News, Oct. 8 to 22.	Oct. 8
Oct. 29.	Iron and steel bridges, Cleveland, O.	Oct. 8
Oct. 29.	Sewers, Marietta, O.	Oct. 8
Oct. 31.	**Extension to court house, Lancaster, Pa.** **Advertised, Eng. News, Oct. 1 to 22.**	**Oct. 1**
Nov. 2.	**Chemical fire engine, etc. (2), Glenfield, Pa.**	**Oct. 1**
Nov. 2.	Dredging plant, Wilmington, N. C. Advertised, Eng. News, Oct. 8 to 22.	Oct. 8
Nov. 2.	Pipe sewers, Sonora, Cal.	Oct. 8
Nov. 5.	Lighthouse, Boston Harbor, Mass.	Oct. 8
Nov. 5.	Street railway franchise, Santa Rosa, Cal.	Oct. 8
Nov. 5.	Hotel, theatre, etc., Washington, D. C.	Oct. 1
Nov. 9.	Lighthouse tower, New Bedford, Mass.	Oct. 8
Nov. 14.	Pumping engines (6), Chicago, Ill. Advertised, Eng. News, Sept. 24 to Oct. 22.	Sept. 24
Nov. 14.	Grain elevators, etc. (2), Galveston, Tex.	Sept. 24
Nov. 14.	Sewage pumping mach'y, Mexico, Mex.	Aug. 27
Nov. 17.	Hospital building, Cherokee, Ia.	Oct. 8
Nov. 24.	County jail and residence, Atlanta, Ga.	Oct. 1
Dec. 30.	Steel rails (150,000 tons), Sydney, N.S.W. Advertised, Eng. News, Sept. 3 and Oct. 1.	Aug. 6
Jan. 8.	Wooden bridge (220 ft.), Tillamook, Ore.	Oct. 8

RAILWAYS.

East of Chicago.

BUTLER & PITTSBURG.—Press dispatches state that the work is over half finished. Over 3,000 men are at work. As stated in our issue of July 16, C. I. McDonald, Penn Building, Pittsburg, Pa., is the principal contractor. Of the sub-contractors, Peyton & Reynold, of Charleston, W. Va., are at work in a deep cut through almost solid rock. They have 1½ miles of the contract and the grading is finished in many parts. A. M. Winsper has 115,000 cu. yds. of excavation through rock 60 ft. deep, which is difficult work. F. A. Masselli, of Columbus, O., has two miles of work, and has opened every cut with his force of 150 men. Admirable progress has been made, and work has just begun on a heavy cut, having in it over 40,000 cu. yds. of excavation. C. B. Donaghy has two miles of heavy work and has it nearly completed. The Ferguson Contracting Co. is also nearly through. Two miles of heavy cutting have been brought into good shape by Dell & Diulus Bros. The only tunnel on the road is 350 ft. long, which is being driven by Contractor Simon Harrold. This tunnel is one of the most important contracts on the line. It is almost two miles long, with its approaches, and 75,000 ft. of earth and rock will be taken out of the approaches alone. The most important contract on the entire road is that at the Summit cut, which Contractor McDonald is doing. Over 162,000 cu. yds. of earth will have to be taken out, and 200 laborers are employed. The general contractor has also a cut 30 ft. deep and 500 ft. long at Brimstone Corners over half done, and the digging is being pushed with great speed. Spellacy & Ellwier, of Columbus, who have almost two miles of digging, have 150 men at work, and D. A. Sanders has 140 men and 40 horses on his half-mile contract. The cuts in these portions are heavy, deep and rocky, and the advance made is necessarily tedious. Ch. Engr., F. E. House; Pres., Jas. T. Odell.

BENTON HARBOR & EASTERN TRANSIT.—This railway, it is said, is to be built from Benton Harbor, Mich., to connect with the Grand Trunk early next year. The Arnold Transportation Co. is said to have the deal in hand and will run its boats in connection with the line.

CINCINNATI, UNION CITY & CHICAGO.—It is announced that this railway, projected from Union City to Huntington, Ind., will soon be built. The panic of 1893 caught the promoters of the enterprise, work was suspended, and the company has been involved since in litigation over claims for labor and material. John H. Bliss and F. W. Short, of Chicago, have acquired nearly all of these claims and secured control of the property. It is stated that enough funds will be at hand to assure the resumpton of work on the road, which is partially graded.

CARP & ALMONTE.—It is stated that this railway is to be built between Carp and Almonte, Ont.; Surveyors Bell & Wilkie are making a preliminary survey of the proposed line to be paid for by subscriptions from citizens of the two towns.

DEPEW & TONAWANDA.—This railway, about 12 miles long, near Buffalo, is completed, and will soon be formally opened for travel. It is a branch of the Lehigh Valley, and extends from the new town of Depew to North Tonawanda.

DEAD RIVER LOGGING.—A press dispatch from Skowhegan, Me., states that E. C. Greenwood has completed the survey for this proposed logging railway. The work will not be commenced this fall but will be built next spring and summer. There has been no contract for the work yet. This road will start from Dead River, in Crocker township, and extend ten miles, ending in the valley of the Carrabassett.

ERIE.—Mayor P. F. Wanser has announced that the contract for the elevation of the Erie R. R. tracks will be ready by the end of next week, and that the work will probably begin as soon as the contract is signed.

GOSHEN & WABASH.—This company has been formed to build a railway from Goshen, via Ligonier, to Elkhart, Ind. Directors: J. J. Burns, W. L. Stone, K. E. Ripley, F. G. Hubbell and Alfred Lowry.

MONTREAL & OTTAWA.—It is stated that construction work is going forward rapidly. This line is being built by the Canadian Pacific to accommodate a section of farming country. Track has been laid for ten miles beyond Rigaud, through which place the line will run, to St. Eugene; and it is expected that before winter the line will be completed to Alfred, 45 miles further on. Stations will be erected at St. Eugene, Vankleek Hill, Caledonia Springs and Plantagenet. Next year this railway will be completed to Ottawa. Ch. Eng., P. A. Peterson, Montreal, Que.

MANITOULIN & NORTH SHORE.—A charter for a single or double track railway was granted this company by the Ontario Government in 1888 which charter was amended in 1891 and 1894. The route on which the charter was granted was from the town of Little Current, Manitoulin Island, Ontario, northward across the islands in Georgian Bay to some point on the Soo branch of the Canadian Pacific Ry. at or near Stanley, a distance of about 42 miles. The amendment of 1891 authorizes the company to issue bonds to the amount of $20,000 per mile. The date for commencement of the work of construction is fixed as March 23, 1897, and completion three years later. The Ontario Government has granted a subsidy of $3,000 per mile and the Dominion Government has granted a subsidy of $3,200 per mile. Directors: Peter Ryan, Toronto; W. P. Chapman, Hamilton; E. S. Townsend, Toronto; David Isaacs, Niagara Falls; R. H. Bowes, Toronto; David Phillips, Niagara Falls; John Ryan, Toronto. The company is now advertising for bids for the construction and equipment of the road, which will be received by Mr. MacIntire, Niagara Falls, Ont., until Oct. 12. The road will be built in six months from the time work is commenced. It will be in operation not later than May 1, 1897.

PITTSBURG, SHENANGO & LAKE ERIE.—The Pittsburg press states that the Carnegie Steel Co. is making extensive preparations for the completion of an ore line to Lake Erie. Large freight yards are being constructed at the company's various mills and the capacity of the big docks of the Pittsburg, Shenango & Lake Erie road, at Conneaut harbor, is being doubled. The grades of the Shenango road are being reduced and sharp curves are being taken out. Over $400,000 is being expended on this work alone. Laborers have been started on a curve north of Greenville. This will be straightened, as will the old sharp curves near it. The heavy grades north of Greenville will also be cut down at once. Some of these grades now exceed 52 ft. to the mile. They will be reduced to 28 ft. Ch. Engr., Geo. W. Sykes, Greenville, Pa.

PHILADELPHIA & READING.—The Philadelphia "Record" states that improvements are being made at West Falls. The roadway is being widened about 40 ft. on the river side, abutments for a new 50-ft. bridge at the West Falls road are being constructed, the old archway will be removed, and the approach leading from the bridge across the Schuylkill will be extended about 12 ft. Two additional tracks will be laid, and double tracks run into the southern portion of the Pencoyd Iron Works for freight purposes. Nolan & Co. are the contractors. They expect to have the roadbed and arch ready for use by Dec. 1. The grading from Pencoyd to the Falls road is finished and only about 75 ft. of grading below the road is yet to be done. Ch. Engr., H. K. Nichols, Philadelphia, Pa.

STONE VALLEY.—An effort is being made to build a railway through Stone Valley in Huntingdon county, Pa., from Pine Grove Mills, Pa., connecting with Beech Creek R. R. to Huntingdon, Pa., connecting with Broad Top R. R. Meetings are being held in the valley and R. C. Patterson, at present at Petersburg, Pa., a western capitalist, agrees to take all the bonds provided the construction does not cost more than $6,000 per mile.

Southern.

ATLANTA & SELMA.—It is stated that A. R. Littlejohn, of New Orleans, is interested in the project to build a railway from Atlanta, Ga., to Selma, Ala., and which may be extended to New Orleans. R. M. Mitchell, of Atlanta, is also interested.

BALTIMORE & OHIO.—It is reported that contracts for improvements have recently been awarded as follows: At Locust Point yards, work to begin at once on enlarging and improving the facilities for handling freight, to cost about $50,000. A contract has been awarded to Burns & Wade for grading an extension of the yards, which will necessitate the removal of from 60,000 to 70,000 cu. yds. of earth and rock. W. H. Thorne has the contract for masonry and piers for the extension of the Fort Ave. bridge, Baltimore, a distance of about 400 ft. Lane Bros. & Co., Esmont, Va., have the contract for grading yard E at Cumberland; estimated cost, from $30,000 to $40,000.

LINVILLE LUMBER.—It is stated that a line eleven miles long is now being surveyed to develop lumber lands near Linville, N. C. A company has been organized with a capital stock of $200,000. Among those interested are: A. B. Camp, E. H. Camp, S. T. Kelso, all of Linville.

NORFOLK & WESTERN.—Press dispatches state that with the completion of the reorganization of the Norfolk & Western system, the extension of this railway to a connection with the Marietta & North Georgia will again be considered. At present the Norfolk & Western terminates at Bristol, Tenn. By building through Cocke and Sevier counties, in Tennessee, the connection with the Marietta & North Georgia road could be made, and the Norfolk & Western thus have an entrance into Atlanta. It is stated that engineers have been making surveys from Bristol.

SPARTANBURG & WHITNEY.—It is stated that surveys are being made for a railway from Spartanburg to Whitney, S. C., a distance of 1½ miles. Ch. Engr., Henry Wells. The line would be a branch of the Southern system.

TREDEGAR MINERAL.—The Gadsen, Ala., "Times" states that work is in progress on this line which runs from Jacksonville to Centre and near the latter place will connect with the Chattanooga Southern. This road traverses a mineral region of Alabama and through forests of pine, oak and hickory. Gen. Burke, Jacksonville, Ala., is interested.

Northwest.

GREAT NORTHERN.—J. F. Stevens, Ch. Engr., St. Paul, Minn., writes us that the extension from Hope to Aneta, N. Dak., is 28¼ miles long. All contracts let to Foley Bros. & Guthrie, St. Paul, Minn.——A press dispatch states that Foley Bros. & Guthrie are building a 33-mile branch of the Great Northern from Halstad to Crookston, Minn. One-half the track is reported laid, work progressing at the rate of two miles a day. Within the next two weeks the entire branch will be completed and in operation.

N. C. FOSTER LUMBER.—It is stated that this company of Fairchild, Wis., will immediately commence the construction of an extension of their private line from Fairchild through to the town of Greenwood, giving 25 miles of private road in all. At Greenwood the Foster road will connect with the Wisconsin Central.

CHICAGO, MILWAUKEE & ST. PAUL.—The Milwaukee "Journal" says that work will be commenced in a few days on a branch which will leave the Wisconsin Valley line at Casanovia, Wis., and extend to Rhinelander, a distance of about 20 miles. It will pass through a rich timber and agricultural section.

SHEBOYGAN, ST. PAUL & WESTERN.—This company has been incorporated with a capital stock of $350,000, by Frank Geele, Frank L. Roenitz, Arthur F. Winter, James Mallman and Paul Krez. The road is to be constructed from the city of Sheboygan, Wis., to a point on the Milwaukee and Northern division of the Chicago, Milwaukee & St. Paul, at or near Random Lake, in Sheboygan county, and will be 18 miles in length.

SAGINAW & GRAND RAPIDS.—It is reported that a special meeting of the board of directors will be held at Alma, Mich., Oct. 17, for the purpose of considering propositions for an extension and the construction and acquisition of other lines and branches. Address, James E. Howard, Secy.

WINONA & WESTERN.—It is stated that this company may build from Simpson to Rochester, Minn., a distance of seven miles. The work, if done, will be undertaken next season.

Southwest.

CENTRAL LOUISIANA.—It is stated that a new company has been formed to build this railway from Abbeville to Palmetto, La., passing through Crowley and Washington, a distance of 75 miles. It is also proposed to extend the line south from Abbeville to a port on Vermillion Bay, 25 miles. Pres., Hampden Storey; Ch. Engr., William Bradford.

GULF & INTERSTATE.—The Dallas, Tex., "News" says that this company has notified the railroad commission of Texas that it has completed 70 miles of its road to Bolivar Point, and asks that the commission send its engineer to Galveston to inspect the road and report on the application for the registration of additional bonds. The commission has ordered Engineer Charles Comer to make the inspection.

GULF.—This company has been incorporated at Guthrie, Okla. Ter., to build a railway through the counties of Grant, Garfield, Kingfisher, Logan, Oklahoma, Payne, Kay, Noble, Lincoln, Pawnee, Pottawatomie, and also through the Choctaw and Chicasaw nations, Cherokee, Creek and Graham counties, Tex., to Denison. Incorporators: G. S. Dill, John Grattan, R. L. Hall and L. B. Haven, of Medford, and John A. Blair, of Caldwell, Kan. Headquarters, Wakita, Okla.

GULF & BRAZOS.—It is intended to run this line from Henrietta to Velasco, on the Gulf of Mexico, passing through Waco, Mineral Wells and Jacksboro, Texas. It will connect with the St. Louis, Oklahoma & Texas Air Line, now under construction from Sapulpa, I. T., to Henrietta. Pres., W. A. Squires, Henrietta, Tex.

KANSAS CITY, FORT SCOTT & MEMPHIS.—The Indian Territory extension of this line has been completed and opened for business from Baxter Springs, Kan., to Miami, Ind. Ter., a distance of 14 miles.

ST. LOUIS & SAN FRANCISCO.—It is stated that the survey for the extension of the St. Paul branch from Elkins towards Huntsville, Ark., commenced Sept. 24, as a preliminary to the beginning of work which will be pushed until finished.

ST. LOUIS, POMONA & SOUTHERN.—Work, it is said, will begin soon on this railway. A Mr. Merriweather, of Pomona, Kan., is the chief promoter.

TEXARKANA & FORT SMITH.—Reports say that track laying on that part of the line in Texas, between the Neches and Sabine Rivers, was to have been commenced on Oct. 1. The grading is now about finished, and will be completed in about six weeks.

Rocky Mountain and Pacific.

COLORADO SPRINGS, PIKE'S PEAK & CRIPPLE CREEK.—This company has been incorporated to build a railway 30 miles long from Colorado Springs to Cripple Creek, Colo.; capital stock, $500,000; incorporators: Leslie Harris, N. M. Keith, Manitou Springs, Colo.; C. B. Weeks, W. A. Moore and H. E. Headley, of Colorado Springs.

RIO GRANDE WESTERN.—It is stated that track-laying has been completed to Eagle Rock Tunnel, three miles up Sevier Canon, and 20 miles below Richfield, Utah. Ch. Engr., E. J. Yard, Salt Lake City, Utah.

CORRALITOS.—Press reports state that the firms at present holding construction contracts with the Corralitos road are Gilbert Webb, Juarez, Mex.; Richard Caples, El Paso, Tex.; W. C. Bradbury & Co., Denver, Colo.; Farnsworth, Beck and others, of the Mormon colonies in Mexico, State of Chihuahua. J. Fewson Smith, of the railroad is chief engineer, with headquarters at Juarez. The road is being built by the Sierra Madre Construction Co., whose officers are, Pres., A. Foster Higgins; Treas., Solon Humphreys; and Secy., George Rowland, all of New York.

VENTURA & OJAI VALLEY.—This company has been incorporated to construct and operate a railway from Ventura to Nordhoff, Cal., a distance of 25 miles. Capital stock, $200,000, commencing with $50,000. A. P. Cross, S. R. Thorpe, J. E. Loomis, S. H. Garrett, all of Los Angeles, Cal.

Foreign.

CENTRAL AMERICAN.—Four out of the five Central American States are pushing the construction of railways through their territory, several new concessions or grants having been made lately. The "Iron Age" states that a new contract has just been signed with New York, California and Colorado capitalists to finish the western terminus of the Costa Rica Interoceanic Ry., thus connecting the two oceans and passing through San Jose, the capitol. The company has a capital of $1,500,000, and work will commence at once. Nicaragua is improving the port of Corinto with a view to extending the Managua R. R. in a northerly direction. The American contractors on the Rama R. R., which will ultimately connect Lake Nicaragua and the Atlantic, are pushing the surveys.

The Republic of Salvador has lately finished its Pacific line to Santa Ana, the contractors and principal engineers being American. Several bankers and contractors have now obtained a grant to run a line from Santa Ana to the town of Ahuachabam, on the Guatamala frontier. The concession is to run for 99 years, all preliminary work to be done within a year from date, otherwise a forfeit of $25,000 to be paid by the contractors. During the last four weeks eight vessels have arrived with iron for the Northern Interoceanic of Guatemala. Rails have been laid to Zacapa, on the central plateau, the most difficult work having been completed when the line crossed the swampy district of Amates and Tenedores. Grading has been carried to within 60 miles of the capital. Other lines now constructing in this country are the Cuban R. R., which opens up the extensive coffee districts of the North to the New York markets; the line from Quezaltenango to the Pacific and the extensions of the Central Ry. to Patulul. Bridge-work is now the most important part of the contracts with the Government. A new bridge is to span the Gualan River and an American bridge company gets the contracts at and near the port of Iztapa, which is to be the western terminus of the Interoceanic.

STREET AND ELECTRIC RAILWAYS.

BOSTON, MASS.—It is stated that the West End St. Ry. Co. is soon to give out a contract which aggregates about $365,000, for a new system of brakes.

EAST BRIDGEWATER, MASS.—Attempts are being made to organize a local company to construct an electric railway about seven miles long, to Campello. H. J. Nutter, Frank N. Fisher, Robt. O. Harris and Samuel Shaw are interested.

EVERETT MASS.—Citizens are attempting to get an extension of the West End Ry. tracks.

MEDWAY, MASS.—It is reported that the selectmen are to grant two franchises for electric railways—one to the Ray Co. and one to the Milford Co.

HUDSON, MASS.—Efforts are being made to secure subscriptions for an electric railway from Hudson, via Bolton, to Lancaster, a distance of about eight miles. The capital stock is $100,000. Water power is to be used in operating and dynamos. Among those interested are: Henry Tower, Geo. A. Tripp and Caleb L. Bringham, of Hudson; and W. N. Felton and H. N. Otterson, of Bolton, Mass.

SOUTH FRAMINGHAM, MASS.—The Framingham St. Ry. Co. has been granted permission to change its motive power from horse to electric on the Union Ave. line to Framingham. Pres. James R. Entwistle is quoted as saying that the company is ready to proceed with the work as soon as permission is granted. It is stated that several extensions may be built.

SPRINGFIELD, MASS.—A press dispatch states that the Springfield & Southwestern St. Ry. Co. is at work on a survey through Feeding Hills to Southwick Ponds. This route would be a branch of the main line from Springfield through Suffield to Hartford. It is intimated that the street railway company intends to develop Southwick Ponds into a pleasure resort.

WARREN, MASS.—Meetings of citizens are being held to promote the building of a proposed extension of the Southbridge & Fiskdale Electric Ry. to touch Brifield, Palmer and Warren. F. D. Lincoln and N. S. Hubbard, of Warren, are interested.

PLAINVILLE, CONN.—It is stated that a party of capitalists has been looking over the route between Plainville and Farmington, with a view to connecting these two villages by an electric railway.

BUFFALO, N. Y.—The Buffalo Ry. Co. has been granted permission to lay tracks on several additional streets.

EAST CHESTER, N. Y.—A committee of citizens, composed of William Allen, J. B. Holler, William Johnson, Thomas Egan, Dr. Webb and Dave D. Russell have asked the Union Trolley Co. to extend the 5th Ave. trolley line to East Chester. President Maher said that he would present the request to the company, with the recommendation that it be granted.

NEW YORK, N. Y.—The State Railroad Commission has granted permission to the Third Ave. R. R. Co. to use the overhead trolley system for ten years on its Kingsbridge extension above 162d St.

ROCHESTER, N. Y.—The "Herald" states that a project is on foot to establish a trolley line between Rochester and Fairport. Plans for the new road has been submitted and the right of way has been obtained along the route deemed most suitable.

SAVONA, N. Y.—A press dispatch states that an electric railway from Savona to Keuka will be built.

SYRACUSE, N. Y.—On Sept. 27, at Albany, a hearing was given by the railroad commission on the Onondaga Lake R. R. Co. for permission to build a railway from Syracuse around Onondaga Lake. An adjournment was taken until Oct. 19, and before that time the commission will inspect the proposed route.

SYRACUSE, N. Y.—The Syracuse St. Ry. Co. has secured permits for erecting a power-house to cost $20,000, and a car barn to cost $30,000.

BOUND BROOK, N. J.—The building of an electric railway is being considered between Philadelphia and Trenton, via Bound Brook. It is stated that L. E. Miller has the contract to build the road from Raritan to New Brunswick and is to have it completed by May 1, 1897.

PATERSON, N. J.—Work was to begin on the construction of the Union Traction Co.'s lines Oct. 5. W. A. Cullen, of Paterson, is the contractor. The line will connect Rutherford with Lyndhurst and Arlington, N. J.

PLAINFIELD, N. J.—It is said that the extension of the electric railway from Plainfield to Scotch Plains is assured, as surveys have already been made and the route is being staked out. The track will be laid up East 2d St. to Netherwood Ave., and from there a new street will be utilized.

CONNELLSVILLE, PA.—The United States Ry. Equipment & Construction Co., Cleveland, O., has been awarded the contract for constructing the Connellsville St. Ry.Co.'s new line, as advertised in Engineering News. It will be a single track overhead trolley system, 2½ miles in length, laid with 56-lb. steel rails.

IRWIN, PA.—An electric railway may be built to this place this fall. The line was completed to Manor last week. The Irwin "Republican" is pushing the project.

PITTSBURG, PA.—The "Commercial Gazette," Sept 28, says that the Consolidation Traction Co. is working to complete one track on Fifth Ave., so as to run into the city the latter part of next week. All the small jobs on side streets have been reconstructed. The casing of the cable system is being lifted on South Highland Ave. by a steam crane. When the Fifth Ave. road is opened for travel new cars with trailers will be used.

WASHINGTON, D. C.—The Montgomery Construction Co. was incorporated Sept. 28, by Geo. E. Teeple, Austin McLanahan, Chas. H. Bryne, Henry W. Williams and N. Winslow Williams, with a capital stock of $100,000. The company proposes to build a line of electric railway between Washington and the suburban town of Tacoma, in Montgomery county, Md., for which a charter has been granted by Congress.

BALTIMORE, MD.—The City & Suburban Ry. Co., on Sept. 28, began surveys for the extension of its Catonsville branch to Ellicott City, a distance of three miles. Work, it is said, will begin in a few weeks. A double track will be laid, and a heavy T-rail will be used. The road will probably continue through Ellicott City to its western outskirts, if permission can be obtained from the town council.

NORFOLK, VA.—It is stated that Berkley, Portsmouth and Norfolk may be connected by an electric line. Preliminary surveys have been made. The line may be built as an extension of the Norfolk St. Ry.

RICHMOND, VA.—The Richmond Traction Co. has been granted permission to extend its lines.

CHESTER, W. VA.—The East Liverpool & Rock Spring St. Ry. Co. was incorporated Oct. 5, capital stock, $100,000, commencing with $30,000, to construct a street railway to connect Chester, W. Va., and East Liverpool, O. Incorporators: Jas. E. McDonald, Wm. L. Smith, Geo. H. Owen, J. S. Hilbert, East Liverpool, O.; and E. D. Marshall, Chester, W. Va.

ATLANTA, GA.—The "Journal" states that plans for the building of a rock ballasted electric railway from Atlanta to Marietta are matured. A line has been surveyed and land terminal has been secured. New York capitalists are interested and it is probable that a road costing $350,000 will be built. It is not improbable that electric engines will be used instead of the overhead wire.

TAMPA, FLA.—It is reported that the Consumers' St. Ry. Co. may extend its lines to Tarpon Springs.

BUCYRUS, O.—On Sept. 28 the county commissioners granted the franchise to the right of way between the Galion line and the Bucyrus corporation line for an electric railway. The franchise is granted to Wm. E. Haycox, of Mansfield, and Fred. B. Perkins, of Toledo, and a bond of $3,000 is required to be placed in the hands of the commissioners on or before May 1, 1897, for the commencement of the work; the work must begin on or before June 1, 1897, and be completed by Aug. 1, 1898.

CINCINNATI, O.—The commissioners have granted a franchise to Charles Kilgour to construct and maintain a street railway to be operated by electricity or other motive power.——The Mount Auburn Electric Ry. Co. has received an offer of a bonus of $1,000 to extend its lines to the village of Hartwell and it is stated, will soon begin work.

CLEVELAND, O.—James Ritchie, Ch. Engr., Hickox Bldg., writes us that the Cleveland & Chagrin Falls Electric R. R. was organized in 1896 to build an electric railway from the eastern limits of Cleveland to Chagrin Falls, a distance of 14 miles. The officers are: Pres., V. A. Taylor; Secy., J. E. Latimer; Supt., R. L. Palmer; Treas., C. G. Barkwill; Ch. Engr., James Ritchie. The grading and masonry of 12 miles is completed, 1.6 miles of track laid and 2½ miles of material for track is distributed in addition. The power-house will be located at Orange, about midway of the line. Entrance to the business center of Cleveland will be had over the lines of the Cleveland City Ry. It is intended to complete the line this year. About four miles is over private right of way, the balance being on the county roads. The curvature is light and the maximum gradient is 4%. The road crosses the Chagrin River on the new high level bridge, 365 ft. long. The other bridges are small, excepting one trestle 250 ft. long. The contractor for construction and equipment complete is the Albion Construction Co. of Chicago.

COLUMBUS, O.—An electric railway is projected from Columbus to Lancaster via Carroll and Groveport. W. H. Lane, Canal Winchester, O., is interested.

LORAIN, O.—Jas. B. Hoge, Secy., writes us that the projected length is 20 miles from Lorain, via Avon Point and Rocky River, to Cleveland; contracts are closed for grading and most of the material; about five miles of grading is already done; capital fully subscribed: J. W. McReynolds is the principal contractor. It is stated that the bids for preparing the roadbed between Rocky River and Lorain were as follows:

J. N. LeDuke & Co., Cleveland	$30,485
Barnett & Carr, Cleveland	30,925
D. L. Miller & Co., Lock Haven, Pa.	31,240
H. Leach, Cleveland	31,410
M. F. Condon, Cleveland	33,200
M. Spellacy & Co., Columbus, O.	34,780
Currie & McKay, Detroit	34,900
Neal Norton, Cleveland	36,275
McCracken & Connell, Cleveland	38,940
Jacob Meyer, Lorain, O.	42,110
Northern Ohio Paving & Construc. Co., Cleveland	54,450
Wm. McReynolds, Cleveland	30,150

RAVENNA, O.—The county commissioners have granted a franchise to the Akron & Cuyahoga Falls Rapid Transit Co., to erect a street railway over the stone bridge at Kent, and from the east corporation line of Kent to the west corporation line of Ravenna. Within 90 days the company must secure a franchise through Kent, or this franchise is forfeited. All work is to be completed before July 11, 1897.

WASHINGTON COURT HOUSE, O.—It is stated that a number of capitalists intend building an electric railway to Hillsboro, via Greenfield. The board of trade is interested.

YOUNGSTOWN, O.—The Youngstown Park & Falls St. Ry. Co. will apply for a franchise to extend its lines.

CHICAGO, ILL.—The General Electric Ry. Co., it is stated, will build a system of underground conduit electric railway on the south side.——The trolley lines owned by Chas. T. Yerkes will probably be extended on several streets soon.——Work on the Van Buren St. side of the Union Loop will begin immediately after a favorable decision from the Supreme Court which was to meet Oct. 6. The officials of the Loop company are counting upon a favorable decision, and are putting in all the foundations for the superstructure on Van Buren St. and ordering all the iron for the line.

WAUKEGAN, ILL.—The Bluff City Electric Ry. Co. has been granted a franchise by the county supervisors.

MADISON, WIS.—It is proposed to extend the lines of the Madison St. Ry. to Wingra Park.

MILWAUKEE, WIS.—Work is in progress on an extension of the Milwaukee Electric Ry. to the city limits, from which place it will be built to Wauwatosa after a franchise is secured.

OSKALOOSA, IA.—An ordinance has been granted whereby electricity will be substituted for mules on the street railway. The company agrees to put in and operate 4½ miles of road, and have same in operation by Dec. 1, 1897.

ST. LOUIS, MO.—The Lindell Ry. Co. is said to be endeavoring to extend its lines northeast to O'Fallon Park and to the cemeteries. It has made several inquiries recently for the purpose of purchasing tracts of land in that vicinity.

WELLSTON, MO.—The Wellston, Creve Coeur & St. Charles Ry. Co. is asking for a franchise to construct an electric railway from Wellston to St. Charles.

HOUSTON, TEX.—An effort is being made to extend the Houston Electric Ry., a distance of 26 blocks. Citizens propose to give the company a bonus of $4,000.

CRIPPLE CREEK, COLO.—The Colorado Springs, Pike's Peak & Cripple Creek Ry. Co. was incorporated, Sept. 22, by Manitou and Victor parties, with a capital stock of $500,000, to construct and operate a railway and telephone and telegraph lines between Colorado Springs, Pike's Peak and the Cripple Creek district. The incorporators are Lisle Harris, N. M. Keith, C. B. Weeks, W. A. Moore and H. E. Headley.

LA CANYADA, CAL.—Dr. J. D. Hineman is said to be representing eastern capitalists who may build an electric railway to Los Angeles, a distance of 12 miles.

LOS ANGELES, CAL.—The Mateo St. & Santa Fe Ave. Ry. Co. now operating a horse car line from the Santa Fe depot to the new garbage crematory on Santa Fe Ave., has applied to the city council for an extension of its franchise to take in the heart of the city.

SANTA ROSA, CAL.—Bids will be received until Nov. 5, for a franchise for a street railway. S. B. Fulton, Cy. Clk.——The franchise for the building of an electric railway from this city to Sonoma was granted Sept. 21. The new lines will run via Melitta, Agua Caliente, Kenwood and Glen Ellen, thus opening up the entire valley. It will then run to the Napa county line and on to the Embarcadaro landing. Another line will be constructed from here to Healdsburg and other places, and by this means the whole county will be intersected. The Santa Rosa-Sonoma line will be constructed in two years.

HAMILTON, ONT.—Notice is given that application will be made at the next session of the Parliament of Canada for an act to incorporate the Canadian Electric Ry. & Power Co., to build and operate an electric railway from Cobourg, via Port Hope, Bowmanville, Oshawa, Whitby, Toronto, Oakville and Hamilton, to Suspension Bridge and Niagara Falls.

ELECTRIC LIGHT AND POWER.

OXFORD, MASS.—Horace Fay, of Worcester, Mass., is reported to have purchased the Gates Farm of about 200 acres, on which he will make a number of improvements, including the construction of an electric light and power plant. Edward M. Southwick, Worcester, is to be in charge of the work.

NORWALK, CONN.—It is stated that the Norwalk & South Norwalk Electric Light Co. passed Oct. 1 into the hands of the General Electric Co., its largest creditor. Under the agreement former stockholders will receive an interest of 40% of their holdings.

BUFFALO, N. Y.—The council has voted to ask for bids for an electric light plant for police headquarters at Seneca and Franklin Sts. R. G. Parsons, Secy. Bd. Pub. Wks.

ELMIRA, N. Y.—It is reported that the residents of Elmira Heights will soon vote on the question of building a municipal electric light plant.

JAMAICA (L. I.), N. Y.—Francis Luce and Eugene F. Vacheron, of Woodhaven, have petitioned the town board for electric lights in Woodhaven.

LE ROY, N. Y.—The Le Roy Gas Light Co. has been awarded the lighting contract by the village board for street lighting. This company has had the contract for the past five years. The former price paid was $3,350 per year, but now it will be $1,995. This is for 50 arc lights to burn 22 nights in each month and from twilight until 1 a. m. The Le Roy Hydraulic Electric Co. offered to light the village for $2,000.

NEW YORK, N. Y.—Bids are asked until Oct. 14 for furnishing electric light and gas fixtures, wiring, iron railings, etc., for the armory building on 14th St., near 6th Ave. Archs., Calele & Sargent, 18 Broadway; Wm. L. Strong, Mayor and Chn. Armory Bd., City Hall.

NORTH TONAWANDA, N. Y.—L. Van Dervoort, B. F. Felton and Wm. Gillie, who were appointed a committee to negotiate with the Niagara Falls Power Co. for furnishing this city with light and power, have submitted a report. The company agrees to furnish city with 2,500 HP.

OGDENSBURG, N. Y.—Bids are asked until Oct. 9 for erecting an electric light plant at the state hospital at Point Airy, near this city. I. G. Perry. State Arch., Albany; Wm. J. Akin, Asst. Bldg. Supt.; Geo. Hall, Pres.

CAMDEN, N. J.—The Camden Lighting & Heating Co. has been granted a franchise for constructing conduits in the streets for its wires. Chas. H. Ellis, Pres. Council; T. P. Varney, Clk.

EAST McKEESPORT, PA.—Specifications and plans are being prepared by the East McKeesport Light & Power Co. for lighting this place with electricity, for which the company was recently incorporated.

MIDDLETOWN, PA.—Press reports state that the storm last week destroyed a portion of the electric light plant, together with the machinery. L. V. Nelson, Supt.

PHILADELPHIA, PA.—Chas. Roberts has introduced an ordinance in the council authorizing an appropriation of $25,000 for erecting an electric light plant in Fairmount Park.

WASHINGTON, D. C.—Local papers state that the United States Electric Lighting Co. has decided to spend about $1,000,000 in improving its plant in the District of Columbia. All the machinery in the main plant will be changed for new and additional machinery, the wires are all to be put under ground, and two new plants will also be erected. Pres., A. A. Thomas, Washington.

BRUNSWICK, GA.—Col. J. E. du Bignon is reported to have petitioned the council for a franchise to put in a new electric light plant.——It is stated that the council is also asking for bids for a 100-arc light plant. J. B. Abrams, Chn. Com.

COCHRAN, GA.—It is reported that this place is discussing the question of electric lights and water-works.

CUTHBERT, GA.—This place is reported to have voted to issue bonds for an electric light plant.

FERNANDINA, FLA.—Mr. Fields, of New York, is reported to have been engaged to make estimates for an electric light plant for this city, to be operated in connection with the water-works.

NICHOLASVILLE, KY.—It is reported that M. A. Anderson and others are organizing an electric light company.

CLEVELAND, O.—The Century Lighting Co. has been granted a franchise for an electric light plant. The wires will be laid in a conduit to be constructed by the company. Ex-Councilman Albert Strauss is interested.

FOSTORIA, O.—It is stated that the Fostoria Light & Power Co. awarded contracts Sept. 26 for the machinery necessary to make its plant conform with the specifications of the contract recently awarded it by the city. The Arbuckle & Ryan Co., of Toledo, O., secured the contract for the complete steam plant, and the Fort Wayne Electric Corporation, Fort Wayne, Ind., for the incandescent plant. Estimated cost, $20,000 or $25,000.

GRAND HAVEN, MICH.—Bids are asked until Oct. 14 for furnishing an engine and apparatus for an electric light plant for this city, and also for the purchase of $10,000 of 5% electric light coupon bonds. Engr., H. H. Humphrey, 22 Bennett Bldg., Detroit, Mich.; R. R. Stallings, Mayor; W. N. Angel, Cy. Clk.

GRIGGSVILLE, ILL.—The electric light plant at this place is reported to have been destroyed Sept. 25 by fire. The plant was owned by a private company.

ALAMEDA, CAL.—The court has decided that this city can improve and add to its electric light plant. Theodore Leydecker, Trustee.

BLUE LAKE, CAL.—The Little River Placer Mining Co. intends to put in an electric light plant soon. The owners of the mine are S. F. Pine, G. H. Close, R. S. Morse and Chas. Hill.

LOS ANGELES, CAL.—The Los Angeles Electric Light Co. has been awarded the contract for lighting this city for one year, beginning Jan. 1, 1897, at $9.75 per arc light per month.

MODESTO, CAL.—J. D. Harper is circulating a petition to the city trustees asking that they take means as soon as possible to install an electric light plant in this city.

REDDING, CAL.—The Holt & Gregg Co. has begun the construction of the power house at this place for Dr. Wm. H. Garlick, a Ohio pottery manufacturer. Almarine B. Paul, of San Francisco, Cal., is the agent.

SANTA CRUZ, CAL.—The Big Creek Power Co. has submitted a proposition to the council to furnish power to operate the lighting and pumping system.

THREE RIVERS, QUE.—The North Shore Power Co. has been organized to build an electric light and power plant at this place.

NEW COMPANIES.—Newton Electric Light, Heat & Power Co., Newton, N. J.; $25,000, with full amount paid in; Julius A. Skilton, Henry I. Skilton, Brooklyn, N. Y.; Andrew J. Van Blarcom, Wm. H. Earl, John Huston, all of Newton, N. J.

Fleischhauer Electric Light & Power Co., New York, N. Y.; $10,000; John Keenan, Jacob Fleischhauer, Julius Fleischhauer, New York.

Clinton Mills Power Co., Cooperstown, N. Y.; $10,000; to furnish electricity for light, heat or power in Milford, Hartwick, Middlefield, Otsego and Cooperstown; George Brooks, George M. Jarvis, E. V. Adams, Cooperstown.

Electric Light, Power & Conduit Co., St. Louis, Mo.; $50,000; S. M. Dodd, J. C. Van Blarcom, Richard C. Kerens and others.

Salinas City Light & Water Co., Salinas, Cal.; $200,000, with $500 paid in; H. S. Ball, Luther Rodgers, E. P. Iverson, M. Hughes, F. B. Day, all of Salinas.

Electric Nursery Plant Co., Niagara Falls, N. Y.; $10,000; James S. Simmons, E. H. Stewart, Roanoke, Va.; Col. W. H. Barclay.

People's Electric Light & Mfg. Co., Speers, Pa.; $50,000, with $5,000 paid in; Frank Wentz, Treas., Pittsburg, Pa.

BRIDGES.

FALL RIVER, MASS.—The aldermen are talking of building a new bridge at Bradford Ave. P. D. Borden, Cy. Engr.

LOWELL, MASS.—Geo. Bowers, Cy. Engr., writes us as follows: The Wilder St. bridge is a small wooden bridge 40 ft. long and 30 ft. wide at present; it is proposed to widen this bridge 5 ft. on each side, making it 40 ft. in width. It is a small piece of work. There is no Water St. bridge to be repaired in this city, as mentioned in some newspaper reports. The $20,000 asked for by the street committee is for earth filling on Pawtucket St. to abolish a grade crossing over the Boston & Maine R. R. All the bridge work has been done by the railway company.

MILLERS FALLS, MASS.—E. C. Davis, of Northampton, Mass., is reported to have prepared plans for a new bridge at this place.

OLYNEYVILLE, R. I.—We are informed that no steps have been taken as yet in regard to the proposed Manton Ave. bridge, but steps will be taken this winter.

HARTFORD, CONN.—The bridge commissioners have awarded to O. W. Weand & Co., of Hartford, and also of Reading, Pa., the contract for removing six stone piers of the old East Hartford bridge down to low water level. Morgan G. Bulkley, Chn. Comrs.——C. E. Gross, Pres. Park Bd., informs us that no bridge has yet been authorized or ordered over Park River at Park St. to cost $15,000. The street board has the matter in charge, the park board having no authority in the matter.

BINGHAMTON, N. Y.—An election will be held Oct. 20 to vote again on the question of constructing a new bridge over the Chenango River at Ferry St.; estimated cost, $50,000. An election was held July 14 to vote on the question of issuing $65,000 in bonds for this bridge, but it was defeated. S. E. Monroe, Cy. Engr.

BROOKLYN, N. Y.—John J. McLaughlin, County Engr., Jamaica, N. Y., has recommended to the joint committee on bridges of the aldermen and the Queens county supervisors the plan prepared by Thomas E. Brown, Jr., 38 Park Row, New York, for bascule bridge over Newtown Creek, between Vernon Ave., Long Island City, and Manhattan Ave., Brooklyn. The structure is estimated to cost $105,000, without the substructure or the operating machinery. Plans for this bridge were received July 23, as advertised in Engineering News. The plans submitted were noted in our issue of July 30.

BUFFALO, N. Y.—Bids are asked by the grade crossing commission, 4 Municipal Bldg., until Oct. 15, for masonry, paving, and other work necessary for constructing piers, abutments of, and approaches to a viaduct over the West Shore R. R., the N. Y. C. & H. R. R. R., and N. Y., L. E. & W. R. R. tracks on Chicago St., between Seneca St. and a point at or near the L. V. R. R. crossing. Engr., Geo. E. Mann, Municipal Bldg.; E. B. Guthrie, Ch. Engr., Bureau of Engineering; R. B. Adams, Chn. Grade Crossing Comrs.

NEW YORK, N. Y.—The East River Bridge Commission, 49 Chambers St. New York, has awarded to E. W. Miller the contract for borings for the anchorage on the New York side at 40 cts. a lin. ft. L. L. Buck, Ch. Engr., 46 East 21st St., New York.

STAPLETON (S. I.), N. Y.—The supervisors have directed H. P. Morrison, Engr. County Roads, to prepare plans and specifications and to advertise for bids for the enlargement of the masonry, brick and iron highway bridge over Harbor Brook in Castleton.

BLOOMSBURG, PA.—It is stated that the recent storm destroyed the bridge over the river at Catawissa, Columbia county. This structure was purchased by the county commissioners about two years ago for $30,000.

COLUMBIA, PA.—The Pennsylvania R. R. bridge over the Susquehanna River, which was nearly a mile long, was destroyed by the storm, according to reports. Only two iron spans of the bridge remain. Wm. Pritchard, Constructing Engr., P. R. R. Co., is making surveys for a new steel structure.

HOLLIDAYSBURG, PA.—Several bridges in and around this place were destroyed by the recent storm.

McKEESPORT, PA.—The Schultz Bridge & Iron Co., McKee's Rock, Pa., has the contract for the rebuilding of the 3d Ave bridge, the old suspension span will be replaced by a truss span.

NEW BRIGHTON, PA.—It is proposed to build a new bridge over Black Horse Run and viewers have been appointed. No work is likely to be done until next year, according to reports.

PITTSBURG, PA.—The Ben Avon Bridge Co. has been incorporated to erect a bridge over Spruce Run at Ben Avon; capital stock, $1,000; J. N. Davidson, Treas., care Second National Bank, Allegheny, Pa.

BALTIMORE, MD.—The Lake Roland Elevated R. R. Co. has been granted permission to build an iron bridge over the Windsor Mill road.

HANCOCK, MD.—Reports state that the recent storms washed away 13 bridges between this place and Berkeley Springs.

RIVERTON, VA.—It is stated that the iron bridge belonging to the Norfolk & Western R. R. Co., over the Shenandoah River at this place, was destroyed Sept. 29, at a loss of $5,000. W. W. Coe, Ch. Engr., Roanoke, Va.

CIRCLEVILLE, O.—Bids were asked until Oct. 5 for the purchase of $10,000 of bridge bonds, according to reports.

CLEVELAND, O.—Bids are asked until Oct. 29 for building an iron and steel superstructure for the bridge at Willow St. over the Old River bed. D. E. Wright, Dir.

COLUMBUS, O.—The city engineer and the county surveyor are considering plans for lowering the Broad St. bridge, as the grade of the street is to be lowered. Henry Maetzel, County Surv.

INDIANAPOLIS, IND.—Bids are asked until Oct. 12 for constructing the substructure of the proposed bridge over White River at Judge Harding St., West Indianapolis. J. F. Reineke, Chn. County Comrs.; H. B. Smith, Audr.——The commissioners state that eventually there will be a bridge built at Raymond St.

INDIANAPOLIS, IND.—Bids are asked by the board of public works until Oct. 14 for girders for a bridge over the canal, and until Oct. 16 for a bridge over pleasant Run at Beecher St. B. J. T. Jeup, Cy. Engr.

LAINGSBURG, MICH.—The voters have decided to rebuild the bridge east of this place, at a cost of $1,250.

OREGON, ILL.—The county supervisors on Sept. 26 appropriated $12,000 for constructing a new 160-ft. steel and iron bridge over the Rock River at this town, provided Oregon also appropriates $8,000. W. A. Hunt, County Comr.; J. C. Foster, County Clk., Oregon.

SHELBYVILLE, ILL.—It is stated that a new steel bridge about 1,400 ft. long will be built over the Kaskaskia River at this place.

WATERLOO, IA.—The Rapid Transit Co. is reported as about to let contracts for constructing four bridges on the Cedarfalls line. The largest one will be about 400 ft. long. It is to be of steel, and is estimated to cost $15,000. The other three structures will be wood.

DULUTH, MINN.—The commissioners have condemned property for the right of way for an approach for the bridge to be constructed over the St. Louis River, at Fond du Lac. C. E. Richardson, Cy. Clk.

ATCHISON, KAN.—We are informed that nothing has been done yet towards rebuilding the Fifth St. bridge Fred. Giddings, Cy. Engr.

HOUSTON, TEX.—Bids are asked by the Indiana Bridge Co., 411 Binz Bldg., Houston, for erecting a 300-ft. steel draw span.

WACO, TEX.—The question of making improvements to the superstructure of the suspension bridge is being considered. Stephen Turner, Cy. Engr.

DENVER, COLO.—P. O'Brien, Cy. Engr., writes us that no plans have yet been prepared for the 14th St. viaduct, but are simply in contemplation.

COLORADO.—Press reports state that the storm and high water Sept. 23 destroyed a large bridge at Salt Wash, seven miles from Grand Junction; also a number of bridges over the Pine and Florida Rivers, near Durango, and the new iron and steel bridge over the Dolores River, near Montrose, just completed by the county, was washed away. H. A. Sumner, State Engr., Denver, Colo.

PENDLETON, ORE.—Bids are asked by the county clerk for constructing a 119-ft. Howe truss bridge over McCoy crossing; estimated cost, $2,000.

TILLAMOOK, ORE.—Bids are asked until Jan. 8 for constructing a 220-ft. wooden bridge over the Big Nestacca River, also an approach the same length. J. D. Edwards, County Clk.

AUBURN, CAL.—Bids are asked until Oct. 10 for repairing the Rattlesnake bridge over American River by adding 1,200 ft. of 2-in. steel cable to be laid in concrete Wm. I. May, County Clk.

FRESNO, CAL.—Bids are asked until Oct. 12 for constructing a combination iron and wooden bridge on the Fresno Slough. T. G. Hart, Clk.

LOS ANGELES, CAL.—Bids are asked until Oct. 12 for building a bridge over the Los Angeles River on the Los Fells road. C. A. Luckenbach, Cy. Clk.——It is also proposed to build a bridge over the Los Angeles River, north of the city limits. Chas. Compton, Cy. Engr.

MODESTO, CAL.—The supervisors have voted to rebuild several of the river bridges in Stanislaus county; estimated cost, $15,000.

REDLANDS, CAL.—Bids are asked by the city engineer until Oct. 14 for abutments for a steel bridge at Church St., plans for which have been prepared by the city engineer. L. W. Clark, Clk.

SACRAMENTO, CAL.—The supervisors received the following bids Sept. 28, for constructing a 225-ft. steel bridge over the Consumner River: J. C. Boyd, County Surv.; San Francisco Bridge Co., San Francisco, $4,444; California Bridge Co., $4,950; Thompson Bridge Co., $4,650; J. A. McMahon, $6,495; Healy, Tibbits & Co., $7,493; Darby, Laydon & Co., $7,757; Johnson & Peterson, $6,440; Cotton Bros., $5,590; G. B. Dean, $7,700. The Thompson Bridge Co., McMahon, Laydon & Co., Johnson & Peterson and Dean also submitted bids for a combination bridge.

SAN FRANCISCO, CAL.—Bids are asked until Oct. 15 for repairing the railway bridges and trestles, the railway track, etc., at Point Sur Light Station, Cal. Maj. Chas. E. L. B. Davis, U. S. Engr., San Francisco.

QUEBEC, QUE.—Press reports state that the civic deputation to Ottawa on the bridge question claims to have the positive assurance of Premier Laurier and his colleagues that at the proper time the government will financially assist the project. It is said that the aid promised will be in the shape of a grant of 15%. of the total cost of the bridge, that is to say, if the latter reaches $5,000,000 the government will give $750,000 of the amount. It is expected that the city corporation will take stock in the company to the extent of $250,000 and guarantee the interest on an issue of bonds to the extent of $1,000,000.

HAZELMERE, B. C.—The large bridge south of the North Bluff Road, on the Hall's Prairie Road, was completly destroyed by forest fires last Sept. 20. A new bridge will be built immediately, according to reports.

BUILDINGS.

BEVERLY, MASS.—J. A. McGinty, 53 State St., Boston, has prepared plans for a 2-story brick church at Cabot and Essex Sts., to cost $60,000; pastor, Rev. F. J. Curran.

BOSTON, MASS.—Bids are asked until Nov. 5 for erecting a light-house at Spectacle Island, Boston Harbor. Maj. W. R. Livermore, U. S. Engr., Boston.——At the convention of the Y. M. C. A's. of Massachusetts and Rhode Island to be held at North Adams, Mass., Oct. 22, the question of constructing association buildings at each of the union railway stations in Boston, to cost $40,000 each, will be considered.——Plans have been prepared for adding four stories to the historical buildings on Tremont St. Mayor Quincy is interested.——Winslow & Wetherell, 3 Hamilton Place, have prepared plans for a 5-story brick block on Fulton St. for Thos. E. Proctor. It is stated that the contract has been awarded to Gooch & Pray, 166 Devonshire St., at about $65,000.——Gerry & Northrup, 51 Bristol St., have been awarded the contract for constructing a $50,000 residence on Fisher Ave., for T. L. Gay, 150 Fisher Ave.; Arch., W. Y. Peters, 6 Beacon St.——The council has passed ordinances appropriating $145,000 for improvements to the city hall and to four other municipal structures. Alderman W. J. Donovan can probably give information.

NEW BEDFORD, MASS.—Bids are asked until Nov. 9 for erecting and delivering the Butler Flats light tower, New Bedford Harbor, Mass. Maj. W. R. Livermore, U. S. Engr., Boston.

SOMERVILLE, MASS.—Edward F. Staples has been awarded the contract by the aldermen for erecting a new school building to cost $23,000, with heating and ventilating apparatus. Arch., E. M. Sargent, Somerville.

WORCESTER, MASS.—The masonic charity and educational association has voted to buy the Mower property on Mower Ave., as a site for the masonic temple. The foundation will be laid this fall, and the temple will cost about $100,000.

HARTFORD, CONN.—Wm. C. Brocklesby, 278½ Main St., Hartford, has had plans prepared by him accepted for the proposed school building in the First school district estimated to cost $56,650, not including furnishing. Bids for the construction will be received at once, but only from local builders. Dr. Geo. C. Bailey, Chn. Com.

BINGHAMTON, N. Y.—Bids are asked until Oct. 8 for erecting an addition to the boiler house of the state hospital; two bonds of $2,000 each required. I. G. Perry, State Arch., Albany and Binghamton; Alex. Cumming, Pres. Bd. Mgrs.

BROOKLYN, N. Y.—Press reports state that Secretary Herbert has adopted the plan submitted in competition by John L. Smithmeyer, Corcoran Building, Washington, D. C., the designer of the Congressional Library, for the new ward of the Brooklyn naval hospital, and will in a few days invite proposals for its construction within the $50,000 appropriated by congress. The plans call for a structure of white brick and marble of classic lines. Accommodations will be arranged for 80 patients.

BROOKLYN, N. Y.—It is stated that the St. Nicholas Ice Co. has leased the Clermont Ave. Rink and will at once make arrangements for putting in a plant and converting the building into an ice skating rink.——Poulson & Eager, Brooklyn, have been awarded the contract for constructing a new iron and copper cupola on the city hall at $34,000. The other bids received Sept. 30 were as follows: John T. Cashman, $36,000; Milliken Bros., New York, $34,880; John Cooper & Sons, New York, $39,875. Archs., V. C. Griffith, 95 Fifth Ave., New York, and C. W. & A. A. Stoughton, 1665 Washington Ave., New York.——It is stated that J. W. Mackay, 254 Broadway, New York, and San Francisco, Cal., proposes to erect a costly mausoleum over his son's grave in Greenwood Cemetery

BUFFALO, N. Y.—The C. W. Evans estate will build a 3-story business block of brick and stone, to cost $50,000. Arch., Edward A. Kent, 94 White Bldg.——H. G. Davie will build a 4-story brick flat building on Ellicott St., at a cost of $18,000. H. L. Jekel, architect.

CAZENOVIA, N. Y.—A. Russell, The Bastable, Syracuse, N. Y., is reported to have prepared plans for a new edifice for the St. James Church to cost $30,000.

NEW BRIGHTON, N. Y.—Geo. E. Harding, Arch., 253 Broadway, New York, John J. Keeney and Percy King have been appointed a committee to secure plans for a new $75,000 school building.

NEW YORK, N. Y.—Bids are asked until Oct. 12 for erecting two 2-story brick wings for the accommodation of 264 patients in single rooms, a kitchen, a 2-story building containing dining-rooms, etc., for the Manhattan state hospital at Ward's Island, N. Y., and for the steam heating and ventilating of these buildings. I. G. Perry, State Arch., Albany and Binghamton, N. Y.; John McAnerney, Acting Pres. Bd. Mgrs., 1 Madison Ave., New York.——Bids are asked until Oct. 29 for the labor and materials required for the stone and brickwork, roof covering and interior finish above second story (except plumbing, gas piping, heating apparatus, elevators and electric wiring) of the United States Appraiser's Warehouse at New York. Wm. Martin Aiken, Supervising Arch., Washington, D. C.——J. R. Thomas, 160 Broadway, is preparing plans for a new east side hospital for which the last legislature appropriated $200,000. The building will be of brick and 140 × 120 ft.——J. H. McGuire, 171 Broadway, is preparing plans for a chapel and lecture room to cost $175,000 for the New York Catholic Protectory at Van Nest, 24th Ward.—The American Realty Co. is reported to have decided to erect an 11-story building at Rector St. and Trinity Place.——Plans have been filed by H. S. Wood, 120 West 49th St., for two 8-story stores on Bleecker St. to cost $274,000, Arch., F. T. Camp, 114 Nassau St.; by the Singer Mfg. Co., Pres., F. G. Bourne, 149 Broadway, for a 10-story building at 149 to 153 Broadway, Arch., Ernest Flagg, 54 Broad St.; by Francis S. Kinney, of Pequannock, N. J., for a 5-story dwelling at 33 and 35 West 54th St., to cost $50,000; by J. E. Weed, 388 Pacific St., Brooklyn, for a 7-story brick flat on West End Ave. to cost $60,000.——J. C. Burne, 101 West 42d St., has prepared plans for several 5-story brick flats for Lewis Richards to cost about $250,000.—R. P. & J. H. Staats, 29 Broadway, New York, have been awarded the contract for erecting a new 2-story ferry building for the Pennsylvania R. R. Co. at the foot of 23d St., New York.——The Washington Life Insurance Co. will next May begin the construction of a new office building at Broadway and Liberty St.

NEW YORK, N. Y—The Pavonia ferryhouse of the Erie R. R. Co. at Chambers St. and the North River, was destroyed by fire Oct. 6, causing a reported loss of about $80,000. Gen. Mgr. M. E. Staples, New York.

NIAGARA FALLS, N. Y.—The Niagara Falls Hospital Association will build a large hospital of brick and stone. The city has been requested to make sewer connections. About 1,200 ft. of pipe will be required.

POUGHKEEPSIE, N. Y.—Dodge & Devanney are reported to have been awarded the contract for erecting a new dormitory for Vassar College at a cost of $200,000. Pres., Dr. James M. Taylor.

ROCHESTER, N. Y.—Sibley, Lindsay & Curr, Division St., are having a 7-story 157 × 66 ft. addition erected to their building. W. H. Gorsline has the contract for the mason work and the Rochester Bridge & Iron Co. that for the iron and steel work. Arch., J. F. Warner, 225 Powers Bldg.

BRIDGETON, N. J.—Stearns & Castor, Bourse Bldg., Philadelphia, have prepared plans for a school building, 80 × 54 ft., to cost $25,000.

CAMDEN, N. J.—Bids are asked until about Oct. 20 for erecting a $15,000 bank building in Orange City, N. J., for the Central Trust Co., Camden: estimated cost, $15,000. Arch., Thos. Stephen, Masonic Temple, Camden.

CAPE MAY, N. J.—A committee has been appointed by the state firemen's association to secure plans for a firemen's home to cost $100,000. Pres., Gen. B. W. Spencer; Wm. H. Brown, Newark, John Kennell, Paterson, and John S. Gibson, Newark, are interested.

HOBOKEN, N. J.—R. P. & J. H. Staats, 29 Broadway, New York, N. Y., have been awarded the contract for erecting the new pier and steel shed thereon at the foot of 2d St., for the North German Lloyd Steamship Co.

TRENTON, N. J.—The Trenton school board has rejected bids for a new school building as being too high, according to reports.

VERONA, N. J.—Bids are asked until Oct. 20 for constructing, plumbing, etc., the new Essex county hospital for the insane to be erected at Overlook, Verona. Arch., E. A. Wurth, 748 Broad St., Newark, N. J.; C. W. Heilman, Chn. Com. The work is open only to Essex county contractors.

ALLEGHENY, PA.—A permit has been granted for a 3-story, 146 × 98 ft., addition to the Sixth Ward school building; estimated cost, $96,400.

GIRARD, PA.—It is reported that ground has been secured by the masons for a national masonic university to be erected near this place.

HAVERFORD, PA.—Frank Furness,Provident Life Bldg, Philadelphia, is reported to have prepared plans for a $60,000 clubhouse for the Marion Cricket Club.

PHILADELPHIA, PA.—An ordinance has been introduced in the council appropriating $85,000 for a new school building at 54th St. and Landsdowne Ave.——Isaac Pursell, Arch., 119 South Fourth St., has let the contract for erecting the Baptist Chapel at Broad and Ritner Sts. to A. M. Green, of Germantown; estimated cost, $150,000.

PHILADELPHIA, PA.—Bids are asked until Oct. 12 for erecting a 3-story brick stable. Arch., G. A. Geiger, 1330 Poplar St.

PITTSBURG, PA.—Bids are asked until Oct. 12 for erecting a steam ventilating building, and also for making a number of improvements about city buildings. Arch., H. S. Bair, City Hall; J. O. Brown, Dir. Dept. Pub. Safety.——The St. Margaret's Hospital Co. has been granted a permit for a hospital and a boiler house on 56th St., between Lawrence and Davison Sts., to cost $250,000. The building will be of brick 350 × 150 ft., also by the board of education for a new school building, 126 × 75 ft., to cost $50,000. Work was begun on this school last August by Wm. Kerr's Sons. Arch., U. J. L. Peoples, 116 4th Ave.

PITTSBURG, PA.—T. H. Scott, Standard Bldg., is preparing plans for additions to the building owned by Frank McCann. The addition will be a 6-story hotel.——W. F. Trimble & Sons have been awarded the contract for erecting a 6-story brick warehouse on Penn Ave. for Chas. Lockhart; estimated cost, $44,094.

WILKES BARRE, PA.—It is reported that the prison commissioners have advertised for bids for furnishing and putting in place a new boiler in the county prison.

BALTIMORE, MD.—Bids are asked until Oct. 13 for a new tin roof on the main portion of the U. S. custom house in this city. F. T. Shaw, Custodian.

WASHINGTON, D. C.—Bids are asked until Oct. 13 for remodeling the hydraulic elevator machinery in the Winder Bldg., in this city. W. M. Aiken, Supervising Arch., Washington.

WASHINGTON, D. C.—Bids are asked until Oct. 28 for the interior finish of basement, first floor, etc., of the post office building in this city. W. M. Aiken, Supervising Arch., Washington.

PORTSMOUTH, VA.—The Seaboard Air Line has purchased considerable additional water-front at Portsmouth, along the Elizabeth River, which now gives the company about one mile of open water front terminal facilities, and it will erect large warehouses on the newly-acquired property at once, covering a front of about 400 ft. and running back over 350 ft.

NEWBERN, N. C.—Bids are asked until Oct. 23 for heating and ventilating apparatus for the court house and post office building in this city. Wm. Martin Aiken, Supervising Arch., Washington, D. C.

ATHENS, GA.—Strahan & Sheffield, Archs., Athens, are desirous of securing catalogues from builders and dealers in architectural supplies.

BRUNSWICK, GA.—It is reported that the Southern Ry. Co. has decided to erect a grain elevator in this city. J. W. Lovett, supervisor of bridges and buildings, Atlanta.

SAVANNAH, GA.—The passenger depot of the Plant System, at this place, which was totally destroyed by the wind storm of last week, will be rebuilt.——The freight depots and large warehouses at this place, of the Central R. R. of Georgia and Georgia & Alabama Ry. were partially destroyed by the storm—the roofs and walls being principally destroyed. These will also be rebuilt at once by the companies.

INDIANAPOLIS, IND.—Local papers state that the city comptroller has investigated the advisability of constructing a new city hall on the court house grounds.

CHICAGO, ILL.—John Hauser, 1941 Third Ave., has prepared plans for two 2-story brick flats on 119th St. for Isaac White, to cost $60,000.——Edward W. Curtis, Jr., is reported as preparing plans for three additional floors for the Royal Insurance Bldg., 180 Jackson St.; estimated cost, $100,000.

CHICAGO, ILL.—It is stated that the Heidenreich Construction Co., 541 Rookery Bldg., has been awarded the contract for building a grain eelvator at 59th and Leavitt Sts., for the Pittsburg, Cincinnati, Chicago & St. Louis R. R. Co., Jas. B. Hill, agent, 16 Pacific Ave.

FULTON, ILL.—A fire last week destroyed the main building of the Northern Illinois College, causing a reported loss of $100,000. Pres., R. A. Morley, Fulton.

FREEPORT, ILL.—Julian Barnes, Marquette, Chicago, is reported as preparing plans for a new school building for this city, to cost about $20,000.

CHEROKEE, IA.—Bids are asked until Nov. 17 (postponement from Oct. 6) for constructing the hospital for the insane at Cherokee, according to reports. Archs., Josselyn & Taylor Co., Cedar Rapids, Ia.; E. H. Conger, Co-operative Bank, Des Moines, Ia., Treas.

MILWAUKEE, WIS.—The board of public works has received plans from the following architects for a new $40,000 school building in the 21st Ward: Albert C. Seims and Frank E. Gray, Fernekes & Dollver, Schnetzke & Liebert, W. D. Kimball, Colby & Abbott Bldg.; I. J. Knapp, Builders' & Traders' Exchange; H. J. Van Ryn, Merrill Bldg.; Marshall & Ryder, Loan & Trust Bldg.; G. A. Dick, Mollerus & Lotter, Rau & Kirsch, 1 Grand Ave.; Charles A. Fink, Metropolitan Bldg.; John Jacobi, 279 3d St.; John Van Roo, of Milwaukee; and A. K. Aldrich, of Galesburg, Ill.

BLAIR, NEB.—Bids are asked until Oct. 10 for erecting a 2-story brick store, 100 × 48 ft. Address, Sas Bros., Blair.

OMAHA, NEB.—The following bids were received Sept 29 for plumbing and gas piping for the U. S. public building in this city; W. M. Aiken, Supervising Arch., Washington, D. C.: J. J. Hanighen, Omaha, $8,625, time, 90 days; Theo. Heuck, 110 S. 14th St., Omaha, $10,941, 3 months; Bellany & Horning, Omaha, $12,344, 3 months; John Rowe & Co., Omaha, $10,650, 90 days, and W. W. Sykes & Co., Minneapolis, Minn., $10,813, 90 days.

KANSAS CITY, MO.—The supervising architect, Washington, D. C., received the following bids Sept. 25 for the iron and steel work for roof, etc., of the U. S. public building in this city, as advertised in Engineering News:

		Time.
Wisconsin Bridge & Iron Co., Milwaukee.	$8,665	60 days
Fort Pitt Bridge Works, Pittsburg.......	9,790	58 days
Haugh-Woelke Iron Works, Indianapolis.	7,005	60 days
Milwaukee Br. & Ir. Wks., Milwaukee..	9,978	60 days
Gillette-Herzog Mfg. Co., Minneapolis...	7,973	60 days
Missouri Valley Br. & Ir. Wks....	7,965	60 days
Stewart Iron Works, Cincinnati, O......	8,888	60 days
L. Schreiber & Sons Co., Cincinnati, O..	8,960	60 days
Universal Construction Co., Chicago....	7,428	3 mos.
Brown-Ketcham Iron Wks., Indianapolis.	7,404	60 days
Thos. Marshall, Pittsburg, Pa....	7,999	4 mos.
Kansas City Wire & Iron Wks., Kan. City.	8,886	60 days
Koken Iron Works, St. Louis, Mo.......	9,100	60 days
Snead & Co. Iron Works, Louisville, Ky.	9,582	60 days

——W. F. Hackney, Beals Bldg., has prepared plans for a new $100,000 manual training school building in this city.

LA JUNTA, COLO.—The county commissioners are considering the question of a new court house, to cost $15,000.

GALVESTON, TEX.—The Galveston, La Porte & Houston Ry. Co. has purchased two blocks of land for a station in this city. Ch. Engr., H. J. Simmons, Houston.

HOUSTON, TEX.—Bids are asked until Oct. 15 for the metal work for the range beacon, fogbell signal, etc., and for constructing an oil house, wharf, boat house, etc., at the Brazos River Light Station, Tex. Maj. J. R. Quinn, U. S. Engr., New Orleans, La.

SEATTLE, WASH.—Plans have been prepared for about $90,000 worth of improvements to the Mutual Life building on Pioneer Place. Arch., W. E. Boone, 717 New York Life Bldg., Seattle.

PASADENA, CAL.—Plans and specifications have been prepared for the United Presbyterian Church to be built at Los Robles Ave. and Colorado St.

OAKLAND, CAL.—Chas. Mau, 957 Broadway, Oakland, is reported to have prepared plans for a $30,000 house for the Acme Athletic Club.

SALINAS, CAL.—W. G. Hind is preparing plans for Adam Lang for a 3-story hotel building on his lot on Castroville St. in this city.

LOS ANGELES, CAL.—It is reported that Mr. Potter is to erect a $100,000 hotel in this city. C. W. Gray, Los Angeles, can probably give information.

SAN FRANCISCO, CAL.—The Pacific Union Club is considering sites for its proposed new clubhouse.——The board of fire commissioners have filed plans for two new fire department buildings.——The Spring Valley Water-Works has also filed plans for a 6-story building at Geary and Stockton Sts., to cost $30,000; Arch., Clinton Day, Mutual Life Bldg.——J. H. O'Brien has been awarded the contract for a new roof for the old City Hall at $197,000. Archs., Shea & Shea, 26 Montgomery St.

SAN FRANCISCO, CAL.—The appropriation of $200,000 for the Mission High School has been approved by the board of supervisors. A site will now be chosen and the work of construction begun at once.

TULARE, CAL.—Bids are asked until Oct. 10 for constructing the Elk Bayou school building. A. V. Berry, Chn. Trustees.

WHITTIER, CAL.—Bids are asked until Oct. 17 for erecting a $30,000 trades school building. Supt. J. E. Coffin, Whittier; C. H. Keyes, Chn. Com., Berkeley, Cal.

SALT LAKE CITY, UTAH.—An addition is to be built to St. Mark's hospital, 100 × 30 ft. The building when completed will enable the hospital to admit about 100 patients.

ST. JOHN, N. B.—Bids are asked until Oct. 10 for erecting a warehouse on Water St., for W. H, Thorne. Arch., G. E. Fairweather, 84 Germain St.

WATER-WORKS.

DEERING, ME.—There is some prospect that the city will investigate the desirability of securing a water supply from Duck Pond, with a power plant.

BOSTON, MASS.—Bids are asked until Oct. 16 for furnishing 42 and 48-in. cast-iron water pipe, as stated in our advertising columns. F. P. Stearns, Ch. Engr.; W. N. Davenport, Secy., 3 Mount Vernon St.

PAWTUCKET, R. I.—The council has appropriated $7,000 for extending water mains.

PAWTUCKET, R. I.—Efforts are again being made to secure an extension of the water mains to Marieville.

DARIEN, CONN.—The plant of the Darien Water Co. partially completed, is reported to have been sold to the Stamford Water Co.; work to be resumed at once.

CANASERAGA, N. Y.—The water commissioners are reported as advertising for bids for completing the reservoir, which was not accepted from the contractor.

CASTLETON, N. Y.—An election was held last week, according to reports, to vote on an issue of $25,000 in bonds for water-works.

CHERRY VALLEY, N. Y.—The contract for trenching and pipe-laying has been awarded to George Monahan, of Richfield Springs, at $9,500.

DANSVILLE, N. Y.—The $60,000 in water bonds have been awarded to the City Bank of Buffalo, at 3% premium. The bonds will bear 4½% interest and will mature in 1921, with option of call after 1901.

ELMIRA, N. Y.—The Elmira Heights trustees have authorized a contract with the Elmira Heights Water Co. for the construction of works; water supply to be pumped from artesian well to a reservoir; hydrant pressure 110 lbs.

HARTWICK, N. Y.—The Hartwick Water-Works Co. was incorporated Oct. 5 with a capital stock of $18,000, by R. T. Luce, J. M. Bush and A. D. Beach.

KINGSTON, N. Y.—The contract for constructing new reservoir and connecting pipe line has been awarded to Miles Tierney, the bids being as follows:

Hilt & Johnson, Albany, N. Y.	$72,163
Francis Curnan, Rhinebeck, N. Y.	68,614
Campbell & Dempsey, Kingston	60,076
Steward & Rexford, New York	58,480
Clinton Beckworth & Co., Herkimer, N. Y.	57,337
Miles Tierney, New York	53,478

LANSINGBURG, N. Y.—The commissioners are considering the advisability of increasing the water supply by sinking artesian wells.

NEW YORK, N. Y.—Bids are asked until Oct. 27 for building a reservoir and dam at Byram Pond, a channelway to convey the waters of Stony Brook into this reservoir, and improving the channel of Byram River in the towns of North Castle and Bedford; also for the construction of archway and roadway under the old Croton aqueduct on the line of Burnside Ave., 24th Ward. C. H. T. Collis, Comr. Pub. Wks.

NIAGARA FALLS, N. Y.—The board of public works has requested an appropriation for repairing the pumps and pump house.

NYACK, N. Y—The water commissioners have reported to the village trustees in favor of a gravity supply from Spring Valley. James S. Haring, Engr.; E. H. Cole, Clk.

POTSDAM, N. Y.—This village will probably construct a gravity system or a new pumping plant with a system of filters in the near future. W. F. P. Sealy, Supt.

POUGHKEEPSIE, N. Y.—The council has appropriated $3,000 to complete the new filter bed. Chas. E. Fowler, Supt. Pub. Wks.

WHITESBORO, N. Y.—The incorporation of the Whitesboro Water Co. was noted last week. The Utica Water Co. has offered to extend its mains through this village for $2,500 and place 20 hydrants for $100 each per year; municipal works are estimated to cost about $21,000, with $2,380 annual expense. At a public meeting, Sept. 28, it was decided not to construct works but to purchase a steam fire engine instead, at a probable cost of about $3,500.

CAMDEN, N. J.—Jones & Co., bankers of Philadelphia, have disposed of the $200,000 in 30-year 4% water bonds at par.

CLINTON, N. J.—The Clinton Water & Supply Co. was incorporated Oct. 2, with a capital stock of $2,000, commencing with $1,000, by J. M. Johnson and H. G. Frederick, Millersburg, Pa., and W. H. Johnson, C. W. Leigh and others, of Clinton, N. J.

EGG HARBOR CITY, N. J.—The committee appointed about a year ago has reported in favor of works and an ordinance providing for a system passed first reading in the council Sept. 29. It is stated that work will be commenced as soon as possible.

BARNESBORO, PA.—The Barnesboro Water Co. was incorporated Sept. 30 with a capital stock of $15,000, by John Barnes, of Barnesboro, Thos. Barnes, George W. Zeigler, of Philipsburg, and others.

CARLISLE, PA.—M. P. Quinn, of Pottsville, commenced work last week on the proposed plant of the Carlisle Water Co.; water supply from Boiling Springs, 14 miles distant. It is hoped to have the plant completed by Jan. 1.

EMSWORTH, PA.—The Valley Water Co. of this place has published notice of intention to apply for a charter. T. Lee Clark, E. S. Reynolds, A. C. Shaw and W. L. Sloan are interested.

FAYETTE CITY, PA.—Application will be made Oct. 26 by H. C. Huston, M. B. Cutter, Andrew W. Black and others for a charter for the Fayette Water Co., to supply the township of Lower Tyrone, Fayette county.

LANCASTER, PA.—The special committee has approved the plans of S. M. Gray for an improved water supply estimated to cost about $112,000, as follows: 4,800 ft. of 16-in. low service main, $8,640; 5,600 ft. of 30-in. force main, $32,480; gates, valves, etc., $3,500; stand-pipe, $20,000; two 200-HP. boilers, $7,000; one 12,000,000-gallon pump in exchange for old pump, $40,000.

McKEESPORT, PA.—The East McKeesport Water Co. is reported as soon to erect a large pumping station on the banks of the Monongahela River, opposite Duquesne.

NORRISTOWN, PA.—A press report, Oct. 2, states that the Springfield Water Co., comprising nine water companies in Montgomery, Bucks and Delaware counties, has filed a mortgage in favor of the Columbia Ave. Saving Fund, Safe Deposit, Title & Trust Co. for $3,000,000, to secure 30-year 5% bonds to that amount.

PHILADELPHIA, PA.—Local papers announce that the filtration schemes are now being agitated in the councils and it is believed that the proposed loan of $3,000,000 for a system of filters will soon be authorized.

PITTSBURG, PA.—The filtration committee is reported to have voted to visit the plants in operation at Lawrence and Lowell, Mass.

WEST CHESTER, PA.—An extension of the water supply is contemplated, but no steps have yet been taken. D. J. Scott, Pres. Council; E. A. Mercer, Supt. W. W.

CHARLOTTESVILLE, VA.—Surveys for an additional water supply for this city have been completed; length of line 16 miles, with a masonry dam at the head of Moormans River, in the Blue Ridge Mountains. C. D. Carter, Chn. Com.; C. E. Dickinson, Engr.

LUMBERTON, N. C.—Artesian wells are being sunk and it is probable that a system of water-works will be constructed. E. K. Proctor, Jr., Mayor.

ADAIRSVILLE, GA.—The "Banner" of this city is agitating the early construction of works.

AUGUSTA, GA.—The committee has recommended extensions of the mains in West End.——The Augusta "Herald" urges that steps be taken for a new water supply.

COCHRAN, GA.—There is talk of constructing works and an electric light plant.

CLEARWATER, FLA.—F. W. Maloney, superintendent for George H. Fernald, left Sanford last week to begin the construction of water-works at Clearwater, H. B. Plant's new city.

FLORENCE, ALA.—The city purchased the works at the sale Sept. 30 for $125,000. T. A. Howell, Supt.

ONEONTO, ALA.—Efforts are being made to secure the construction of water-works.

HILL CITY, TENN.—Chattanooga papers state that water-works will probably be constructed at this place after the election.

MILAN, TENN.—This place will soon have water-works, according to reports.

SOUTH PITTSBURG, TENN.—This city was reported last week as on the verge of a water famine, owing to the dry weather.

FRANKLIN, KY.—An election will be held Nov. 3 to vote on an issue of $21,000 in bonds for the construction of municipal works. James N. LaRue, Mayor; S. N. Forline, City Clk.

LANCASTER, KY.—John E. Stormes is reported as receiving bids for sinking an 8 and 6-in. artesian well 1,000 to 1,500 ft. deep.

CANTON, O.—L. E. Chapin, Cy. Engr., has been directed to make surveys and estimates for getting more well water, also for an improved water supply.

EAST CLEVELAND, O.—Bids are asked until Oct. 17 for furnishing and laying a water main in Euclid Ave. George L. Quayle and A. F. Ingersol are the committee. ——The council has rejected the two bids received for the $35,000 in water bonds.

HIRAM, O.—B. S. Dean, Clk. Bd., informs us that it has been found necessary to postpone the water-works construction; all bids have been rejected and the work will be readvertised late in the winter so as to put in the plant early in the spring.

ZANESVILLE, O.—Bids for a 6,000,000 or 8,000,000-gallon pumping engine were received Sept. 28 as follows: Nordberg Mfg. Co., Milwaukee, $22,424 to $33,305; Snow Steam Pump Co., Buffalo, $13,017 to $24,848; Laidlaw-Dunn-Gordon Co., Cincinnati, $12,228 to $36,730; Holly Mfg. Co., $18,500 to $22,515; Henry R. Worthington, $13,900 to $23,365. T. D. McCaddon, Secy.

LEAVENWORTH, IND.—At a meeting Sept. 29 the citizens subscribed $5,000 toward water-works, which will probably be built by a company; it is hoped to have the plant in operation by Dec. 1.

MUNCIE, IND.—C. C. Brown, Consult. Engr., Indianapolis, has reported to the council in favor of increasing the pumping and boiler plant about 50% and of improving the distribution system.

DELRAY, MICH.—Efforts are being made to secure a village charter; there is talk of water-works to cost $20,000, fire department $8,000, electric lights and other improvements.

WYANDOTTE, MICH.—The city clerk has been authorized to advertise for bids for two new boilers for the water-works.

BLUE ISLAND, ILL.—Bids are asked until Oct. 19 for furnishing and laying a 6-in. cast-iron water main in three streets. P. R. Fletcher, Village Engr; Fred Hohmann, Village Clk.

CHICAGO, ILL.—Bids are asked until Oct. 12 for laying water service pipes in eight strets.——The amount of deposit for pumping machinery, as advertised in Engineering News, has been changed from $25,000 to $10,000. Joseph Downey, Comr. Pub. Wks.

KANKAKEE, ILL.—The asylum authorities have commenced the construction of a new reservoir 70 ft. long and it is stated that a filter plant will be put in.

LAGRANGE, ILL.—This village is reported as much exercised over the condition of the water supply, which is believed to be polluted.

PLYMOUTH, ILL.—It is reported that ordinances have been adopted to bond the town for $3,000 for a water supply.

SUPERIOR, WIS.—It is reported that more wells will be sunk next spring.

WAUKESHA, WIS.—James K. Anderson, Pres. Waukesha Water Co., has made a proposal to the Chicago board of education to furnish the public schools with pure spring water through the line built for the World's Fair.

SIDNEY, IA.—Bonds to the amount of $10,000 have been voted to extend the water-works; will commence construction as soon as bonds are sold.

DULUTH, MINN.—Bids are asked until Oct. 23 for furnishing water gates, check valves, etc.; also for trenching and laying 1,500 ft. of 60-in. steel intake pipe and for placing the submerged crib at the outlet end. W. B. Patton, Cy. Engr.; M. J. Davis, Pres. Bd. Pub. Wks.

EAGLE BEND, MINN.—Bids are asked until Oct. 17, according to reports, for boring a well. Peter Munch, Clk. School District 85.

MILACA, MINN.—It is reported that bonds have been voted for water-works.

WHITE SULPHUR SPRINGS, MONT.—M. S. Parker, of Great Falls, has reported that works can be constructed for $30,000; no definite action yet taken.

KANSAS CITY, KAN.—It is reported probable that the Metropolitan Water Co. will construct a large reservoir, abandoning the Kaw Point pumping station and pumping its entire supply at Quindaro.

FORT SMITH, ARK.—The Municipal Water Co. is reported about to commence the construction of settling basins and other improvements to cost about $40,000. Pres., Geo. M. Myers, Kansas City; Supt., S. T. Rosamond.

PALESTINE, TEX.—A contract was closed Sept. 24 with J. W. Brynes & Co., of Galveston, according to press reports, to construct works for $90,000; water supply from wells; council has refused to purchase the present plant.

TRINIDAD, COLO.—A water company is negotiating for the sale of its plant to the city; company has a 50-year franchise and has heretofore refused to sell.

DENVER, COLO.—The advisory board of health has adopted a resolution urging the appointment of a commission to investigate the sources of water supply and make necessary recommendations.

NEWBERG, ORE.—Bids are asked for the purchase of $15,000 in 20-year water bonds; population, 1,100; no present indebtedness. J. G. Hadley, Cy. Recdr.

ANAHEIM, CAL.—Bids are asked until Oct. 13 for the purchase of $11,000 in water bonds and $7,000 in electric light bonds, as noted in our issue of Sept. 17. C. S. Rogers, of Anaheim, is preparing specifications for the water-works and bids for the construction will be received as soon as the bonds have been sold. M. Nebelung, Cy. Clk.

LOS ANGELES, CAL.—Efforts have been made by the council to purchase the existing plants, but press reports announce that these efforts have been unsuccessful and that the council has instructed the city clerk to advertise for bids for the construction of a water plant adequate to the city's needs.

SALINAS, CAL.—The Salinas City Light & Water Co. was incorporated Oct. 1 with a capital stock of $200,000, commencing with $500, by H. S. Ball, Luther Rodgers, E. P. Iverson and others of Salinas.

MONTREAL, QUE.—The superintendent has reported that the upper level reservoir leaks 70,000 gallons each 24 hours; $120,000 is asked for this and other improvements.

THREE RIVERS, QUE.—A new 9-in. main will probably be laid at an early date. O. Z. Hamel, Supt.

WINNIPEG, MAN.—It is reported that the city council will print the pamphlet describing the proposed water-works with supply from driven wells and distribute the same in time for the electors to vote on an issue of $600,000 in bonds for such a plant next December.

SEWERAGE.

DEERING, ME.—The city engineer has been directed to prepare estimates and to advertise for bids for building a sewer in three streets to cost $4,200. I. W. Barbour, Cy. Engr.

MANCHESTER, N. H.—The question of constructing sewers for draining that portion of the city known as Whittier Land is being considered by the sewer committee. John C. Ray is interested.

BOSTON, MASS.—The aldermen have voted to appropriate $150,000 for sewers. W. J. Donovan, Alderman from East Boston, is interested.

BOSTON, MASS.—Bids are asked until Oct. 13 for building a sewer in Ruggles St., the work to include 9,390 ft. of earth excavation and refill for 2 ft. 6 ins. × 3 ft. brick sewer; 210 cu. yds. brick masonry (American cement mortar); 10 cu. yds. brick masonry (Portland cement mortar); 193 cu. yds. concrete; 14.8 M. ft. B. M. spruce lumber and 217 spruce piles. B. W. Wells, Supt. of Sts.

HOLYOKE, MASS.—J. J. Kirkpatrick, Cy. Engr., writes us that all sewers are built by city laborers. Lyman & Kellogg, of Holyoke, have been awarded the contract for furnishing 1,450 ft. of 24 and 10-in. sewer pipe at 78½% off the price list.

HYDE PARK, MASS.—J. H. McKnight, of Everett, Mass., and T. H. Bryne, of Medford, Mass., have been awarded the contracts for constructing four sections of the sewer system, as advertised in Engineering News. Engr., P. W. Blake, Hyde Park; F. A. Wyman, Chn. Comrs.

MARLBORO, MASS.—The council is reported to have voted to issue $4,000 in bonds for new filter beds. C. F. Bigelow, Cy. Engr.

QUINCY, MASS.—C. F. Knowlton, Comr. Pub. Wks., writes us that an appropriation of $68,000 for building one section of the brick main sewer has been ordered to a second reading in the council and will probably be passed this fall. Surveys and plans are all prepared. E. W. Branch is the official in charge.

STONEHAM, MASS.—Ferguson & Quimby, of Boston, have the contract for building six miles of sewers and the city will build three miles by day labor. Des. Engr., B. R. Felton, 10 Tremont St., Boston; L. L. Gerry, Engr. and Supt. of Streets.

UXBRIDGE. MASS.—Edward Parker, Town Clk., writes us that no action has yet been taken on the Dribble Tail Brook sewer.

WORCESTER, MASS.—S. M. Gray, Providence, R. I., and T. M. Drown, Pres. Lehigh University, Bethlehem, Pa., have been engaged to consult with F. A. McClure, Cy. Engr., in regard to the purification of the sewage of this city; estimated cost, $890,000.

WARREN, R. I.—We are informed that no sewers will be built at present. Plans for a complete system have been prepared by Chas. F. Chase, 75 Westminster St., Providence, R. I.

MIDDLETOWN, CONN.—The sewer committee has recommended the construction of 500 ft. of brick sewer in North Main St. E. P. Augur, Cy. Engr.

TORRINGTON, CONN.—Surveys are being made for a storm sewer in Main St.

JAMAICA, N. Y.—The state board of health and the village authorities are again considering the plans for the proposed sewer system. Dr. P. M. Wood, Chn. Sewer Comn.; J. J. McLaughlin, Village Engr.

JAMESTOWN, N. Y.—At an election held Sept. 26 the question of issuing $50,000 in bonds for sewers was defeated. John Conway, Chn. Bd. Pub. Wks.

JAMESTOWN, N. Y.—The board of public works is reported to have been directed to make new plans for the disposal of sewage. The favored plan is to extend the sewers to Cassadaga Creek.

ONEIDA, N. Y.—We are informed that the following bids were received Sept. 29 for constructing two miles of pipe sewers. as advertised in Engineering News; Engrs., Stanwix Engineering Co., Rome., N. Y.; M. J. Dewey, Pres. Comrs.:

John Marsden, Utica, N. Y.	$5,990
L. D. Hurlburt, Syracuse, N. Y.	8,123
E. G. Gay, Oneida	9,045
Makin & Cockman, Niagara Falls, N. Y.	10,007
Fitch & Fisher, Oneida	7,751
F. H. Gott, Buffalo (awarded contract)	5,132

SYRACUSE, N. Y.—The question of constructing the two intercepting sewers into Onondaga Creek to cost $1,000,000 is again being considered. Des. Engr., Samuel M. Gray, 174 Weybosset St., Providence, R. I.; Wm. A. Sweet, Engr., Syracuse.

HOBOKEN, N. J.—Bids are asked until Oct. 28 for rebuilding the sewer in 3d St. M. V. McDermott, Cy. Clk.

NEW BRUNSWICK, N.J.—The contract for constructing pipe sewers, for which bids were received Oct. 5, as advertised in Engineering News, has been awarded to James Gilligan, of New Brunswick, at $6,644. The itemized bids will probably be published next week. Asher Atkinson, Cy. Surv.

ALLEGHENY, PA.—Sewer contracts were awarded last week as follows: Wm. J. Dunn, $754; Sloan, McIlvain & Ott Bros., $3,500; Harvey Sloan, $10,451. D. L. Fulton, Supt. Sewers; Robt. McAfee, Dir. Pub. Wks.

PITTSTON, PA.—The council has let a contract for constructing pipe sewers to Hart & Gibbons, at $3,357.

CLEVELAND, O.—We are informed that the following bids were received Sept. 23 for constructing 3,865 ft. of 8 to 6-ft. circular brick sewer, with junctions and plank sheetings left in trench, all bidders being residents of Cleveland. D. E. Wright, Dir. Pub. Wks.: L. H. Fahey (awarded contract), $41,264; Northern Ohio Paving & Construction Co., $62,528; Clements Bros.' Construction Co., $64,363; Ford P. Beers, $66,710; Campbell Bros., $68,949; W. H. Ford & Co., $75,986; M. Bramley, $83,447; J. Connelly & Son, $86,769.

MARIETTA, O.—Bids are asked until Oct. 29 for improving sewers in the fifth district. Carl Becker, Cy. Clk. ——We are informed that the T. B. Townsend Contracting Co., of Zanesville, O., has been awarded the contract for constructing 42,000 ft. of 24 to 8-in. pipe sewers. W. P. Mason, Cy. Engr.

CRAWFORDSVILLE, IND.—At the last council meeting it was voted to issue $20,000 in bonds to begin a system of sewerage and thereby give employment to the city's poor during the winter. The work is to be done by the city, no contract. No other steps have yet been taken. Steps towards plans will be taken at once. F. Hoffman, Cy. Engr.

INDIANAPOLIS, IND.—Bids are asked until Oct. 14 for constructing a main sewer in five streets; also for 1,110 ft. of 36 to 32-in. brick and about 3,800 ft. of 22 to 6-in. pipe sewers. B. J. T. Jeup, Cy. Engr.

RICHMOND, IND.—Bids are asked until Oct. 16 for constructing a sewer, according to reports; bond, $5,000. J. H. Winder, Clk.; H. L. Weber, Cy. Engr.

DETROIT, MICH.—J. A. Mercier & Co. have been awarded the contract for constructing 1,754 ft. of brick sewer in McClellan Ave., at $3.42 per ft. and James Hanley for constructing a brick sewer in Cadillac Ave., at $1,148. H. D. Ludden, Cy. Engr.

CHICAGO, ILL.—Bids are asked until Oct. 12 for constructing private drains in seven streets and sewers in 25 other streets. Joseph Downey, Comr.——The question of constructing an intercepting sewer north of Fullerton Ave. and south of 39th St. is being discussed by the mayor and the city authorities; estimated cost, $2,225,000. L. B. Jackson, Cy. Engr.

LINCOLN, ILL.—It is reported that this city will soon ask for bids for constructing a sewer system for the Brainard branch. T. S. Davy, Cy. Engr.

WEBSTER CITY, IA.—Nothing definite has yet been done in regard to sewers for this city. Engr., Edward E. Fox, 702, 86 La Salle St., Chicago, Ill.

TOPEKA, KAN.—The council has acted favorably on the report for sewers in North Topeka. W. H. Barnes, Cy. Engr.

ST. PAUL, MINN.—Bids are asked until Oct. 10 for a sewer in Waltham St. John Copeland, Comr. Pub. Wks.; John C. Mueller, Clk.

GALVESTON, TEX.—The commissioners' court is considering the question of draining about 12,000 acres of land in Arcadia, North Arcadia and South Alta Loma; estimated cost about $20,000.

TELLURIDE, COLO.—The Telluride Sewerage Co. has been incorporated by Arthur M. Read, H. H. Daniels and A. E. Pattison, with a capital stock of $25,000, to construct a sewerage system in this city.

PORTLAND, ORE.—The council has decided to construct a 12-in. pipe sewer in several streets. A. N. Gambell, Audr.

SAN RAFAEL, CAL.—Geo. L. Richardson, Cy. Engr., writes us that estimates have been prepared for a system.

SANTA MONICA, CAL.—It is stated that arrangements are being made by the city engineer for constructing sewers in this city.

SONORA, CAL.—Bids are asked until Nov. 2 for constructing a pipe sewer in Sonora Creek. R. Inch, Cy. Clk.

SALT LAKE CITY, UTAH.—L. G. Wilkerson and A. L. Hobson have been awarded contracts for constructing sewers in two streets, at $3,082 and $2,888, respectively. F. C. Kelsey, Cy. Engr.

LONDON, ONT.—It is reported that Chas. H. Rust, City Hall, Toronto, Ont., has submitted a report on the proposed sewer system for this city.

GARBAGE DISPOSAL—STREET CLEANING.

BROOKLYN, N. Y—The following bids were received Oct. 5 for the removal, collection and final disposition of garbage in the city from Jan. 1, 1897, to Dec. 31, 1901, all local bidders; Z. Taylor Emery, Comr. of Health; T. B. Willis, Comr. Cy. Wks:

Thos. F. Byrnes (Holthaus system), $166,000 for 1st year, $180,000 for 2d, $191,000 for 3d, $208,000 for 4th, and $224,000 for 5th year.

Jas. Kane and Geo. Cunningham (Brownlee system), $200,000, $180,000, $185,000, $190,000 and $195,000, respectively, for the five years.

Chas. Hart and I. S. McGiehan (system not stated), $179,500, $184,500, $189,500, $149,500, $199,500.

E. J. McKeever & Bro., $148,400 a year, using the McKay system, or $144,000 for the Brownlee system.

Brooklyn Sanitary Co., F. D. Cranford, Pres.; W. J. Cranford, Secy.-Treas. (Arnold system), $113,000, $117,000, $120,000, $125,000 and $130,000 for a plant on Barren Island, or $90,000, $91,000, $92,000, $93,000 and $94,000 a year for a plant to be erected within three miles of the City Hall.

YONKERS, N. Y—The board of trade has adopted resolutions protesting against the proposed construction of a garbage crematory at the foot of Ashburton Ave.

READING, PA.—The contract for a garbage crematory, as advertised in Engineering News, has been awarded to the Dixon Sanitary Crematory Co., Findlay, O., at $10,000; capacity 100 tons in 24 hours. The bids were published in our issue of Sept. 24.

YORK, PA.—The sanitary committee has recommended that a Dixon Crematory be purchased at a cost of $7,400. The bids were received last month, as advertised in Engineering News. John W. Brant, Cy. Clk.

WASHINGTON, D. C.—The garbage crematory, at the foot of South Capitol St., which has been in operation for five months as an experiment, has suspended operations, and local papers state that the garbage is now conveyed down the river in scows and dumped on a farm. No permit for the erection of a new crematory has yet been secured, owing chiefly to the opposition of residents in each neighborhood where a site has been selected.

HELENA, MONT.—The contract for a new garbage crematory was signed Sept. 28; it will be built by Gebbardt & Wagner.

LOS ANGELES, CAL.—The board of public works is preparing specifications preparatory to advertising for bids for street sweeping, according to reports.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked until Oct. 8 for about 10,000 sq. yds. of macadam paving, 17,000 cu. yds. of excavation, 6,300 lin. ft. of guard rail, etc., in Andover and Troro. T. C. Mendenhall, Chn. Mass. Highway Comn., Worcester; Chas. Mills, Ch. Engr., 4 Mount Vernon St., Boston.——Plans for extending Dorcester Ave. have been submitted to the harbor and land commissioners for approval. The department of parks received the following bids Sept. 29 for building a road in the Arnold Arboretum, the work to consist of 44,600 cu. yds. of loam and earth excavation: T. F. Finneran and M. J. O'Hearn, $13,092; James Doonan, $13,750; F. X. Faucier, $15,152; Neil McBride, $15,909; Andrew Carberry, $17,572; Collins & Ham, $18,177; John Crowley, $20,272; Thomas Minton, $20,778; T. M. Broderick, $21,460; H. P. Nawn, $25,159; John A. Whittemore & Sons, $28,540.

CLINTON, MASS.—The road commissioners have asked for an appropriation of $7,150 for macadam paving and sewers. J. Thissell, Cy. Engr.

LOWELL, MASS.—The Good Roads League was organized in Jackson Hall, Sept. 30, to urge the extension of good roads in this vicinity. Pres., T. P. Hall; Vice-Pres., C. H. Conant; Secy. and Treas., Geo. H Stevens.

QUINCY, MASS.—The board of trade is considering the question of widening and improving Hancock St. from City Square to the Neponset bridge; estimated cost of paving, $99,000. S. O. Moxon, Councilman, and W. B. Rice are interested.

HARTFORD, CONN.—Local papers state that the board of street commissioners has decided next year to pave four streets with sheet asphalt and two other streets with asphalt blocks. Chas. M. Northam, Pres. Comrs.

ARDSLEY, N. Y.—The question of issuing $25,000 in bonds for paving is being considered by the citizens.

BROOKLYN, N. Y.—Bids are asked until Oct. 13 for asphalt repaving in Greene St. T. B. Willis, Comr. Cy. Wks.——The commissioner will at once begin the improvement of certain streets in the interest of bicyclists, to cost $2,100.

NEW YORK, N. Y.—Bids are asked until Oct. 12 for grading and flagging in two streets and for constructing sewers in three streets. L. F. Haffen, Comr. St. Improvements, 2622 Third Ave.——It is stated that work will soon be resumed by James D. Leary on the Harlem River Driveway. A retaining wall 800 ft. long will be built. S. V. R. Cruger, Pres. Pk. Bd., and Samuel McMillan, Park Comr., compose the special commission.

RICHMOND HILL, N. Y.—A committee has been authorized to engage an engineer to prepare specifications for the macadamizing of Briggs Ave.

ROCHESTER, N. Y.—Wm. H. Jones & Sons have been awarded the contract for Medina stone paving in Allen St., at $20,573. E. A. Fisher, Cy. Engr.

SCARSDALE, N. Y.—It is stated that the residents of this place have voted to issue $4,500 in street improvement bonds.

STAPLETON, N. Y.—The board of supervisors of this county at its last meeting, Sept. 25, directed Henry P. Morrison, Engr. County Roads, to make surveys and prepare plans and specifications for about 8½ miles of additional macadam road work. Bids will probably be asked about the end of December for this work.

CAMDEN N. J.—Dr. J. H. Wills, of the Egypt Wheelmen, has petitioned the council for permission to build at the club's expense a bicycle path three-quarters of a mile long in Haddon Ave.

JERSEY CITY, N. J.—Bids are asked until Oct. 12 for about 4,500 sq. yds. of paving, 3,100 cu. yds. of earth excavation, filling, 7,000 sq. yds. of asphalt paving, etc. J. C. Kaiser, Chr. Com.

KEARNEY, N. J.—Bids are asked until Oct. 13 for grading, flagging, etc., in two streets. B. E. Canfield, Township Clk.; W. S. Logan, Town Surv., Midland Ave., Arlington, N. J.

ALLENTOWN, PA.—It is reported that the citizens will vote in November on the question of increasing the debt $350,000 for paving and sewers. R. S. Rathbun, Cy. Engr.

ALLEGHENY, PA.—D. L. Fulton, Supt. Bureau of Highways and Sewers, informs us that A. V. Purnell has been awarded a contract for paving and grading at $23,000.

BELLEVUE, PA.—At the election in November the question of issuing $36,000 in bonds for paving will be voted upon.

CONNELLSVILLE, PA.— S. M. Troust, Borough Engr., writes us that the contract was to be let Oct. 3 for 3,700 sq. yds. of repressed brick paving.

JOHNSTOWN, PA.—John H. Dye, F. E. Cresswell and Chas. Hower are making surveys for the proposed Indiana and Westmoreland counties turnpike. About $9,000 has so far been raised by Dr. W. E. Matthews for the road.

SCOTTDALE, PA.—Bennett & Co. have been awarded the contract for paving Broadway, at $1.29 per sq. yd.

BALTIMORE, MD.—The mayor has approved the ordinances for paving and grading in three streets. Janon Fisher, Cy. Comr.

HAGERSTOWN, MD.—The commissioners have ordered the widening and improvement of two streets. J. E. Roger, Cy. Engr.

SPARTANBURG, S. C.—J. M. Elford, Cy. Clk., writes us that the city is now macadamizing certain streets. Des. Engr., A. Madole; C. M. Amos is the official in charge.

ATLANTA, GA.—Porter King, Mayor, has approved the contract awarded to A. W. Hammond for paving Whitehall St.

AUGUSTA, GA.—It is stated that the Aiken Improvement Society is considering the question of building a wagon road from Aiken to this city.

CHATTANOOGA, TENN.—The city has been authorized to issue $37,000 in 6% street improvement bonds. Robt. Hook, Cy. Engr.

AKRON, O.—Hayes & Sons, of Cleveland, have purchased $46,000 of 5% improvement bonds. S. W. Parshall, Cy. Engr.

CLEVELAND, O.—The board of park commissioners received the following bids Sept. 23 for improving Doan Brook Parkway, all bidders being residents of Cleveland: Northern Ohio Paving & Construction Co., $101,741; W. H. Ford & Co., $114,593; W. J. Gawne, $110,359; Brannan & DeCelle, $80,107; Burnett & Carr, $72,803; and James B. Macdonald, of Fairmount, O., $68,738 (awarded contract).——The following bids were received Sept. 23 for 14,014 sq. yds. of brick paving in East Madison Ave.: M. J. Bromley, $19,106; Brennan & Buettner, $19,347; The N. O. Paving & Construction Co., $19,486; Burnett & Carr, $20,628; Burgess & Gribbin, $23,395. E. A. Roberts, Secy. Bd. Control; D. E. Wright, Dir.

COLUMBUS, O.—The city engineer and the county surveyor are considering the lowering of the grade of West Broad St. Josiah Kinnear, Cy. Engr.

DEFIANCE, O.—It is reported that this city has sold $40,000 of 5% street improvement bonds.

IRONTON, O.—The county commissioners awarded contracts to Harry Brown, J. J. Robinson, Edward Wolfe and Josiah Thompson for building sections of the Branch turnpike.

MARIETTA, O.—Bids are asked until Oct. 26 for brick paving in Fourth St. Carl Becker, Cy. Clk.——W. J. Berry, Bellaire, O., has been awarded the contract for 34,000 sq. yds. of brick paving. W. P. Mason, Cy. Engr.

PLEASANT RIDGE, O.—Bids are asked until Oct. 24 for grading and macadamizing Liberty St., and also John St.; check, $1,000. J. A. Hosbrook, Village Engr., 56 Pike Bldg., Cincinnati; J. B. Hayward, Village Clk.

INDIANAPOLIS, IND.—Bids are asked until Oct. 14 for 1,600 ft. of cement sidewalks.——Resolutions have been adopted for brick paving and sewers in a number of streets.

PERU, IND.—Bids are asked until Oct. 13 for improving certain streets. David Irwin, Cy. Clk.

DULUTH, MINN.—The following contracts have been awarded by the county commissioners for constructing the Miller trunk road: Gulbrandson Bros., section No. 4, $6,716; P. McDonnell, No. 5, $6,450; W. H. Randall, No. 6, $5,215; C. H. Chaffee, section No. 11, four miles, $4,997. Contracts for other sections are also to be let, making the cost about $60,500. John Hawkinson, Supt. of County Roads.

ST. PAUL, MINN.—Bids are asked until Oct. 12 for grading in a number of alleys. John Copeland, Comr.

KANSAS CITY, MO.—The board of park commissioners has rejected the bids for paving Scarritt Ave., at $1.77 per sq. yd.——F. G. Trestrail has been awarded the contract for paving a portion of Grand Boulevard at $1.68 a sq. yd. H. A. Wise, Cy. Engr.

PORTLAND, ORE.—The question of paving First St. with brick is being considered. T. M. Hurlburt, Cy. Surv.

CLOVERDALE, CAL.—The residents of Yorkville are discussing the question of building a road to Fish Rock; and a committee has been appointed by the supervisors to make a report.

EUREKA, CAL.—At the election Nov. 3 the question of issuing $30,500 in bonds for building roads will be voted upon. F. E. Herrick, Surv., Eureka; H. D. Smith, F. Z. Roynton, Com.

SANTA BARBARA, CAL.—The supervisors are considering the question of building a new county road over the Santa Ynez Mountain, to cost about $12,000. F. F. Flourney, County Surv.

SAN RAFAEL, CAL.—Geo. L. Richardson, Cy. Engr., informs us that A. E. Buckman, San Francisco, Cal., has been awarded the contract for grading and macadamizing Fourth St. at $12,000, and E. Schwieran, San Rafael, for grading one section of Irwin St. at $1,500.

MANUFACTURING PLANTS.

BOSTON, MASS.—The "Transcript" says that plans have been submitted by J. C. Spofford for a machine shop to be erected in Marginal St., East Boston, near Jeffries St., for J. H. Long. The plans are for a frame structure, 75 × 100 ft., two stories high, and will cost about $6,000.

BROCTON, MASS.—H. H. Howard and others have leased the old Sawtel caster factory for the manufacture of wire nails, and are putting in machinery for the purpose. The concern, it is said, has orders for its product which will keep it busy for some time.——The Mawhinney Last Co., which is to remove its plant from Worcester here, has purchased the factory at Montello recently occupied by the Field-Hazzard Co.

FALL RIVER, MASS.—The contract for the erection of a large cotton mill in Mexico is said to have been awarded to D. H. Dyer & Son, of this city.

WORCESTER, MASS.—The directors of the new brewery are reported to have awarded the contract for the foundations of the building to the Webb Granite & Construction Co.

CAMDEN, N. J.—A 2½-story brick building at Point and Pearl Sts., used by two woolen and worsted yarn spinning firms, was destroyed by fire Oct. 3. Sheimer & Boyer and James E. Ackroyd were the losers. The loss is estimated at $100,000; insurance, $85,000 to $100,000.

STIRLING, N. J.—The Stirling Silk Mills were totally destroyed, with their machinery and contents, on Oct. 2; loss about $200,000, on which there is about $150,000 insurance. The mills were owned by Alfred Screull, Plainfield, N. J. The mills will be rebuilt when the insurance is adjusted.

ALLEGHENY, PA.—The American Laundry & Mfg. Co. has taken out a building permit for the erection of a 2-story and basement brick building at Madison Ave. and O'Hara St., to cost $13,500. William Lang is president of the company.

BLOOMSBURG, PA.—A wind storm on Sept. 30 destroyed the buildings of the Bloomsburg Mfg. Co. and the Brass & Copper Co. The School Furniture Co. lost the roof, stack and the end of its building. The Paragon Plaster Co.'s building is completely demolished.

CAMBRIA, PA.—It is reported that the Cambria Iron Co. wil make improvements this year in their plant that will cost from $500,000 to $800,000.

LANCASTER, PA.—The brick planing mill of H. Burd Cassel, collapsed during the storm of Sept. 30, destroying valuable machinery and involving a loss of about $10,000.

PENCOYD, PA.—The Pencoyd Iron Works, of Philadelphia, is preparing to erect another large addition to its plant, according to reports.

PHILADELPHIA, PA.—Hales & Ballinger, 1200 Chestnut St., have prepared plans for a factory for Richard C. Remmey & Son, 2600 Cumberland St., to be five stories high; built of brick and iron with slate and tin roof, steam heat and elevator, and to cost $50,000.

STROUDSBURG, PA.—Chas. W. McMurran, of Hightstown, N. J., as trustee, representing New York capitalists, proposes to erect a large plant for the manufacture of brick.

TITUSVILLE, PA.—A dispatch states that Titusville has secured the silk ribbon factory of Chas. Horne, of New York.

PHILADELPHIA, PA.—H. Disston & Sons, it is said, propose to build a one-story brick and iron boiler house, 94 × 50 ft. at Tacony.

BALTIMORE, MD.—The Anheuser-Busch Brewing Association, of St. Louis, Mo., is reported to have had plans prepared for an ice-plant, etc., to cost about $75,000.

SAVANNAH, GA.—The guano works, of Hull & Co., and the Savannah Guano Co.'s mills, were wrecked by the storm last week; and will be rebuilt. Comer, Hull & Co. lost their entire plant, and will put in an entirely new equipment in the new building which they will erect.

JACKSON, MICH.—The Michigan Central is reported to have set aside $160,000 to be expended in new shop buildings at Jackson Junction.

CHICAGO, ILL.—Fire destroyed a large portion of the Chicago Architectural Iron Works plant Sept. 30. The works are at Oakley Ave. and Kinzie St. Loss, about $25,000. The large building known as the finishing works and warehouse was entirely destroyed.——The city architect is preparing plans for a machine shop, repair shop and storage sheds to be built for the city on Ashland Ave., near 22d St., to cost $60,000.

FARMER CITY, ILL.—A plan is on foot to locate an iron foundry here. It is proposed to erect a number of buildings, the main one to be 200 × 50 ft., three stories high. The foundry part will be 100 × 60 ft., one story high. Three or four other buildings will also be erected. The entire plant to be constructed of brick.

MENDOTA, ILL.—It is stated that a stock company has been organized at this place to build a $60,000 box factory.

MARINETTE, WIS.—The United States Leather Co. is said to be advertising for bids for 2,050 ft. of dock and the dredging of a 90-ft. channel 2,000 ft. long and 10 ft. deep. As soon as the contract is let active work on a tannery will start and it will be running in the early part of 1897. It will cost $500,000.

MONTROSE, COLO.—The Farmers' & Merchants' Flouring Mill was burned Sept. 30. Estimated loss, $53,000.

ALAMEDA, CAL.—Dr. W. S. Halpruner, of 1501 Pacific Ave., is said to be working on a scheme to establish a bicycle manufactory in this city.

MINING.

MOUNT CARMEL, PA.—Messrs. Brennan, Boyle & Foy, of Pittston, have decided to erect a breaker of 450 tons capacity, and sink a slope or shaft on their newly acquired coal land, east of this place; cost about $100,000.

NORTH CAROLINA.—Our correspondent writes us as follows: A number of Northern capitalists have been in Charlotte (the center of the gold mining belt of the state) and in adjoining counties for the past week, looking into the possibilities of the gold mining industry in that locality. Several of them have secured options on tracts of gold-bearing land, and the prospects are that considerable money will be expended in thoroughly testing and developing that section——The mica mines in Mitchell county are now being worked more largely than ever before, all of them being in full blast, and the mica is claimed to be of a superior quality to any heretofore taken out. The best mica, and the most extensive mica mines in this country are now being worked in the western part of the state.——Near Lincolnton, where there are several undeveloped gold mines, nuggets weighing 350 dwts. have been found recently. Over 1,800 dwts. of such nuggets have been picked up at odd times on the property of Major Burton, who lives three miles from Lincolnton.

BUTTE, MONT.—It is reported that new boilers and a new hoisting engine will be installed at the Original mine, W. A Clark, owner.

CENTRAL CITY, COLO.—The Denver "Republican" states that Toensmeier & Co. have taken a new lease on the Alva Adams in Lake district and intend to sink another shaft on the west end of the claim, to a depth of 300 ft., and will connect with the west level of the main shaft at that depth. A new 100-HP. boiler will be placed in the main shaft and they intend to sink another lift of 100 ft., working the shaft to a total depth of 425 ft. ——At the Lotus shaft house, in Russell, necessary repairs are being made to the building to withstand the winter, and owner Sternberger says that he will soon put on a larger plant of machinery, intending to sink the shaft, at present a depth of 475 ft., to a depth of 1,000 ft.

CRIPPLE CREEK, COLO.—The tunnel, owned by the Squaw Mountain Tunnel & Mining Co., has been leased by R. M. Maloney, Lyman White and E. J. Cooper, at $200,000, for 18 months. They are bound by the lease to run 600 ft. of tunnel during the first 12 months, besides other work on the veins already cut. A new plant and machinery will be put in.

BAKER CITY, ORE.—A stamp mill is to be erected at the Maid of Erin mine, on Powder River, in the spring, according to reports. Col. Alexander may be addressed.

SONORA, CAL.—It is stated that the owners of the Confidence mine intend to erect hoisting works, a 30-stamp mill and an electric plant.

VIRGINIA, NEV.—It is said that plans and specifications have been prepared for the building of a new 30-stamp mill near the Clifton tunnel. P. T. Farnsworth, Gen. Mgr.

SANDON, B. C.—The Reco Mining & Milling Co. has been incorporated with a capital stock of $1,000,000, and will at once erect a concentrator and tramway at the Reco mine. On Sept. 22 one of the ore sheds over the tunnel was destroyed by fire; loss, $500. F. T. Kelly is interested in the company.

MISCELLANEOUS CONTRACTS.

BOILERS.—Atlanta, Ga.—The Georgia Ice Co. is reported as about to purchase two new boilers.

FIRE HOSE.—Niagara Falls, N. Y.—The fire and water committee has voted to advertise for bids for 2,000 ft. of fire hose.

WHARF.—Boston, Mass.—Bids are asked by the harbor and land commissioners, 65 Bowdoin St., until Oct. 14 for building a wharf at South Boston flats.

FIRE ENGINE.—Whitesboro, N. Y.—At a public meeting last week it was voted to purchase a steam fire engine to cost about $3,400. Address Dr. W. W. Jones.

RETAINING WALL.—Niagara Falls, N. Y.—The management of the Gorge Road will build a retaining wall, 30 × 50 ft., facing the abutments of the new steel bridge.

SMOKESTACK.—St. Paul, Minn.—Bids are asked until Oct. 9 for a smokestack set up complete at the Centerville pumping station. John Caulfield, Secy. Water Comrs.

HARBOR WORK.—Olympia, Wash.—A local paper states that Savage & Scofield have just been awarded a contract, at about $11,000, for government work on the harbor at Everett.

ROCK CRUSHER.—Lynchburg, Va.—This city will buy a rock crusher and other machinery to be used in improving the streets and roads of the town. La Fayette P. Rodes, Cy. Engr.

DREDGING PLANT.—Wilmington, N. C.—Bids are asked until Nov. 2 for furnishing a new or second-hand dredging plant, as stated in our advertising colums. Lt. Col. D. P. Heap, U. S. Engrs.

CANAL.—Boston, Mass.—The Maritime Canal Co., which proposes to build a canal across Cape Cod, has been authorized by the Massachusetts Railroad Commissioners and Harbor and Land Commissioners, sitting jointly, to issue from time to time the $6,000,000 of stock and $6,000,000 of bonds.

FILLING.—Brooklyn, N. Y.—Bids are asked until Oct. 14 for filling in a portion of the wharf at the foot of 96th St. Engr., E. C. Swezey, Third Ave. and 39th St.; E. R. Kennedy, Pres. Shore Road Comn.

DREDGING.—Sault Ste Marie, Mich.—The Lake Superior Power Co. received four bids last week for dredging at the head of the proposed canal, all at the same price; work will be re-advertised.

ROCK.—Portland, Ore.—Bids are asked until Oct. 29 for furnishing rock and placing same on the north jetty at the entrance to Coos Bay, Ore., as stated in our advertising columns. Capt. W. L. Fisk, U. S. Engrs.

GRADING.—New York, N. Y.—Bids are asked until Oct. 12 for grading about 50 acres at Sandy Hook, N. J., the site of the new post of Fort Hancock. Address Capt. C. A. Devol, A. Q. M., Army Bldg.; Jas. M. Moore, A. Q. M. Gen., U. S. A.

SURVEYS AND MAPS.—Sea Cliff, N. Y.—Bids are asked until Oct. 19 for surveying and furnishing maps of this village, as stated in our advertising columns. C. S. Dunning and G. H. Brouwer, Committee, Room 28, 47 Broadway, New York.

TELEPHONE LINES.—Long-distance telephone lines are to be built between Columbia and Charleston, S. C., and from Charleston to Augusta, Ga., to Atlanta and other points. Dist. Supt. Easterling, of Atlanta, Ga., has the matter in charge.

FLUME.—Cleveland, O.—Bids are asked until Oct. 15 for the reconstruction of the wooden flume in Walworth Run, from the westerly line of Scranton Ave. to a point 250 ft. southerly of the Abbey St. viaduct; check, $200. D. E. Wright, Dir. Pub. Wks.

DRAINAGE DITCH.—Omaha, Neb.—Bids are asked until Ost. 27 for constructing an external drainage ditch in the U. S. public building at Omaha, as stated in our advertising columns. Wm. M. Aiken, Supervising Architect, Washington, D. C.

BELT-POWER ELEVATORS, ETC.—Washington, D. C. —Bids are asked until Oct. 13 for furnishing two belt-power elevators, 3 iron cupolas and 800 tons of coal for the Washington navy yard, as stated in our advertising columns. Edwin Stewart, Paymaster Gen., U. S. N.

DRY DOCK AND MARINE RAILWAY.—Vancouver, B. C.—Press reports state that a marine railway and dry dock which will be able to handle all lumber ships and most steamers arriving at this port, will be constructed by English capital. The site has been chosen near the sugar refinery and the money has been raised.

PARK AND RAILWAY.—The Stribbling Springs Park Co., of Augusta county, Va., has been incorporated to subdivide 3,000 acres into building lots, construct ten miles of electric railway, modernize the hotel and build numerous cottages. Pres., E. D. Root, Winchester, Va.; Engr., C. E. Dickinson, Charlottesville, Va.

BRICK CONDUIT.—Boston, Mass.—The following bids were received Sept. 24 for constructing a 15½ × 17-ft. brick conduit for Stony Brook, section 5: Shea, Chapman & McCalla, New York city (all others Boston), $47,642; H. P. Nawn, $53,655; J. P. O'Connell, $60,613; Metropolitan Construction Co., $63,223; T. O'Leary, $63,326; D. E. Lynch, $77,037; Trumbull & Ryan, $89,008.

CANAL WORK.—Albany, N. Y.—The contract for repairing the steel dam across the Mohawk River at Cohoes, has been awarded to Curringham & Monty, of Sandy Hill, at $11,710.——The bids for rebuilding lock No. 9, Champlain Canal, between Mechanicsville and Stillwater, were as follows:

Jno. Cunningham, Sandy Hill (accepted)	$27,447
Troy Public Works Co., Troy, N. Y.	28,613
Whalen & Higgens, Waverly, N. Y.	28,092
Flood & Sherrill, Sandy Hill, N. Y.	30,739
Beckweth & Quackenbush, Greenbush, N. Y.	30,773
Hilt & Johnson, Greenbush, N. Y.	37,578

STONE DRY DOCK.—Norfolk, Va.—Rear-Admiral Geo. Brown, commandant at the navy yard, has sent to Washington specifications for a new stone dry dock to be constructed at the Norfolk yard. It will be 600 ft. long and 30 ft. deep over the sill, thus having sufficient capacity to hold any vessel afloat. Local papers state that the new timber dry dock has been attacked by worms and although it is only seven years old, it will be worthless in less than six years more. An appropriation of $10,000 will be used for sheathing the timbers of the dock with copper. The material from which the new stone dry dock will be constructed, should the work be authorized, will be the artificial stone manufactured at this yard. This composition is made of washed pebbles, cement and fine sand and is very durable.

PIER WORK, ETC.—New York, N. Y.—Bids are asked by the department of docks until Oct. 13 for repairing and extending pier at West 131st St. and North River.——The department of docks will construct four piers near Washington Market, North River, from 676 to 726 ft. in length and 125 ft. in width, with 250 ft. of open water between them; water to be 35 ft. deep up to the bulkhead line; entire cost of improvement to be $8,000,000.——The North Side board of trade is agitating the question of having the Bronx Kills, which run between the Harlem River and Long Island Sound, converted into a channel 350 ft. wide and 50 ft. deep, in accordance with a Government survey made in 1881, and having the Bronx River widened and dredged to a navigable depth, as far as West Farms. If the Bronx River should be converted into a navigable waterway 100 ft. wide it is claimed it would be of inestimable value to the entire North Side, and would give new and valuable water front two miles long and penetrating well into the 24th ward.

SHIP YARD.—Brooklyn, N. Y.—Owen P. McGowan and others, who recently bought the old Mumm's shipyard, at the foot of 55th St., are said to intend to thoroughly equip it for the repair and building of steam and sailing craft of every description. The improvements involve the dredging out of the basin, new buildings and machinery. The basin will be dredged out to a depth of 20 ft. over an area 135 × 800 ft. This work will be begun soon. Provision will be made for two marine railways, one of which will be capable of handling vessels of 500 tons, and drawing 11 ft. of water. The other will be for those of 200 tons burden and 9 ft. draft. The new boiler and machine shop is 70 × 100 ft. It will be equipped with the latest machinery and appliances. Nearby and connected with the machine shop will be a blacksmith shop. The establishment will also be provided with a large furnace shed for frame setting, plate setting and shop work and a building for the storage and display of plans. It will be some time before the plant is completed.

CONTRACT PRICES.

PUMPING STATION WORK.—New Bedford, Mass.—The following bids were received Oct. 1 for the building of foundations for the engine house, boiler house and chimney and coal shed at the new pumping station, Little Quittacas Pond, and for the laying of 400 ft. of intake into that pond, and for the masonry connection between Little and Great Quittacas, as advertised in Engineering News; Geo. S. Rice & Geo. E. Evans, Engrs., 95 Milk St., Boston; R. C. P. Coggeshall, Supt.:

Quantities.			E. W. Everson, $99,480.	Aab & Co., $89,192.	Steward & McDermott, $86,797.	Acock & Son, $73,235.
Earth excavation	14,000	cu. yds.	$0.75	$1.26	$0.65	$0.35
Borrowed earth	18,000	" "	.35	.50	.30	.30
Rock excavation	100	" "	3.00	1.00	2.00	4.00
Dredging	4,000	" "	1.25	.40	1.50	1.00
Masonry:						
Concrete[1]	1,300	" "	6.00	4.90	4.50	5.50
Concrete[2]	190	" "	8.00	7.00	6.50	6.50
Rubble stone[1]	3,200	" "	7.00	6.90	5.50	4.75
Rubble stone[2]	210	" "	9.00	8.50	6.00	5.75
Rubble stone, dry	100	" "	3.50	3.40	2.50	3.00
Brick, Am.cem. mor	725	" "	14.00	11.50	13.50	10.00
Brick, Port.cem.mor	280	" "	16.00	13.40	15.50	12.50
Brick, white enmld	25	" "	60.00	33.33	70.00	45.00
Dimension stone	150	" "	40.00	22.00	47.50	30.00
Rip-rap in place	1,800	" "	2.00	1.80	2.00	2.50
Hamrd dress'g, stone	2,500	sq. ft.	.65	.60	.70	.75
Piles driven, in place	4,500	lin. ft.	.50	.30	.25	.30
Spruce sheet'g in plc	200	M. ft.	45.00	20.00	35.00	30.00
Spruce timb'r in pl'ce	35	"	30.00	24.00	30.00	30.00
So. pine tmbr in plc	10	"	50.00	38.00	40.00	40.00
Lay'g 40-in. c. i. pipe	54	lin. ft.	6.50	2.70	3.00	2.50
" 30-in. " " "	56	" "	6.50	2.00	2.00	2.00
" 12-in. " " "	100	" "	1.00	.70	.50	1.00
" 8-in. " " "	650	" "	.60	.29	.40	.50
" 6-in. " " "	1,000	" "	.50	.27	.30	.30
Wooden fence	3,000	" "	.50	.20	.35	.30
Hydrants to be set	4		15.00	7.00	10.00	5.00

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[1] American cement mortar. [2] Portland cement mortar.

PUMPING ENGINE.—Toledo, O.—The following bids were received Oct. 1 for furnishing a 15,000,000-gallon pumping engine, as noted in Engineering News, of Sept. 17; T. R. Cook, Supt.; J. D. Cook, Consult. Engr.:

Bids for 15,000,000-gallon Pumping Engine, Toledo, O., Oct. 1, 1896.

Bidder.	Class of engine.	Diam. cylinders, ins. h.p.	Diam. cylinders, ins. int.	Diam. cylinders, ins. l.p.	No. cylinders.	Size plunger, ins.	L'gth stroke, ins.	Piston speed ft. pr.min.	Duty.[1]	Steam pressure, lbs.	Price.
Geo. F. Blake Mfg. Co.	Vert. Triple.	30	52	79	3	30	60	100	135,000,000	125	$79,500
Geo. F. Blake Mfg. Co.	Vert. Triple.	26	44	65	3	24½	60	150	135,000,000	125	69,100
Geo. F. Blake Mfg. Co.	Cross Comp.	38	..	76	2	36¾	60	100	125,000,000	125	75,500
Geo. F. Blake Mfg. Co.	Cross Comp.	31	..	67	2	30	60	150	125,000,000	125	62,800
Holly Mfg. Co.	V. Crs.-Com.	30½	..	61	2	26	60	200	115,000,000	125	42,250
Holly Mfg. Co.	Vert. Triple.	27	46¾	69	3	30	60	200	135,000,000	125	53,175
Holly Mfg. Co.	Vert. Triple.	27	46¾	69	3	30	60	200	135,000,000	125	55,350
Fraser & Chalmers	Single.[2]	20	22	49	3	20	36	...	135,000,000	160	77,820
H. R. Worthington	Vert. Comp.	30	..	60	4	(2) 32	60	140	110,000,000	125	52,000
Manistee Iron Works	Vert. Triple[3]	23	40	61	3	(6) 22	96	200	135,000,000	...	75,000
Manistee Iron Works	Vert. Triple[4]	35	55½	85	3	(3) 32	60	...	135,000,000	...	85,000

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[1] Lbs. of water raised 1 ft. per 100 lbs. of coal; evaporation 10 lbs. [2] Seventy revolutions, 125,000,000 duty at half speed; includes foundation. [3] Includes foundation and removal of old pump. [4] Direct-connected.

BRICK PAVING.—Albany, N. Y.—The following bids were received for paving Second St., from Ten Broeck to Knox St., with vitrified brick; all local bidders:

Quantities.	R. H. Strong[1]	Mulderry Bros.[2]	Callanan & Co.[3]	T. H. Dumary.[4]
Brick paving 8,890 sq. yds.	$2.05	$2.04	$1.97	$1.97
Pav'g relaid 100 " "	.45	.25	.25	.50
Sidewalks:				
Vit. brick 30,000 sq. ft.	.07	.085	.10	.09
4-ft. flag 7,000 " "	.13	.145	.16	.13
Relayg wlks 30,000 " "	.04	.035	.07	.035
Straight curb, 5,890 ft.	.65	.84	.95	.50
Circ'lar curb 260 "	.65	.84	.95	.50
Curb reset 75 "	.10	.12	.12	.20
Alley basin 1	70.00	75.00	80.00	25.00
Days to complete work	350	240	250	150
Total	$27,170	$28,513	$30,370	$25,728

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[1] Catskill brick and New York cement; [2] Mack brick and Hoffman cement; [3] Catskill brick and Hoffman cement; [4] Catskill or Canton brick and Hoffman cement.

DREDGING.—Norfolk, Va.—The following bids were received by Capt. Thos. L. Casey, U. S. Engrs., Sept. 28 for dredging the harbor at Norfolk, at its approaches, as advertised in Engineering News:

Bidder.	Amount bid, cu. yd.	Daily amt guaranteed excav., cu. yds.	Time. Commence.	Time. Complete.
Virginia Dredging Co., Richmond	$0.108	2,000	30 dys.	10 mos
Elijah Brainard, New York	.099	5,500	10 "	10 "
Sanford & Brooks, Baltimore	.099	4,000	30 "	10 "
P. Sanford Ross, Jersey City	.097	3,500	30 "	10 "
Morris & Cumings D'g Co., N.Y.	.08¾	2,000	20 "	10 "
Chester T. Coler, Norfolk, Va.	.135	2,500	7 mos.	12 "
Balt. Dredging Co., Baltimore	.10	3,000	10 dys.	10 "
Rittenhouse R. Moore, Mobile, Ala.	.109	3,000	60 "	10 "
American Dredging Co., Phila.	.102	4,000	20 "	10 "

REPAIRING ASPHALT PAVING.—Omaha, Neb.—Judge Powell has refused to grant an injunction restraining the city from contracting with John Grant for repairing asphalt paved streets. The bids were received in June and the contract has since been awarded. It covers 40 paving districts, aggregating 200,000 sq. yds., and is for five years, the price to be paid being 98 cts. to $1.10 a sq. yd. for repairs actually made.

NOTE:—The reader will observe that these last two pages of Construction News are numbered consecutively with the loose part of the Supplement. The leaf may be readily cut out and pasted thereto by those who keep the Supplement on file.

MACADAMIZING.—Council Bluffs, Ia.—The following bids were received Sept. 25 for macadamizing a roadway in Broadway, from 12th St. to the bridge, about five miles; class A for macadam composed entirely of limestone and class B for macadam composed of a bottom course of limestone and a top course of Sioux Falls granite; prices are per cubic yard:

Bidder.	Class A.	Class B.	Grading.
L. W. Furnas	$2.70	$3.50	$0.20
F. H. Guanella	1.78½	2.37	.34
J. J. Hughes	1.97¾	2.19	.25
E. Van Court & Co.	1.89	2.45	.35
E. A. Wickham	1.83½	2.35	.25
J. E. Riley	2.37½	3.00	.27

The lowest bids on stone alone, omitting grading, give the following totals: Class A, 16 ft. wide, $10,471; 18 ft. wide, $11,781; 20 ft., $13,089. Class B, 16 ft. wide, $12,847; 18 ft. wide, $14,454; 20 ft., $15,059. Awarding of contract was postponed one week. Thos. Tostevin, Cy. Engr.

METAL MARKET PRICES.

FOUNDRY PIG IRON.—New York: $11 to $12. Pittsburg: $10.75 to $11.50. Chicago: $10.50 to $11.50.

LEAD.—New York: 2.7 to 2.8 cts. Chicago: 2.6 cts. St. Louis: 2.55 to 2.6 cts.

BARB WIRE.—Pittsburg: $1.75 to $1.80 for galvanized and $1.55 and $1.65 for painted in carload and less than carload lots at mill.

NAILS.—Pittsburg: $2.55 per keg for carload lots and $2.65 for less than carload lots of wire nails at mill, $2.30 and $2.40 for cut nails at mill. Chicago: $2.70 and $2.80 for wire nails, $2.45 and $2.55 for cut nails. New York: $2.70 and $2.80 for wire nails and $2.45 and $2.55 for cut nails.

SCRAP.—Car wheels, $10.50 to $11.50; wrought turnings, $9 to $9.50; cast borings, $7 to $7.50, all delivered at purchasers' works; hammered car axles, $15.50 to $16, delivered at New York; wrouought pipe and tube, $7.50 to $8, delivered at New York: No. 1 railway wrought, $11 to $12; cast machinery, $11 to $11.50 at mill.

TRACK MATERIAL.—New York: angle bars, 1.2 to 1.3 cts.; spikes, 1.6 to 1.65 cts.; track bolts, 1.85 to 1.95 cts. with square and 1.95 to 2.05 cts. with hexagon nuts. Chicago: angle bars, 1.4 to 1.45 cts.; spikes, 1.7 to 1.75 cts.; track bolts, $1.95 to 2 cts. with square, and 2.05 to 2.1 cts. with hexagon nuts.

RAILS.—New York: $28 at eastern mills and $28.75 at tidewater; old rails, $12.50 to $13.50 for iron, and $11 to $11.50 for steel; light rails, $29; girder rails, $28 up to 7-in., and $30 for over 7-in. rails. Pittsburg: $28 for standard sections of 45 lbs. and over; old rails, $15 to $16 for iron, and $12 to $13 for steel. Chicago: $29 to $31 for standard sections, $28 for light sections; old rails, $12 for iron and $8.50 to $9 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.7 to 1.75 cts.; channels, 1.7 to 1.75 cts.; angles, 1.35 to 1.4 cts.; tees, 1.6 to 1.7 cts.; universal mill plates, 1.3 to 1.4 cts.; steel plates, 1.35 to 1.45 cts. for tank; 1.45 to 1.55 cts. for shell; 1.6 to 1.7 cts. for flange; 1.8 to 1.9 cts. for ordinary firebox; 2.25 to 2.5 cts. for locomotive firebox. Pittsburg; beams, 1.55 to 1.75 cts.; channels, 1.55 to 1.75 cts.; angles, 1.15 cts.; tees, 1.4 cts.; Z-bars, 1.3 to 1.35 cts.; universal mill plates, 1.2 to 1.25 cts.; steel plates, 1.15 to 1.2 cts.; for tank, 1.25 to 1.3 cts. for shell; 1.35 to 1.4 cts. for flange; 2.5 cts. for ordinary firebox, 2.5 to 3.5 cts. for locomotive firebox. Chicago: beams, 1.7 to 1.8 cts.: channels, 1.7 to 1.8 cts.; angles, 1.3 to 1.35 cts.; tees, 1.55 to 1.6 cts.: universal plates, 1.35 to 1.4 cts.: steel plates, 1.35 to 1.4 cts. for tank; 1.55 to 1.6 cts. for flange; 2.15 to 2.25 cts. for ordinary firebox; 4 cts. for locomotive firebox.

IRON AND STEEL.—According to the reports in the "Iron Age" the outlook is encouraging for a good revival in business after the election shall have put affairs on a sound-money basis. There has been more activity in Bessemer pig in the central west than there has been for some time, and in the Chicago district some large inquiries are in the market. Under moderate transactions, relatively speaking, Bessemer pig has advanced to $11 in the valleys as the asking price for delivery into next year. Steel bars are phenomenally low, only 1 ct. per lb. at Pittsburg. In Pig Iron for foundry purposes the feeling is better and more inquiries are coming forward, although the actual consumption is not believed to have been growing much of late. Makers, notably those of the south, are holding out for better prices, and $7 for No. 2 Foundry at Birmingham is regarded as rock bottom.

At Philadelphia, movements in the iron and steel trade have not been large during the past week, neither have prices appreciated, but there is a strong indication that things are surely shaping for a very decided improvement in the future. So far as actual transactions are concerned, however, there is no particular change from the earlier weeks of the month, and it is not unlikely that similar conditions will rule during October, as manufacturers will not accept ruling prices for long deliveries, and consumers will not pay an advance until the election of McKinley is an accomplished fact.

At Pittsburg, the last week of September was the best for some time, as far as sales of pig iron and steel were concerned. The situation is steadily improving and October is expected to show still further improvement. In the opinion of many people in the trade here, the country could hardly be in better condition for the revival in business which is expected to come with the defeat of free silver at the November election. Stocks are practically exhausted all over the country and railways are badly in need of material and will buy heavily as soon as they can realize on their securities. The extension of electric lines in the next five years will be rapid and will require a large tonnage of iron and steel in various shapes. The fact that stocks are practically extinct is illustrated by the way in which buyers are trying to place orders at present prices, but for deliveries running through the first half of 1897.

At Chicago inquiries are increasing, the demand is becoming more general and confidence is growing on all sides. The railways are particularly prominent in making inquiries for prices, some desiring figures for a year's supplies. The improved feeling appears to be based almost entirely on the belief in McKinley's election, and a great deal of business has been partly placed that is contingent on that event. At the same time there are some influences which are assisting in improving the general situation, one of which is the reduction in freight rates on grain to Eastern points.

INDUSTRIAL NOTES.

THE S. MORGAN SMITH TURBINE WORKS, York, Pa., has recently shipped two 33-in. water wheels to a town in Wisconsin.

MILLER BROS. & CO., Pittsburg, Pa., are stated by the press to have the contract for the erection of a large steel plant at Mariopol, Southeastern Russia.

THE NILES TOOL WORKS, Hamilton, O., it is reported, will soon ship a number of planers and boring machines to Italy and Austria.

THE HAMILTON MACHINE TOOL CO., Hamilton, O., has completed, it is said, another order for drill presses to be shipped to Stockholm, Sweden.

B. W. PAYNE & SONS, Elmira, N. Y., boiler manufacturers, have had their plant attached by the sheriff. The assets of the firm are stated to be $260,000.

THE JAMES McKINNON PILE DRIVING & BRIDGE BUILDING CO., Providence, R. I., has been dissolved by mutual agreement. James McKinnon will continue the business under the firm name.

THE BROOKLYN HEIGHTS RY. CO., Brooklyn, N. Y., has put into service 14 new cars from its own shops. These cars are fitted with electric buttons for the use of passengers in signaling to stop the car.

THE MORGAN ENGINEERING CO., Alliance, O., is reported to have shipped last month 200 tons of machinery to Russia for the new locomotive works there. There were two steam hammers, a hydraulic crane and a hydraulic flanging press.

THE BRIGHTMAN FURNACE CO., Cleveland, O., has sold to the Union Pacific Co., it is said, three large stokers. Contracts are now on hand from the Jewish Orphan Asylum, Cleveland Steam Fitting Co., both of Cleveland, and B. F. Goodrich Co., Akron, O.

THE LACONIA CAR CO., Laconia, N. H., may have a receiver appointed. The capital stock is $200,000; the plant is mortgaged for $150,000 and has outstanding debts of $250,000. The appointment of a receiver is asked so that work may continue on present contracts amounting to $30,000.

THE GATES IRON WORKS, Chicago, Ill., is reported to have shipped two rock crushers, with a daily capacity of 200 tons each, to the Coolgardie gold fields of West Australia. The company has also an order for one of its largest crushers, capacity two tons per minute, for the Basalt Actien Gesellschaft of Kolen, Germany.

THE UNIVERSAL CONSTRUCTION CO., Chicago, Ill., has built a steel car for the Northern Pacific Ry., which has no wood in its construction. The platform is made of rolled steel. It weighs 25,860 lbs., and has a capacity of 80,000 lbs. It is 33 ft. long and standard height. The trucks are massive in construction and the journals are 4¾ × 8 ins. box bearing.

MR. N. F. HUGO, of Duluth, Minn., has the contract for three miles of 42-in. steel force main for the Duluth water-works and is now getting the necessary machinery in place. Mr. Hugo intends to have a plant in operation soon for doing all kinds of structural work, including bridge work. The plates for the force main will be rolled by the Ironton Structural Steel Co., of Duluth.

R. P. & J. H. STAATS, 29 Broadway, New York city, have the contract for the new ferry building for the Pennsylvania R. R. Co., to be erected at the foot of West 23d St., New York city. The building is to be of steel, two stories in height. The same firm has the contract for the new pier and steel shed thereon for the North German Lloyd Steamship Co., to be built at the foot of 2d St., Hoboken, N. J.

THE YOUNGSTOWN BRIDGE CO., of Youngstown, Ohio, is completing a two-span truss bridge for the Pennsylvania Lines Northwest, over the Tuscarawas River. It has contracts for several other bridges for the same company; three girder spans for shipment to Russia; furnace building for the new plant of the Punxsutawney (Pa.) Iron Co.; and among other structural work, several buildings for mining plants in Arizona. Work is also under way on a seven-span bridge for Lewiston, Me., consisting of 85-ft. plate girders, carrying granite pavement.

WM. SKINNER & SONS, Baltimore, Md., are said to have a contract from the Baltmore & Ohio R. R., for ten large freight lighters, for use in New York harbor. Five are covered and the remainder are open freight lighters, equipped with heavy masts and hoisting gear. The latter are for ordinary heavy freight, while the covered lighters are intended principally for moving frozen meats. All the lighters are 80 ft. long, 28 ft. wide and 8 ft. deep. The entire lot is to be finished and delivered by the first of next year and will cost in the aggregate between $40,000 and $50,000.

THE WEST SUPERIOR IRON & STEEL CO., West Superior, Wis., it is said, may be reorganized. It is proposed that the bondholders and creditors shall combine and take possession and operate the plant. The principal obstruction to this is the position of the Land & River Improvement Co., one of the largest stockholders and creditors. The indebtedness of the West Superior Iron & Steel Co. is between $3,000.000 and $4,000,000, of which nearly $1,400,000 is represented by bonds. Mr. John D. Rockefeller is a large bondholder, and is working for a reorganization.

THE JACKSON FILTER CO., 312 North 4th St., St. Louis, Mo., Mr. Powell Jackson, Pres., informs us that it has been awarded the contract for putting in a 500,000-gallon filter for the Sullivan, Ind., water-works, and a 200,000-gallon filter for the Rex Mill Co., Kansas City, Mo.; a 200,000-gallon filter for the St. Charles Hotel, New Orleans, and two 100,000-gallon filters for the Boston Club of New Orleans. Among the plants recently installed by this company are: The 800,000-gallon filters for the Cameron, Tex., water-works; a 200,000-gallon filter for the Century Bldg., St. Louis; a 100,000-gallon filter for the Chemical Bank Bldg., St. Louis; a 300,000-gallon filter for the East St. Louis (Ill.) Ice & Cold Storage Co.; a 300,000-gallon filter in the Planter's Hotel, St. Louis; a 150,000-gallon filter for Anthony & Kuhn Brewing Co., and many filters of smaller capacities.

NEW COMPANIES.—Falls City Chain Works, Louisville, Ky.; $10,000; E. M. Hubbert, Jacob Block and Newton Seibert.

Southern Electric Co., Baltimore, Md.; James F. Morrison, Paul Winsor, John S. Boyd.

Faurot Steam Boiler Mfg. Co., Denver, Colo.; $150,000; Joseph H. Smith, C. B. Ayres, Charles S. Faurot.

Phillipstown Crushing Co., Cold Spring, N. Y.; to deal in road machinery and to contract for crushing stone and constructing and repairing roads; $2,500; Henry Metcalfe, and Richard Giles, of Cold Spring; John M. Touchey and William Church Osborne, of Garrison, N. Y.

Pacific Coast Water Grate Bar Co., San Francisco, Cal.; $100,000, commencing with $75,030; W. N. Faris, S. R. Jacobs, L. P. Bolander.

C. C. Bradley & Son., Syracuse, N. Y.; to conduct a general manufacturing business in wood and iron and hardware specialties; $25,000; Christopher C. Bradley, Christopher C. Bradley, Jr., and Cora M. Bradley, all of Syracuse.

Lansing Boiler & Engine Works, Lansing, Mich.; $100,000.

Greenville Tube Co., Greenville, Pa.; to manufacture iron and steel; $1,000; F. W. Ensworth, G. B. Chase, Carl Buck, Levi Morrison and H. N. Shrom.

State Line Natural Gas Co., Point Marion, Pa.; J. M. Cooper, W. F. Johnson and T. J. Lockwood.

Forciped Co., New York city; to maufacture bicycles and a patented appliance for same; $500,000, commencing with $25; W. E. Prall, Chas. T. Hunt, Fernando Baltes, New York city.

Hamilton Pressed Brick Co., Scranton, Pa.; $100,000, commencing with $10,000; Treas., C. O. Sutton, Scranton, Pa.

George B. Inman Contract Co., New York city; to construct water-works, gas and electric light works, electric railways, etc.; $10,000; George B. Inman, Edwin L. Hunt, New York city, and George Frohl, of Brooklyn, N. Y.

Ajax Electric Co., Brooklyn, N. Y.; to manufacture studs and electric appliances; $50,000; T. C. R. Horsfield, Arthur S. Willdig and W. D. Spelman, of Brooklyn.

Air Pressure Cylinder Co., New York city; to manufacture material and appliances for the transmission or use of gas, air, or other substances at high pressure; $1,000,000; Charles E. Warren, Norton, Conn.; Henry A. Robinson, Yonkers, N. Y.; John T. Little, Jr., Henry L. Stimson, New York city.

Eagle Mfg. Co., Kansas City, Mo.; $100,000, commencing with $50,000; Hiram F. Devol, George H. Devol, Samuel B. Stockley.

Edwards Car Coupler Co., Troy, N. Y.; $500,000; Richard J. Edwards, Galena, Ill.; Charles E. Lewis, Philadelphia; Charles H. Wallow and John A. MacDonald, Troy.

Northern New York Oil, Gas & Mining Co., Chicago; $50,000; Victor Barothy, Herman Will, John Berry and William P. Byrne.

Otway Stone Co., Otway, O.; $50,000.

Standard Telephone Mfg. Co., Philadelphia, Pa.; to manufacture telephones and electrical supplies; $500,000, commencing with $100; Chas. K. Yungman, Geo. F. Payne, Chas. G. Wetter, all of Philadelphia.

Mineola Town Co., Los Angeles, Cal.; to deal in real estate, construct water-works, etc.; $100,000, commencing with $100; F. R. Strong, James M. Wilde, M. E. Hammond, all of Los Angeles.

Bellaire, Benwood & Wheeling Ferry Co., Wheeling, W. Va.; to operate a ferry between Bellaire, O., and Benwood, W. Va.; $100,000; Jas. H. Reed, Jacob Friday, W. C. Jutte, all of Pittsburg, Pa.

Solar Oil Co., Columbus, O.; $25,000, commencing with $300; H. W. Webb, S. V. Point, H. L. Gilbert, all of Columbus, O.

New Jersey & Delaware Leffler Ry. Co., Philadelphia, Pa.; Indiana Leffler Ry. Co., Indianapolis, Ind.; Illinois Leffler Ry. Co., Chicago, Ill.; to deal in mines and timber lands, build railways and canals; each with a capital stock of $5,000,000, commencing in each case with $100; John B. Muchmore, Shelbyville, Ind.; H. W. Lester, Chicago, Ill.; C. E. Payen, Chicago, Ill.

British Canadian Gold Field Exploration, Development & Investment Co., Spokane, Wash.; $2,500,000; W. H. Wallbridge, W. L. Stuart, C. B. Murroy, all of Toronto, Ont.

Hoffman Foreign Machine Co., New York city; to manufacture and deal in machinery; $300,000, commencing with $500; R. L. Shainwald, Chas. Fishel, Adolph Liebes, all of New York city.

Imperial Electric Co., Westfield, N. J.; to manufacture electrical machinery and specialties; $60,000, commencing with $1,000; W. B. Elliot, J. W. Eskholme, Westfield, N. J.; H. J. Linder, Brooklyn, N. Y.

Alcatraz Co., San Francisco, Cal.; to manufacture oils, asphalts, gas, etc., and to conduct a general contracting business; $5,000,000, commencing with $50; Chas. E. Green, C. E. Foerster, A. F. Morrison.

Central Steamboat Co., Providence, R. I.; to build and operate steamboats; $1,000,000, commencing with $10,000; Robert Coit, J. N. Harris, Augustus Brandegree, New London, Conn.

Electric Gas Light, Heat & Power Co., Pittsburg, Pa.; to manufacture gas and electricity and to deal in engines and electric apparatus; John McGarvey, 72 Paccart St., Allegheny, Pa.; G. D. Williams and Ralph Theophilus.

Lincoln Fuel Gas Co., Pittsburg, Pa.; $1,000; Treas., Jeremiah Miller, Pittsburg, Pa.

Warren Granite Co., Bucksport, O.; to manufacture granite; $20,000, commencing with $11,000; Ed. L. Warren and A. I. Warren.

Wiard Foundry Co., of Brooklyn, N. Y.; $10,000; Matthew Wiard, William N. Calder, of New York city, and William J. Berrell, of Bayonne, N. J.

Automatic Switch Lock Co., Charlestown, W. Va.; $50,000, commencing with $50; Harry M. Stevenson, Chas. L. Spencer, Frederic F. Culver, all of New York city.

Forest City Mfg. Co., Cleveland, O., to manufacture nails, nail machinery, iron and steel; $25,000; Charles S. Bently, N. C. Brooks, and L. B. Bears.

American Patent Diamond Dop Co., New York city; to manufacture diamond dops and other diamond cutting and polishing articles; $5,000; E. Loesser, Leon Dreyfus, Ernest Loesser, of New York city.

Rogers Mfg. Co., Kansas City, Kan.; $50,000; John, George S. and Samuel H. Rogers and O. T. Stephenson, all of Kansas City, Kan.

Commercial Construction Co., New York city, to construct electric railways, electric light plants and subways, and deal in electrical suppiles; $10,000; George Hilliard, George M. Still, New York city; Archibald J. Martin, Brooklyn.

Monarch Duplex Engine Co., Tucson, Ariz.; $1,000,000; D. D Hobbs, J. T. Hobbs and W. G. Meade.

Little Giant Fire Extinguisher Co., New York city; to manufacture fire extinguishers; $500,000; Edgar H. Ellis, C. H. Bellows, of Brooklyn; Jay W. Watkins, C. H. Peno, of New York city.

Clinton Hills Powder Co., Cooperstown, N. Y.; $10,000; George S. Brooks, George M. Jarvis and E. V. Adams, all of Cooperstown.

Lincoln Fuel Gas Co., Harrisburg, Pa.; to operate in McKeesport, Elizabeth, West Elizabeth and other towns in Allegheny county; $1,000; Jeremiah Miller, John M. Boyd, Frank J. Paulson, all of Pittsburg.

Los Alamitos Sugar Co., Los Angeles, Cal.; to erect and operate a sugar factory; $1,000,000, commencing with $400,000; William A. Clark and Will A. Clark, Jr., of Butte, Mont., and J. Rose Clark, of Los Angeles.

DESIRABLE ITEMS.

Much of the very best information published in our Construction News columns comes to us from subscribers who send items in reference to work with which they are connected or in which they are interested. Such reliable items are not only greatly desired by us but frequently result in much good to the sender by bringing his name and his work to public attention. If you are not already doing so we ask you, hereafter, to send us the earliest possible information of work that comes under your notice.

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PERSONALS.

Mr. Edward McGovern, railway contractor, of Lancaster, Pa., died Oct. 1.

M. Victor de Lesseps, son of the late Count de Lesseps, died in Paris, France, Oct. 6.

Mr. James T. Goodwin, Superintendent of the Virginia Iron Works, Norfolk, Va., died Oct. 1.

Mr. W. H. Ferguson, Superintendent of the Dayton Coal & Iron Co., of Dayton, Tenn., has resigned.

Capt. W. E. Nason, Superintendent of the Franklin Water-Works, Franklin, O., died Oct. 10.

Mr. James Wood, proprietor of the Duquesne Tin Plate Works, Pittsburg, Pa., died Oct. 2, aged 35.

Mr. Chas. R. Kelsey, Manager of the Sweetwater Coal Mining Co., of Hopkins, Wyo., resigned recently.

Mr. Thomas B. Packer, of the firm of Hubbard & Packer, mechanical engineers, of Pittsburg, Pa., died Oct. 5.

Mr. H. McIntire, formerly Roadmaster of the Des Moines & Fort Dodge R. R., at Grand Junction, Ia., died Sept. 29.

Mr. Chas. P. Russell has been appointed General Superintendent of the North Adams (Mass.) Gas & Electric Light Co.

Mr. Charles H. Russell, City Engineer of Providence, R. I., was married Oct. 7 to Miss Florence Russell, of Lockport, N. Y.

Mr. W. A. Wolford, Master Mechanic of the Cleveland, Cincinnati, Chicago & St. Louis Ry., at the Wabash shops, has resigned.

Mr. Joachim B. Mathisen, of the firm of Howard & Mathisen, architects, San Francisco, Cal., committed suicide Sept. 26.

Mr. E. W. Knapp, Master Mechanic of the Mexican National R. R., at Acambaro, Mex., has been transferred to the City of Mexico.

Mr. Henry Breed, of Lynn, Mass., died Sept. 27, aged 67. He was the first Superintendent of the Boston, Revere Beach & Lynn R. R.

Mr. Henry Holmes, for several years Master Mechanic of the Wabash, St. Louis & Pacific R. R., died at East Buffalo, N. Y., Sept. 29.

Lieut.-Com. William Wilberforce Gillpatrick, U. S. Navy, Light-house Inspector of the Fourteenth District, at Cincinnati, O., died last week.

Mr. Bernard F. O'Connor has been elected President, and Mr. James M. Fish, Secretary, of the Underground R. R. Co., of New York city.

Mr. E. D. Stegall has been appointed Master Mechanic of the Mexican National R. R., at Acambaro, Mex., to succeed Mr. E. W. Knapp, transferred.

Mr. D. R. Murphy has been appointed Division Superintendent of the Duluth, Mississippi River & Northern Ry., with headquarters at Hibbing, Minn.

Mr. Adam Harkness has been appointed Division Superintendent of the Pennsylvania Coal Co., at Dunmore, Pa., to succeed Mr. Anthony Horan, deceased.

Mr. W. H. Brehm has been appointed Master Mechanic of the Missouri, Kansas & Texas Ry., with headquarters at Parsons, Kan., to succeed Mr. C. T. McElvany.

Mr. John L. Wigton has been appointed Master Car Builder of the Missouri, Kansas & Texas Ry., with headquarters at Sedalia, Mo., to succeed Mr. J. Doyle.

Mr. H. Walter Webb, Third Vice-President of the New York Central & Hudson River R. R., has been appointed Receiver of the Ogdensburg & Lake Champlain R. R. Co.

Mr. Edwin Hawley, Vice-President of the Minneapolis & St. Louis R. R., has been elected President of the same, to succeed Mr. W. L. Bull, resigned, as noted in our last issue.

Mr. R. Fitzsimmons, Acting Master Mechanic of the Mexican National R. R., at the City of Mexico, has been appointed Foreman of Engines, with headquarters at Saltillo, Mex.

Mr. Paul Minnis, formerly General Manager of the Home Telephone Co., Mobile, Ala., has accepted the position of electrical engineer with the Best Telephone Mfg. Co., Baltimore, Md.

Mr. H. U. Wallace has been appointed Roadmaster of the First Division of the Illinois Central R. R., with headquarters at Chicago, Ill., to succeed Mr. A. Philbrick, transferred.

Mr. Charles O. Jolly, Superintendent of the Toronto branch of the Ontario Rolling Mill Co., has been made Superintendent of the New Haven Rolling Mill Co., New Haven, Conn.

Mr. H. F. J. Porter, of Chicago, Ill., delivered a lecture on "Hollow Steel Forgings," illustrated by stereoptican views, before the students of Purdue University, Lafayette, Ind., Sept. 28.

Mr. T. F. Grover, Superintendent of the Milwaukee & Wuwatosa Electric Co., has been appointed General Manager of the Fond du Lac Electric Light & Power Co., of Fond du Lac, Wis.

Mr. A. Philbrick, Roadmaster of the First Road Division of the Illinois Central R. R., at Chicago, Ill., has been transferred in the same capacity to the Thirteenth Division, with office at Memphis, Tenn.

Mr. Stewart Rapalje, of Northport, N. Y., died Oct. 8, aged 54. He was the author of a "Digest on Railroads and Corporation Decisions," and was at one time the editor of "The Railway and Corporation Law Journal."

Mr. S. S. Babbitt, mechanical engineer, formerly with the Shoenberger Steel Co., has accepted a position as representative, in Pittsburg, Pa., of Wm. Todd & Co. and Wm. B. Pollock & Co., of Youngstown, Pa.

Mr. George Senft, General Superintendent of the Ligonier Valley R. R., was shot and seriously injured in a conflict which occurred Sept. 29, at Ligonier, Pa., between two parties of laborers over a disputed piece of property.

Mr. A. T. Sabin, Engineer of Maintenance of Way of the Chesapeake, Ohio & Southwestern R. R., has been appointed Roadmaster of the Tenth Road Division of the Illinois Central R. R., his headquarters remaining at Louisville, Ky.

Mr. Lawrence Fisher Frazee, Superintendent of the Bergen Point & Port Richmond Ferry Co., died Oct. 10, aged 83. He was interested in the old Camden & Amboy R. R., and was active for many years in various branches of the Pennsylvania R. R.

Mr. F. W. Brazier, General Foreman of the car shops of the Illinois Central R. R., at Burnside, Ill., has been appointed Assistant Superintendent of Machinery of that road and of the Yazoo & Mississippi Valley R. R., with headquarters at Chicago, Ill.

Prof. William Kendrick Hatt has returned to Purdue University, Lafayette, Ind., to take charge of the work in Applied Mechanics in the Department of Mechanical Engineering, having been pursuing for the past year a course of studies at Cornell University, Ithaca, N. Y.

Mr. Edwin Mitchell, Assoc. M. Am. Soc. C. E., has opened an office at 5 East Lexington St., Baltimore, Md., as a civil and sanitary engineer. He is a graduate of Union University, Schenectady, N. Y., and has been engaged in municipal and railway engineering for the past 11 years.

Col. Augustus Boyd, retired iron manufacturer, of Philadelphia, Pa., died Oct. 5, aged 70. At the age of 21 he became the Manager of the Elizabeth Iron Furnace in Lancaster county. Pa. After the war, in which he served creditably, he engaged in the manufacture of iron at Coatesville, Pa.

Mr. Lewis Kingman, Chief Engineer of the Mexican Central Ry,. with headquarters in the City of Mexico, has been engaged by the management of the Atchison, Topeka & Santa Fe Ry. Co. to inspect the entire Santa Fe system and report an estimate of what it would cost to reproduce the several lines.

Mr. Geo. H. Sturtevant, Jr., and Mr. F. H. Todd, have formed a partnership under the firm name of Sturtevant & Todd, with offices at 506 Association Building, Chicago. They will make a specialty of municipal and railroad engineering, a field in which both have practised for several years past.

Prof. C. P. Matthews has been called to the chair of Associate Professor of Electrical Engineering, Purdue University, Lafayette, Ind., and Prof. Winder F. Goldsborough, Associate Professor of Electrical Engineering, succeeds Prof. Harold Babbitt Smith, Professor of Electrical Engineering, resigned.

Mr. C. F. W. Felt, formerly Resident Engineer of the Gulf, Colorado & Santa Fe Ry., was appointed Sept. 1 Chief Engineer in charge of the maintenance of tracks, buildings and bridges and water service and all construction work, with headquarters at Galveston, Tex,, as was noted in part in our issue of Sept. 3.

Mr. P. J. McWeeney, of Herkimer county, New York, has been appointed Deputy Superintendent of Public Works of the N. Y. State Department of Public Works, and will perform the duties of Superintendent Aldridge in his absence, except those as a member of the State Canal Board and of the Capitol Construction Commission.

Mr. John W. Hill, M. Am. Soc. C. E., consulting engineer, of Cincinnati, O, and Mr. Geo. H. Benzenberg, M. Am. Soc. C. E., City Engineer and President of the Board of Public Works, of Milwaukee, Wis., have been selected by Mayor Swift, of Chicago, Ill., as two of the three experts authorized by the special council committee to investigate the matter of building intercepting sewers.

Mr. Ira Judson Coe, civil engineer, was married Oct. 14, to Miss Harriet Whiteman Halloway, daughter of the Rev. William W. Halloway, D. D., of Dover, N. J. Mr. Andrew H. Green, Jr., Manager of the Solvay Process Works, Detroit, Mich., was the best man, and Messrs. Daniel B. Clark, of the Metropolitan Water-Works, Boston, Mass., and Robert H. Jacobs, civil engineer, of the New York Water-Works, were the ushers. All three were classmates of Mr. Coe, at Cornell University.

Mr. H. Collbran, President and General Manager of the Midland Terminal Ry., with office at Denver, Colo., has left for a six months' trip to Corea, Asia, in the further investigation of certain mining and railway concessions obtained by him and others from the government of that country, Mr. W. T. Carley, a railway engineer of considerable experience in the south, and two mining engineers accompanying him. Mr. W. K. Gillett, Vice-President and Treasurer, will assume the entire management of the road during the absence of Mr. Collbran.

Mr. J. B. Cleveland, Receiver for the Port Royal & Western Carolina Ry., with headquarters at Spartanburg, S. C., has been elected President of the Charleston & Western Carolina Ry., which is a consolidation of the former named road with the Port Royal & Augusta Ry. Mr. A. W. Anderson, Superintendent of the Port Royal & Western Carolina Ry., with offices in Augusta, Ga., will retain that office under the new organization. Mr. A. H. Porter, recently Superintendent of the Central of Georgia Ry., has been appointed Roadmaster of the Charleston & Western Carolina Ry.

Mr. Robert Neilson, M. Am. Soc. C. E., General Superintendent of the Northern Central and the Philadelphia & Erie Division, Pennsylvania R. R., died, in Williamsport, Pa., Oct. 12, aged 59 years. Mr. Neilson was born in Ontario, Canada, Aug. 19, 1837. He graduated from the Renssalaer Polytechnic Institute in 1861 and entered the service of the Philadelphia & Erie Railway as rodman. He has been connected with the Pennsylvania R. R. and its branches ever since. In January, 1882, he was appointed to the position held at the time of his death. He became a member of the American Society of Civil Engineers on Feb. 17, 1869.

Mr. Alfred F. Noyes, M. Am. Soc. C. E., of the firm of Noyes & Hazen, of Boston, died suddenly of heart failure on Oct. 12, at the age of 45. He was City Engineer of Newton, Mass., for the 15 years ending in the middle or latter part of 1893, when he resigned to accept the position of Assistant Chief Engineer of the Massachusetts State Board of Health. In 1895 he was appointed a member of the Metropolitan Sewerage Commission, which has charge of the construction of a great system of trunk sewers for Boston and vicinity. Mr. Noyes had been President of both the Boston Society of Civil Engineers and the New England Water-Works Association.

Major Wm. H. McClintock, Manager of the Alabama Car Service Association, died at Birmingham, Ala., Oct. 2. He was born Dec. 13, 1844, at Edgefield Court House, S. C., and entered the railway service Jan. 1, 1881, being from that time until '82 Assistant Engineer on the Louisville & Nashville R. R. During the following year he was Superintendent of the Road Department, and from Jan. 1, 1883, to April 15, 1886, Assistant Engineer of the Southern divisions of the same road, from Decatur to New Orleans. On the latter date he became Resident Engineer of the Atlanta & West Point R. R. and the Western Ry. of Alabama, and held this office until April 1, 1887, when he was appointed Superintendent of the Columbus & Western and the Savannah & Western Divisions of the Central of Georgia Ry. At the end of 1889 he was appointed Superintendent of Roadway of the Louisville, New Orleans & Texas R. R., and General Superintendent of the New Orleans & Northwestern Ry. in Sept., 1890. In Feb., 1891, he was appointed to the office he held at the time of his death.

Col. Levi K. Fuller, M. Am. Soc. M. E., ex-Governor of Vermont, died at his home in Brattleboro, Vt., Oct. 10. He was born in Westmoreland, N. H., Feb. 24, 1841. When 16 years of age the Windham County Agricultural Society awarded him a prize for a steam engine improvement. He subsequently went to Boston, where he took a course of scientific study. In 1860 he entered the Estey Organ Works, of Brattleboro, as a machinist and he was gradually promoted until he became Vice-President of the company, which position he has held for 20 years. In 1873 he was tendered the appointment of commissioner to the Vienna Exposition by President Grant, but declined the honor, owing to pressure of private business. He was an active member of the American Association for the Advancement of Science and of the American Society of Mechanical Engineers. Mr. Fuller is said to have been granted over 100 patents upon his inventions, chiefly upon machinery for the manufacture of musical instruments. He was interested in astronomy and had an observatory attached to his residence with a fine equatorial telescope. He held many town offices and in 1880 was elected to the state senate. In 1886 he was elected Lieutenant-Governor, and in 1892 was chosen Governor.

William Harrison Grant, M. Am. Soc. C. E., died at his home in Sing Sing, on Oct. 10. Mr. Grant was born at Neversink, Sullivan County, N. Y., on May 15, 1815, and he was educated at the New Paltz Academy, where he studied surveying. After some experience on the New York & Erie Railway, he continued his mathematical studies at Ithaca Academy. He was then appointed assistant engineer on the enlargement of the Erie Canal, under the late William J. McAlpine and remained in that service about nine years, though for two winters he was a deputy clerk in the New York legislature and for a time assistant to Adjutant-General Niven. Later he was an assistant engineer on the Hudson River Railway survey, under Chief Engineer John B. Jervis; but before this road was completed he was made Chief Engineer of the Cleveland

Zanesville & Cincinnati Railway, of which he constructed 60 miles. He then surveyed a railway from Georgetown to Hagerstown, Md., on a route afterwards occupied in part by the Baltimore & Ohio Railway. Returning to New York, he was appointed Superintending Engineer of Central Park and was connected with that work until its completion. Mr. Grant was later made Civil and Topographical Engineer of the Department of Public Works, with the Annexed District under his charge, and he was also constructing engineer of the same department at a later period. In 1876 he formed a partnership with Donald G. Mitchell, as landscape architect. In 1878 he was employed upon the improvement of rivers and harbors in Maryland and Virginia and his last public position was that of Superintendent of the new U. S. Naval Observatory. He resigned all work in 1893 and took up his residence in Sing Sing. In addition to the professional work noted he was connected with the Ontario & Western and the West Shore railways and designed and partly constructed the Yonkers water supply. A widow and three children survive him.

Prince Michael Hilkoff, Imperial Minister of Ways of Communication of Russia, and the master spirit in the construction of the Trans-Siberian railway, was one time a resident of the United States, and is familiar with our methods of constructing and operating railways. As announced in our issue of Sept. 17, this high official is now making an extended tour through this country for the purpose of further studying the latest American practice in railway engineering. A correspondent of the San Francisco "Chronicle," presumably a member of the World's Transportation Commission of the Field Columbian Museum, gives a detailed sketch of the career of Prince Hilkoff, and from this the following abstract is made: Prince Michael Hilkoff traces his descent from a princely Tartar house of six centuries ago. At the age of 16 he was an officer in the Imperial Guards and served during the Crimean War. In 1857 he first visited the United States, bearing letters from the Emperor Alexander II., to President Buchanan, and he travelled very extensively over the country, extending his journey as far as the Rocky Mountains. After spending another year in travel and study in Europe, he entered the service of the Foreign Office at St. Petersburgh at the age of 23. But the ukase of Alexander II. abolishing serfdom throughout Russia, reduced the head of the house of Hilkoff to comparative poverty, and later family dissension led to the son Michael leaving home to seek his own fortune. He sailed for the United States, and arriving in Philadelphia he obtained work in the machine shops of a Mr. Wainwright at a dollar per day, working under the assumed name of John Magill. In the service of Mr. Wainwright he went to the Argentine Republic and was for some time engaged in railway construction, and also obtained his first practical knowledge of locomotive engineering. He was finally called back to Russia by his father, but on his way home he spent some months in the erecting shops of a locomotive builder at Birkenhead, England. After some effort and numerous disappointments he obtained the position of superintendent of locomotives and railway carriages at Moscow, and remained there until about 1879. In 1880 General Annenkoff commenced his famous railway movement into Central Asia, and he secured the services of his old friend and schoolmate, Prince Michael Hilkoff, as chief of the mechanical division of this work. He later became Chief Director of the Trans-Caspian railways and Minister of Public Works of Bulgaria. In 1885 arose the emergency for speedily pushing the Trans-Caspian railway to the Amu Daria, and General Annenkoff again called Michael Hilkoff to his aid. These two men built nearly 500 miles of railway between June 1, 1885, and Dec. 4, 1886. After serving 8 years in Central Asia and the Trans-Caspian region, Prince Hilkoff was made the director of several lines in European Russia, and in 1894 he was promoted to the position he now holds.

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ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF COLUMBUS.
Oct. 17. Secy., M. S. Hopkins, Columbus, O.
ENGINEERS CLUB OF PHILADELPHIA.
Oct. 17. "Electricity in Gold Milling," by H. M. Chance. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERS' CLUB OF MINNEAPOLIS.
Oct. 19. Secy., Elbert Nexsen, 1620 S. E. 4th St., Minneapolis, Minn.
ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.
Oct. 20. Annual meeting, at Chicago. Secy., S. F. Patterson, Concord, N. H.
ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
Oct. 20. Secy., Daniel Carhart, 410 Penn Ave., Pittsburg.
WESTERN RAILWAY CLUB.
Oct. 20. Secy., W. D. Crossman, The Rookery, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
Oct. 20. Secy., F. W. Hart, 15th and H Sts., N. W., Washington, D. C.
AMERICAN INSTITUTE OF ARCHITECTS.
Oct. 20, 21, 22. Annual meeting to be held at Nashville, Tenn. Secy., Alfred Stone, Providence, R. I.
AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 20-23. Annual convention, at St. Louis. Secy., T. C. Penington, 2020 State St., Chicago.
ENGINEERS' AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Oct. 21. Secy., F. Van Vleck, Los Angeles.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Oct. 21. Secy., J. A. Pilcher, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Oct. 21. Secy., S. E. Tinkham, City Hall.
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Oct. 21. Secy., R. W. Pope, 26 Cortlandt St., New York city.
WESTERN FOUNDRYMEN'S ASSOCIATION.
Oct. 21. Secy., A. Sorge, Marquette Bldg., Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
Oct. 21. "Boiler Efficiency with Low Grade Fuels," by Wm. H. Bryan. Secy., Wm. J. Bryan, Turner Bldg.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Oct. 21. "Suspension Bridges—A Study," by Geo. S. Morison. Secy., C. W. Hunt, 127 E. 23d St., New York.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Oct. 22. Secy., C. H. McLeod, Montreal, Can.
ENGINEERING ASSOCIATION OF THE SOUTH.
Oct. 23. Secy., L. P. Brown, Nashville, Tenn.
INDIANAPOLIS ENGINEERING CLUB.
Oct. 24. Secy., C. C. Brown, Indianapolis, Ind.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Oct. 27. "Gas Producers and the Mechanical Handling of Fuel for Same," C. L. Saunders. Secy., F. A. Colburn, Case Library Bldg.
WISCONSIN POLYTECHNIC SOCIETY.
Oct. 27. Secy., W. K. Means, Loan and Trust Bldg., Milwaukee, Wis.
CHICAGO ELECTRICAL ASSOCIATION.
Nov. 6. "The Metric System in Electrical Industries," by F. S. Hickok. Secy., J. R. Cravath, 810 Old Colony Bldg.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.—At the meeting of Oct. 5, a discussion of continuous rails on concrete foundation in connection with asphalt pavements was opened by Mr. Wilson and continued by Mr. Curtin. C. L. Annan, Secy.

IOWA ENGINEERS' SOCIETY.—Articles of incorporation of this society were filed for record on Oct. 3 in Des Moines, Ia. Incorporators are L. Higgins, C. R. Allen, Seth Dean, F. L. Easley and J. D. Wardle. The society is an organization of civil engineers.

THE WESTERN SOCIETY OF ENGINEERS.—At the regular meeting of Oct. 7, a paper on "Steel for Boilers and Fire Boxes" was read by T. L. Condron, and H. F. J. Porter, of the Bethlehem Iron Co., spoke on "Steel Forgings," illustrating his lecture by stereopticon views of steel in process of construction.

BROOKLYN ENGINEERS' AND ARCHITECTS' ASSOCIATION.—This society has been organized in Brooklyn, N. Y., and all civil, mechanical, naval, military, electric and mining engineers are eligible for membership. In the Brooklyn library an alcove with several thousand books of reference has been set apart for the use of the association. Mr. A. J. Provost is temporary chairman of the organization, and the committee which has been appointed to draft a constitution and by-laws includes Mr. Provost, William G. Ford, Walter Meserole, A. J. Caldwell and George W. Wilson.

AMERICAN RAILWAY ASSOCIATION.—At the meeting held in New York on Oct. 7, with the President, Mr. E. T. D. Myers, in the chair, the business consisted principally of the reading of reports from a number of committees, including those on train rules, on gages, on general regulations, on standard wheel and track gages, on general regulations for employes and the report of the executive committee. There are now 252 railway companies, operating 154,000 miles of road, represented in the association by their presidents, vice-presidents, general managers, general superintendents, division superintendents, or other officers of the operating departments.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Oct. 7, Mr. Benjamin M. Harrod, Vice-President, in the chair, the Secretary read a paper by Mr. W. A. Rogers on "The Reconstruction of the Grand River Bridge." The bridge is on the line of the Chicago, Milwaukee & St. Paul Ry., and the new structure consists of steel truss spans on masonry piers, replacing wooden spans on pile piers. The trusses were erected on the old piers and then shifted longitudinally onto the new piers. All the work was done by the Bridge and Building Department of the road.

The Secretary announced that although the library had been kept open every Wednesday evening during the season, for about two years, on request of a number of members, the attendance has been very small. As a further experiment the Board of Direction has decided to keep it open every week day during November and December. He announced the deaths of Mr. Robert L. Harris, of New York city; Mr. Francisco De Garay, City of Mexico; and Mr. Vernon H. Gridley.

The nominating committee has presented to the Board of Direction, as required by the constitution, the following nominations for the offices to be filled at the next annual meeting: President, Benjamin M. Harrod, New Orleans, La.; Vice-Presidents, George H. Mendell, San Francisco, Cal., and John F. Wallace, Chicago, Ill.; Treasurer, John Thomson, New York city. Directors: James Owen, Newark, N. J.; Rudolph Hering, New York city; H. G. Morse, Wilmington, Del.; B. L. Crosby, St. Louis, Mo.; H. S. Haines, Atlanta, Ga.; and L. M. Johnson, Eagle Pass, Tex.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—At the September meeting Professor Fessenden presented a paper on "The Economic Use of Electric Motors for Driving Machine Shops," which stated that reliability, flexibility and convenience in operation were questions of more importance than that of cost. The reason for this being that the total cost for power in the average manufacturing business is only a small fraction, less than one quarter of 1% of the total cost of the finished output. Hence a shut-down for a single day means the loss of more money than the coal bill would amount to in a number of months. Estimates were given of the total first cost, and operation of, a machine shop when the power was furnished in five different ways. It was demonstrated that when the tools were run electrically in large groups, the first cost and cost of operation were greater than with engine-driven shafting, but that with small groups or with individually driven tools the reverse was the case. This is due to the fact that by doing away with the friction losses the size of the generating plant could be decreased, and the saving so made through having a smaller steam plant, and no main countershafting or large belts, hangers, etc., more than counterbalances the additional cost for motors and dynamo. He pointed out that it was not sufficient to simply choose a good engine and a dynamo having high efficiencies, but that the shape of their characteristic curves must be carefully chosen so as to correspond to the class of work to be done. Otherwise poor results might be obtained under the actual conditions of working.

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CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work. Place.	See Eng. News.
Oct. 15.	Lighthouse work, Brazos River, Tex.	Oct. 8
Oct. 15.	Repairing r'y bridges, etc., San Francisco.	Oct. 8
Oct. 15.	Rebuilding flume, Cleveland, O.	Oct. 8
Oct. 15.	Masonry, abutments, etc., Buffalo, N. Y.	Oct. 8
Oct. 15.	Church building, Raleigh, N. C.	Oct. 1
Oct. 15.	River bank protection, Evansville, Ind.	Oct. 1
	Advertised, Engineering News, Oct. 1.	
Oct. 15.	Bridges (2), Elk Point, S. Dak.	Sept. 24
Oct. 15.	Asphalt paving (5,000 sq. yds.), Niles, O.	Sept. 24
	Advertised, Engineering News, Sept. 24.	
Oct. 15.	Electric lighting, Manistee, Mich.	Sept. 24
Oct. 15.	Pipe (1,215 tons, 30-in.), Evansville, Ind.	Sept. 24
	Advertised, Engineering News, Sept. 24.	
Oct. 15.	County court house, South Bend, Ind.	Sept. 10
Oct. 16.	Railway bridge, Rumford Falls, Me.	Oct. 1
	Advertised, Eng. News, Oct. 1 and 8.	
Oct. 16.	Water pipe (48 and 42-in.), Boston, Mass.	Oct. 8
	Advertised, Engineering News, Oct. 8.	
Oct. 16.	Bridge, Indianapolis, Ind.	Oct. 8
Oct. 16.	Sewer, Richmond, Ind.	Oct. 8
Oct. 16.	Paving, Boston, Mass.	Oct. 15
Oct. 16.	Pipe sewers, Buffalo, N. Y.	Oct. 15
Oct. 16.	Heating, plumbing, etc., Chicago, Ill.	Oct. 15
Oct. 16.	Electric light plant, Chicago, Ill.	Oct. 15
Oct. 17.	Sidewalks, Union, N. J.	Oct. 15
Oct. 17.	Water main, East Cleveland, O.	Oct. 8
Oct. 17.	Well, Eagle Bend, Minn.	Oct. 8
Oct. 17.	School building, Whittier, Cal.	Oct. 8
Oct. 17.	Pumping engine, Kansas City, Mo.	Sept. 17
	Advertised, Eng. News, Sept. 17 and 24.	
Oct. 17.	Dredging, Philadelphia, Pa.	Sept. 24
Oct. 17.	Dredging in Lemon Creek, N. Y.	Sept. 24
	Advertised, Eng. News, Sept. 24 to Oct. 15.	
Oct. 17.	Increased water supply, Watervliet, N. Y.	Sept. 24
Oct. 17.	Paving bonds ($17,000), Niles, O.	Sept. 24
	Advertised, Engineering News, Sept. 24.	
Oct. 17.	Brick arch (60 ft.), Mansfield, O.	Oct. 1
Oct. 19.	Pipe sewer, Fresno, Cal.	Oct. 1
Oct. 19.	Dredging in South River, N. J.	Sept. 24
	Advertised, Eng. News, Sept. 24 to Oct. 15.	
Oct. 19.	Brick paving, Cincinnati, O.	Sept. 24
Oct. 19.	Paving, Toledo, O.	Oct. 1
Oct. 19.	Water main, Blue Island, Ill.	Oct. 8
Oct. 19.	Survey and maps, Sea Cliff, L. I.	Oct. 8
	Advertised, Enginering News, Oct. 8.	
Oct. 19.	Arc lights, poles, etc., Kankakee, Ill.	Oct. 15
Oct. 19.	Power pumps (2), Chicago, Ill.	Oct. 15
Oct. 19.	Asphalt paving, New York, N. Y.	Oct. 15
Oct. 19.	Park work, Newark, N. J.	Oct. 15
Oct. 19.	Filling (160,000 cu. yds.), Boston, Mass.	Oct. 15
Oct. 19.	Paving, Jersey City, N. J.	Oct. 15
Oct. 19.	Pipe sewers, Lincoln, Ill.	Oct. 15
Oct. 20.	Ambulance station, New York, N. Y.	Oct. 15
Oct. 20.	Sewers, Trenton, N. J.	Oct. 15
Oct. 20.	Repairing cribwork, New York, N. Y.	Oct. 15
Oct. 20.	Addition to school building, Baltimore.	Oct. 15
Oct. 20.	Bridge abutments, Woonsocket, R. I.	Oct. 15
Oct. 20.	Water mains (26 sts.), Chicago, Ill.	Oct. 15
Oct. 20.	Hospital building, Verona, N. J.	Oct. 8
Oct. 20.	Bank building, Camden, N. J.	Oct. 8
Oct. 20.	Heating and ventilating, Allegheny, Pa.	Oct. 1
Oct. 20.	Sewer bonds ($212,000), Cleveland, O.	Oct. 1
Oct. 20.	Water-works, Blanchester, O.	Oct. 1
Oct. 20.	Water extensions, Pueblo, Colo.	Oct. 1
Oct. 20.	Drainage channel, Peoria, Ill.	Sept. 17
	Advertised, Eng. News, Sept. 17 to Oct. 1.	
Oct. 20.	Rip-rap embankment at Agate Bay, Minn.	Sept. 24
	Advertised, Eng. News, Sept. 24 to Oct. 15.	
Oct. 20.	Electric light plant, Blanchester, O.	Oct. 1
Oct. 20.	Plumbing, heating, etc., Buffalo, N. Y.	Oct. 1
Oct. 21.	Dredging harbor at Newport, R. I.	Oct. 1
	Advertised, Eng. News, Oct. 1 to 15.	
Oct. 21.	Brick paving, Ottumwa, Ia.	Oct. 15
Oct. 21.	Graveling and sidewalks, Indianapolis, Ind.	Oct. 15
Oct. 21.	School building, etc., New York, N. Y.	Oct. 15
Oct. 22.	Power house, Genoa, Neb.	Oct. 15
Oct. 22.	Electric wiring, etc., Brooklyn, N. Y.	Oct. 15
Oct. 22.	Barracks, stable, etc., Fort Riley, Kan.	Oct. 1
Oct. 22.	Repairing sidewalks, Cincinnati, O.	Oct. 1
Oct. 22.	Jetty and levee work at San Diego, Cal.	Oct. 1
Oct. 22.	Improving roads, Stapleton, N. Y.	Sept. 24
Oct. 23.	Heating, ventilating, New Berne, N. C.	Oct. 8
Oct. 23.	Laying 60-in. intake pipe, Duluth, Minn.	Oct. 8
Oct. 23.	Water gates, valves, etc., Duluth, Minn.	Oct. 8
Oct. 23.	Graveling, Indianapolis, Ind.	Oct. 15
Oct. 23.	Belgian block paving, Camden, N. J.	Oct. 15
Oct. 23.	Electric power for bridge, Brooklyn.	Oct. 15
Oct. 23.	Cast-iron sewer pipe, etc., Brooklyn.	Oct. 15
Oct. 24.	Wells, stand-pipe, etc., Huntington, Ind.	Oct. 15
	Advertised Engineering News, Oct. 15.	
Oct. 24.	Macadamizing, etc., Pleasant Ridge, O.	Oct. 8
Oct. 24.	Dredging in Chicago River, 1,300,000 yds.	Oct. 1
	Advertised, Eng. News, Oct. 1 to 22.	
Oct. 26.	Dredging Elizabeth River, Va.	Oct. 1
	Advertised, Eng. News, Oct. 1 and 15.	
Oct. 26.	Brick paving, Marietta, O.	Oct. 8
Oct. 26.	Pumping engines, McKeesport, Pa.	Oct. 15
	Advertised. Engineering News, Oct. 15.	
Oct. 26.	Motor battery, North Point, Md.	Oct. 15
Oct. 26.	Electric light plant, Watertown, Mass.	Oct. 15
Oct. 26.	College building, Athens, O.	Oct. 15
Oct. 26.	Sinking wells, etc., McKeesport, Pa.	Oct. 15
	Advertised. Engineering News, Oct. 15.	
Oct. 26.	Armory foundation, Buffalo, N. Y.	Oct. 15
Oct. 26.	Cement walks (53,600 sq. ft.), New York.	Oct. 15
Oct. 26.	Dredging Baltimore Harbor, Md	Oct. 15
Oct. 27.	Electric light plant, Cuthbert, Ga.	Oct. 15
	Advertised. Engineering News, Oct. 15.	
Oct. 27.	Macadamizing Paterson, N. J.	Oct. 15
Oct. 27.	County court house, Wise, Va.	Oct. 15
Oct. 27.	Ditch at U. S. bldg., Omaha, Neb.	Oct. 8
	Advertised, Eng. News, Oct. 8 and 15.	
Oct. 27.	Reservoir, dam, etc., New York, N. Y.	Oct. 8
Oct. 28.	Interior building work, Washington, D. C.	Oct. 8
Oct. 28.	Sewer, Hoboken, N. J.	Oct. 8

Oct. 28. Breakwaters, New London, Conn. ....Oct. 1
Advertised, Eng. News, Oct. 1 to 22.
Oct. 28. School building, Springfield, Ill. ....Oct. 15
Oct. 28. Steel pipe, Vancouver, B. C. ....Oct. 15
Oct. 29. Improving canal (28 miles), Albany, N. Y. .Oct. 15
Advertised, Eng. News, Oct. 15 and 22.
Oct. 29. Waste weir, etc., at Cartersville, N. Y. ..Oct. 15
Advertised, Eng. News, Oct. 15 and 22.
Oct. 29. Sand, Philadelphia, Pa. ....Oct. 1
Oct. 29. U. S. bldg. work, New York, N. Y. ....Oct. 8
Oct. 29. Rock for jetty, Coos Bay, Ore. ....Oct. 8
Advertised, Eng. News, Oct. 8 to 22.
Oct. 29. Iron and steel bridges, Cleveland, O. ......Oct. 8
Oct. 29. Sewers, Marietta, O. ....Oct. 8
Oct. 30. Electric wiring, heater, etc., Boston ......Oct. 15
Oct. 30. Steel water pipe (3 m.), Duluth ....Oct. 15
Advertised, Eng. News, Oct. 15 and 22.
Oct. 31. Brick and pipe sewers, Sharpsburg, Pa. ...Oct. 15
Oct. 31. Extension to court house, Lancaster, Pa. ..Oct. 1
Advertised, Eng. News, Oct. 1 to 22.
Nov. 2. Chemical fire engine, etc.(2), Glenfield, Pa. Oct. 1
Nov. 2. Dredging plant, Wilmington, N. C. ....Oct. 8
Advertised, Eng. News, Oct. 8 to 22.
Nov. 2. Pipe sewers, Sonora, Cal. ....Oct. 8
Nov. 2. Light-house tower, New Orleans, La. ....Oct. 15
Nov. 2. Street bonds ($4,370), Wyoming, O. .....Oct. 15
Nov. 5. Post office building, New London, Conn. .Oct. 15
Advertised, Eng. News, Oct. 15 and 22.
Nov. 5. Lighthouse, Boston Harbor, Mass. ....Oct. 8
Nov. 5. Street railway franchise, Santa Rosa, Cal. .Oct. 8
Nov. 5. Hotel, theatre, etc., Washington, D. C. ..Oct. 1
Nov. 6. Water bonds ($300,000), Cleveland, O. .....Oct. 15
Nov. 9. Hospital building, etc., Fort Leavenworth .Oct. 15
Advertised, Eng. News, Oct. 15 to 29.
Nov. 9. Lighthouse tower, New Bedford, Mass. ...Oct. 8
Nov. 10. Dams, etc., Rock Island, Ill. ....Oct. 15
Advertised, Eng. News, Oct. 15 to Nov. 5.
Nov. 10. Dredging machinery, Portland, Ore. .....Oct. 15
Advertised, Eng. News, Oct. 15 to Nov. 5.
Nov. 11. Hydraulic dredges (2), St. Louis, Mo. ...Oct. 15
Advertised, Eng. News, Oct. 15 to Nov. 5.
Nov. 12. Administration building, Springfield, O. ..Oct. 15
Nov. 14. Pumping engines (6), Chicago, Ill. ......Sept. 24
Advertised, Eng. News, Sept. 24 to Oct. 22.
Nov. 14. Grain elevators, etc. (2), Galveston, Tex. .Sept. 24
Nov. 14. Sewage pumping mach'y, Mexico, Mex. ...Aug. 27
Nov. 18. Hospital building, Cherokee, Ia. ....Oct. 8
Nov. 24. County jail and residence, Atlanta, Ga. ....Oct. 1
Nov. 30. Breakwater extension, Buffalo, N. Y. ....Oct. 15
Advertised, Eng. News, Oct. 15 to Nov. 5.
Dec. 30. Steel rails (150,000 tons), Sydney, N.S.W. .Aug. 6
Advertised, Eng. News, Sept. 3 and Oct. 1.
Jan. 8. Wooden bridge (220 ft.), Tillamook, Ore. ..Oct. 8
Dec. 9. Hospital building, Los Angeles, Cal. .....Oct. 15
No date. Electric light plant, Demopolis, Ala. .....Oct. 15
Advertised, Engineering News, Oct. 15.

RAILWAYS.

East of Chicago.

BUTLER & PITTSBURG.—The Pittsburg, Pa., "Post" states that the new equipment to be bought for this road, described last week, includes 25 locomotives and 400 cars. The Pittsburg, Shenango & Lake Erie, which is the northern outlet for the Butler & Pittsburg, will also order new equipment and heavier rails.

CINCINNATI, UNION CITY & CHICAGO.—A press dispatch from Wabash, Ind., states that this uncompleted railway, noted in our issue of Oct. 8, will be sold Oct. 28. John Bliss and F. W. Short, of Chicago, are said to be trying to reorganize the company so as to complete the road.

LAWRENCE LUMBER.—E. E. Greenwood, Ch. Engr., Skowhegan, Me., writes us that the Lawrence Bros. Lumber Co., St. Gardiner, Me., has had this railway, noted in our issue of Oct. 8, as the Dead River, located to develop timber land in Franklin County, Me. Its outlet is on the bank of the Dead River. The road will be built next season and extensions made later.

MIDLAND.—It is reported that the contract between the Midland Ry. Co. and the Dominion government for the construction of a railway between Truro and Windsor, N. S., has been signed.

ST. LAWRENCE & ADIRONDACK.—It is stated that the extension between Beauharnois and Caughnawaga, Que., which has been in progress for some months, is now complete to connect with the Canadian Pacific at Caughnawaga.

ST. CATHARINES & NIAGARA CENTRAL.—This company may ask from Parliament the right to issue new bonds, and to extend its line to meet the Toronto, Hamilton & Buffalo Ry. at Smithville, Ont.

ST. JOSEPH VALLEY.—A press dispatch states that work is in progress on this line between Buchanan and Benton Harbor, Mich. The existing line is 11 miles long. Ch. Engr., W. W. Graves, St. Joseph, Mich.

Southern.

BUTTERS' LUMBER.—W. H. Butters, Hub, N. C., writes us that this line is 15 miles long, from Hub to Fair Bluff, N. C., and is now nearly finished; all material is purchased. Pres., H. Butters; Ch. Engr., B. A. Jackson, Hub, N. C.

KENTUCKY MIDLAND.—A press dispatch states that this railway is ordered to be sold by the Franklin Circuit Court on Jan. 1, 1897. The upset price is fixed at $150,000. It has been ordered sold twice before, once at $320,000 and once at $250,000, but no bids were received. The road is 40 miles long and cost over $1,000,000 to build it. G. B. Harper, Receiver, Frankfort, Ky.

TENNESSEE, GEORGIA & ALABAMA.—It is stated that preliminary surveys have been begun on this railway, noted in our issue of Sept. 17.——The United States Construction Co. has been organized at Atlanta, Ga., with a capital of $250,000 to construct the railroad between Augusta and Chattanooga. Ch. Engr., F. S. Wallace, Chattanooga, Tenn.

WASHINGTON, ANNAPOLIS & CHESAPEAKE.—Surveys for several routes are in progress. L. H. Hyer is in charge of the survey and is stated to have been at Davidsonville, Md., last week. The line runs from Washington to a point on the Severn River.

Northwest.

CHICAGO & ALTON.—It is said that the Chicago & Alton has determined on building a branch into Peoria, Ill. For the last few months it has been running trains to that city over the tracks of Toledo, Peoria & Warsaw, a distance of 12 miles. Surveys are now in progress. Ch. Engr., H. C. Draper, Chicago, Ill.

FLINT & PERE MARQUETTE.—This line is now completed a distance of about 19 miles from near Monroe, Mich., to Alexis Junction, O.

PENNSYLVANIA CO.—The Chicago "Herald" says that Thomas Rodd, Ch. Engr., Pittsburg, has submitted incomplete plans for the elevation of the company's tracks from 55th to 63d Sts., Chicago. The plans call for substantially the same construction as was employed in the elevation of the Rock Island tracks, steel bridges at the street crossings with earth embankments between. It is probable that work will soon begin.

GREAT NORTHERN.—A. R. Cook, Mgr., Hope, N. Dak., writes us that the extension from Hope, noted last week, touches the towns of Aneta, Findley and Sharon, a distance of 28 miles and is now almost finished. The Halstad branch is now completed to Carmen, Minn., a distance of 33 miles. There are five stations, about 6 miles apart. The line is through a rich section of the Red River Valley. Foley Bros. & Guthrie, of St. Paul, are the contractors.

NORTHERN PACIFIC.—A press dispatch from Frazee, Minn., says that this company has been making improvements in its yard at that place, and is also building and preparing to put in an iron bridge across Otter Tail River, near Frazee. The company has had between 100 and 200 men at the work for the last month.

SHEBOYGAN, ST. PAUL & WESTERN.—A report from Sheboygan, Wis., says that this company, noted in our issue of Oct. 8, has asked Sheboygan to issue $35,000 in city bonds to aid the project.

WISCONSIN & MICHIGAN.—The press states that it is now officially announced that the Wisconsin & Michigan Ry. will extend to Iron Mountain and Norway, Mich., next spring. Track will be laid from the northern terminus of the line at Faithorn Junction. It will require 15 miles of track to reach the Menominee range. Ultimately the line will reach Ironwood and Bessemer. Ch. Engr., A. M. Kinsman, Menominee, Mich.

Rocky Mountain and Pacific.

FLORENCE & CRIPPLE CREEK.—Surveys are said to have been made for the branch line, from Victor, Colo., to Goldfield and Altman, about 12 miles. Grading has begun. J. B. Orman has the contract for the work.

PE ELL.—Geo. H. Ellsbury, Centralia, Wash., writes us that the survey is now in progress from Pe Ell, Wash., to the mouth of the Columbia River. The first object of the survey was to find a suitable location and pass through the Coast Range of mountains; there is ample capital behind the proposition if the location is satisfactory; this is now beyond doubt, as the survey is past the summit; a very easy pass has been found and the grade established proves to be more satisfactory than was even anticipated; the force of engineers is still in the field and will be through in about three weeks. The distance from Pe Ell to the mouth of the Columbia River is about 30 miles, and the object of building is to open up the large quantities of coal which lie near Centralia and to establish a coaling station at the mouth of the Columbia, the only good and deep harbor on the Pacific coast north of San Francisco; and also to establish a short route from Puget Sound points to San Francisco. The jetty recently completed at the mouth of the Columbia has altogether altered the channel and transferred it from the Oregon to the Washington side.

MONTANA.—Reports state that tracklaying on this line to Castle is now complete for 22 miles from Helena, Mont. About 250 men are at work. The contract calls for the completion of the work by Nov. 15.

STREET AND ELECTRIC RAILWAYS.

BOSTON, MASS.—The "Financial News" states that the Southbridge & Fiskdale Electric Ry. will probably be extended through Brimfield, Mass.

CLINTON, MASS.—It is reported that $150,000 has been subscribed for building the Worcester & Clinton Electric Ry.

FALL RIVER, MASS.—The city council has granted an extension of the time for the completion of the tracks of the Globe St. Ry. Co. until Aug., 1897.

FRAMINGHAM, MASS.—It is understood that a new line extending from Marlboro to Framingham Center via Southboro may be built by the Framingham Union St. Ry. Co. Pres. Jas. R. Entwistle.

MILFORD, MASS.—The Milford, Holliston & Framingham St. Ry. Co. has been granted a franchise. The lines may be built this fall.

WEST ROXBURY, MASS.—A company is said to have been organized to build a street railway between West Roxbury and Newton, a distance of ten miles.

WORCESTER, MASS.—The Consolidated St. Ry. Co. has bought land for an extension of its tracks.

SHELTON, CONN.—The Shelton St. Ry. Co., it is said, will relay its track; John Fagan & Sons have been awarded the contract for the construction.

BINGHAMTON, N. Y.—The Binghamton St. Ry. Co. has obtained permission to make extensions.

BUFFALO, N. Y.—A franchise for extensions has been granted the Buffalo Ry. Co.

FLUSHING, N. Y.—The Highway Commissioners of the towns of Flushing and Newtown have granted the Brooklyn City R. R. Co. permission to cross Strong's bridge over Flushing Creek. The company has agreed to pay $2,000 toward the cost of the new iron bridge. The work of completing the line into this village will be pushed forward, and it is expected that cars will be running in a few days. The opening of the road will give Flushing a direct connection with Brooklyn for the first time.

LYNBROOK, N Y.—It is reported that electricity may be substituted for steam on the Long Beach Ry.

OSWEGO, N. Y.—It is stated that the Oswego St. Ry. is to be sold under first mortgage bonds held by the Knickerbocker Trust Co., of New York. C. Sidney Shepard, of New York, who has advanced the local company about $60,000, will, in all probability, become the road's owner.

MOUNT VERNON, N. Y.—It is understood that the Union Electric Ry. Co. will soon extend its trolley line from Mount Vernon to Eastchester.

BENSALEM, PA.—It is rumored that the East Penn Traction Co., recently incorporated with a capital stock of $350,000, will build a trolley line 51 miles long, to touch Bensalem, Flushing, Newportville, Emilie, Falkington, Morrisville and other points. Among those interested are: Malcomb A. Buckman, Wm. Barnsley, John L. Janney and A. J. Cleaver, all of Newtown, Pa.

DOYLESTOWN, PA.—Geo. S. Gaudy, Philadelphia, Pa., is quoted as saying that the Doylestown & Willow Grove projected trolley line will be built soon.

PITTSBURG, PA.—The Second Ave. Traction Co. has started work on the laying of a permanent roadbed and track on the California Ave. branch, from Woodland Ave. to city line at High Bridge. The new road will be built of 9-in. T-rails and new ties will be used entirely. Granite blocks will be laid between the rails and for a distance of 1 ft. on either side.

WESTCHESTER, PA.—Wm. S. Kirk, Pres., 806 Province Bldg., Philadelphia. Pa., writes us that good progress is being made and that bids are now being received for building the projected electric railway.

RICHMOND, VA.—Mayor Taylor has signed the ordinance granting a franchise to the Traction Co. to build a line to Hollywood. The company will begin the construction of this extension at once.

CHESTER, W. VA.—J. E. McDonald, Pres., East Liverpool, O., writes us that the electric line of the East Liverpool & Rock Spring St. Ry. Co., now building between East Liverpool and Chester, is two miles long and will be completed inside of 60 days. The capital stock of the company is $30,000, all paid in.

DE LAND, FLA.—Frank E. Bond writes us that the electric railway projected from De Land to Datona is 27 miles long. The surveys are made and a 50-year franchise granted by De Land with exemption from taxation for 20 years. Work is in progress on obtaining right of way. It is expected to start on construction by Jan. 1.

BUCYRUS, O.—On Oct. 7 the city council granted a franchise for an electric railway to Wm. E. Haycox, of Mansfield, and Fred B. Perkins, of Toledo. The road is to connect Bucyrus and Galion, and will be built next year; noted in our issue of Oct 8.

CLEVELAND, O.—An ordinance has passed the city council allowing the Consolidated Ry. Co. to extend its tracks.

IRONTON, O.—It is reported that the street railway will be changed into an electric system.

CHICAGO, ILL.—Press dispatches say that $5,000,000 in bonds of the General Electric Ry. of Chicago have been underwritten by J. Pierpont Morgan & Co., of New York. There will be an immediate issue of $3,000,000 of these bonds to provide for the construction of 11½ miles of road provided for under the present ordinance owned by the company. The remaining $2,000,000 will be issued as the money is needed for further extensions.——The Lake Street and the Metropolitan Elevated railways are to be notified to raise their tracks at Rockwell St. The work will cost about $5,000.

MILWAUKEE, WIS.—A local paper states that work on the Milwaukee & Wauwatosa Dummy line tracks has not been resumed since its suspension on Aug. 6. The property is still under the direction of the courts, and in the hands of a receiver in the interest of the mortgage bondholders. The option held by J. S. McDonald of Detroit for the promoters of the projected Waukesha line has expired, but can be renewed by the new directors of that company. A practical railway contractor is quoted as saying that 80% of the ties must be replaced with new ones within the coming year. The estimated cost of renovating the track and constructing a power-house and electric equipment is about $65,000. It is said that the bonded indebtedness of the old company is $125,000, for which new bonds will be issued if a readjustment and reorganization plan is consummated.

DES MOINES, IA.—The Des Moines City Ry. Co. is making arrangements, it is said, to extend its lines.

OMAHA, NEB.—An ordinance has been granted the Metropolitan St. Ry. Co. allowing it to extend its lines on certain streets.

PINE BLUFF, ARK.—D. C. Bell is interested in a proposed electric railway.

AUSTIN, TEX.—F. H. Waitress, of Chicago, and J. O. Weatherbee, of Boston, owners of a majority of the stock of the Austin Rapid Transit Ry., are said to be considering the extending of their lines to the driving club track and other points in the near future.

HOUSTON, TEX.—Citizens are attempting to secure an extension of the Houston Electric St. Ry.

PHOENIX, ARIZ.—D. A. Abrams writes us that nothing will be done on the street railway project until after the election.

BERKELEY, CAL.—The Ryder Electro-compressed Air Motor Co., which was incorporated in San Francisco in May, will put its new motor system on the Central University and ferries car line during the present month. After the Berkeley system is in operation it is stated that the Santa Rosa St. Ry. Cos. will consolidate and equip the entire system with the Ryder motor.

ELECTRIC LIGHT AND POWER.

BARTON, VT.—It is reported that this place will ask for authority to issue $40,000 in bonds for an electric light plant. It already has permission to issue $10,000 in bonds.

BOSTON, MASS.—Bids are asked until Oct. 15 for furnishing a boiler and all piping, pumps, etc., for an electric plant at the House of Correction, Deer Island, Boston Harbor; estimated cost, $12,000. F. B. Bogan, Supt. Pub. Bldgs., Old Court House.——An appropriation of $25,000 has been made for other electrical work.

BOSTON, MASS.—Bids are asked until Oct. 30 for electric wiring, heating, etc., for the state house. Arch., A. G. Everett, State House, Boston; J. D. Long, Chn. Comrs., 27 Mount Vernon St.

BRAINTREE, MASS.—The residents of this place have voted to appropriate $3,000 for a new generator for the electric light plant.

MARBLEHEAD, MASS.—The committee has submitted a report on the construction of an electric light plant for this place. J. B. Litchman, Chn.

NEW BEDFORD, MASS.—The aldermen have appointed a committee to report not later than Nov 12, on the question of an electric light or gas plant. A. B. Drake, Supt. Pub. Wks.

WATERTOWN, MASS.—Bids are asked until Oct. 26 for an electric light and power plant at the arsenal. Maj. J. W. Reilly, Ordnance Dept., Watertown.

BARRINGTON, R. I.—The council will hold a meeting Oct. 17 to consider the question of granting a 25-year franchise to the Bristol Electric Light Co.

WARREN, R. I.—The Bristol County Gas & Electric Co. has asked for a 25-year franchise.

ALEXANDRIA BAY, N. Y.—It is reported that A. E. Hume has purchased the plant of the Alexandria Bay Electric Light & Power Co. and will at once make a number of repairs to it.

BROOKLYN, N. Y.—Bids are asked until Oct. 22 for the electric wiring and fixtures for the county court house. T. B. Willis, Comr. Cy. Wks.

BUFFALO, N. Y.—The board of public works has been directed to prepare plans and advertise for bids for the electric lighting of the public buildings for three and five years. James Mooney, Chn. Comrs.——A contract has been made by the Buffalo Transmission Co. with the Niagara Falls Power Co. for transmitting power to this city by way of North Tonawanda. Geo. Urban, Jr., and Tracy C. Becker, are interested in the Buffalo company.

FLUSHING, N. Y.—It is stated that the trustees have decided to issue $4,000 in bonds for erecting 40 arc lights. G. A. Roullier, Village Engr.

HAMBURG, N. Y.—There is some talk of building a new electric light plant in this place. The three-year contract with the Hamburg Water & Electric Light Co. has expired and the price of $70 per light a year is considered too high.

WHITESTONE, N. Y.—It is reported that the construction of an electric light plant and an electric fire alarm system is to be considered. Engr., G. A. Roullier, Flushing.

EGG HARBOR CITY, N. J.—Geo. Pfeiffer, contractor for the water-works at Camden, N. J., has secured a conditional contract for an electric light plant and water-works in this city. This contract must be ratified by the citizens at an early election.

CHAMBERSBURG, PA.—The Chambersburg Electric Light Co. will increase its plant at once.

PITTSBURG, PA.—The question of building an electric light plant to cost $10,000 for the city hall is being discussed. J. O. Brown, Dir. Pub. Safety.

CUTHBERT, GA.—Bids are asked until Oct. 27 for constructing an electric light plant, as stated in our advertising columns. Robert L. Moye, Mayor and Chn. Comn.

ROME, GA.—It is stated that the plant of the Rome Light Co. is to be enlarged. C. E. Woodruff, Receiver, Rome.

FERNANDINA, FLA.—The committee is reported as wanting bids for an engine to operate an arc dynamo of 40,800 c. p. and incandescent dynamo of 500 32 c. p., and 500 16 c. p. lights.

ATLALLA, ALA.—It is stated that an electric light plant is proposed for this place.

DEMOPOLIS, ALA.—This city wishes to have an electric light plant; probable cost $5,000; with two 75-HP. boilers, one 100 HP. engine and five miles of wire, as described in our advertising columns. Gesner Williams, Mayor; J. G. Chisholm, Clk.

OKOLONA, MISS.—At an election held Oct. 5 the people voted in favor of building an electric light plant and water-works. Plans and specifications will be prepared at once, according to reports. E. J. Ezell, Chn. Com.

CAMDEN, TENN.—It is stated that an electric light plant for this place is being considered.

CLARKSVILLE, TENN.—It is reported that the Clarksville Electric St. Ry. Co. has decided to put in an electric light plant at once.

BRIGHTWOOD, IND.—Dr. Wm. H. Johnson, Pres. Town Bd., proposes to erect an electric light plant to cost about $4,000.

GLADSTONE, MICH.—The plant of the Gladstone Electric Light Co. was destroyed by fire Oct. 10. The contract with the city expires in a short time and unless a new contract is made the plant will not be rebuilt.

WEST BAY CITY, MICH.—This city is reported to be asking for propositions for an electric light plant, with an option by the city to purchase the plant. Geo. Wask, Cy. Clk.

CHICAGO, ILL.—Bids are asked until Oct. 16 for erecting and furnishing an electric light plant for the isolation hospital at 34th St. and Lawndale Ave. Joseph Downey, Comr. Pub. Wks.

CHICAGO, ILL.—Bids are asked until Oct. 19 for furnishing two triplex power pumps for the public library in Dearborn Park. W. B. Wickersham, Secy., City Hall; Archs., Shepley, Rutan & Coolidge, Venetian Bldg., Chicago.

KANKAKEE, ILL.—Bids are asked until Oct. 19 for poles and arc lights for the city lighting. Engr., F. B. Rae, 134 Monroe St., Chicago, Ill.; J. H. Brayton, Mayor; S. L, Swinney, Clk.

STAUNTON, ILL.—We are informed that the following bids were received Sept. 29 for an electric light plant; Engrs., Bryan & Humphrey, Turner Bldg., St. Louis, Mo.:

Steam plant:

Russell & Co., Massillon, O.	$2,663
A. L. Ide & Son, Springfield, Ill.	2,700
Dudley Machinery Co., 11 N. 3d St., St. Louis.	2,075
Moses P. Johnson Machinery Co., St. Louis.	1.722
Electric Eng. Co., 8 S. Commercial St., St. Louis.	....
[2]Benj. H. Richards, Edwardsville, Ill.	1,351

	Apparatus.	Const'n.
General Electric Co., Schenectady, N. Y.	$3.880	....
[1]Ft. Wayne Elec. Corp., Ft. Wayne, Ind.	4,567	$3,747
Western Electric Co., Chicago, Ill.	3,700	....
E. B. Tyler, 11 S. 9th St., St. Louis.	3,664	4,520
Electrical Engineering Co., St. Louis.	....	4,282

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[1] Awarded contracts; [2] erecting buildings, bid rejected.

STAPLES, MINN.—Press reports state that the council has voted to grant a franchise for an electric light plant. R. Aundle, Pres. Village.

GENOA, NEB.—Bids are asked until Oct. 22 for erecting a brick power house at the Indian school. J. E. Ross, Supt., Genoa.

BIG TIMBER, MONT.—The Big Timber Electric & Power Co. is preparing to put in a 70-HP. water motor at the site of its plant on the Yellowstone River. The water will be taken from the Boulder River.

BEEVILLE, TEX.—Arrangements are reported to have been made by L. D. Rhodes, of Karnes City, Tex., for putting an electric light plant in this town.

WACO, TEX.—It is reported that the committee has reported on a city electric light plant to cost $40,000. Stephen Turner, Cy. Engr.

CAMERON, MO.—It is stated that at an election held recently it was voted to issue bonds for erecting an electric light plant.

ARLINGTON, ORE.—The erection of an electric light plant is being considered, according to reports.

PARRSBORO, N. S.—Dr. J. R. Smith is reported to have been granted a franchise for an electric light plant.

AUBURN, ONT.—J. M. Campbell, of Kingston, Ont., is reported to be preparing plans and specifications for the plant for the Auburn Light & Power Co.

PETERBORO, ONT.—The council of this city is reported to be considering the question of an electric light plant.

MONTREAL, QUE.—It is reported that the National Underground & Conduit Co., of New York, N. Y., has been awarded the contract for building a conduit by the Lachine Rapids Hydraulic & Land Co.

NEW COMPANIES.—Bryan Water, Ice, Light & Power Co., Bryan, Tex.; $20,000; J. N. Cole, W. E. Sandles, G. W. Smith.

Akron Light, Fuel & Power Co., Akron, Erie county, N. Y.; $10,000; J. W. Stearn, J. Henry Troutman, Irving D. Eckerson, Richard H. Bell, of Akron; J. S. Campbell, of Butler, Pa.

Bossert Electric Construction Co., Utica, N. Y.; $16,000, with all paid in; Pres., Wm. F. Bossert, 40 Broadway, Utica; Vice-Pres., H. P. Crouse, Utica; Secy. and Treas., Seth C. Adams, Utica.

Wheeling Private Electric Corporation, Wheeling, W. Va.; $25,000, with $50 paid in; H. S. Sands, H. E. Hohman, T. H. P. Keyser, Robt. W. Kyle, all of Wheeling.

BRIDGES.

BANGOR, ME.—It is stated that the Boston & Maine R. R. Co. is having plans prepared for a new steel bridge over the Piscataquis River. H. Bissell, Ch. Engr., Boston, Mass.

BOSTON, MASS.—The state board of health is reported to have asked for bids for rebuilding the canal bridge over the Sudbury River in Wayland. The structure will be of stone and concrete, 30 ft. long and 20 ft. wide. S. W. Abbott, Secy. Bd., State House.

MALDEN, MASS.—The aldermen have been asked by the aldermen of Everett to appoint a committee to consider the question of widening the Malden bridge. E. W. Lydston, Cy. Engr., of Everett, Mass.; G. A. Wetherbee, Cy. Engr., of Malden.

PROVIDENCE, R. I.—The council has appropriated $2,000 for rebuilding the Tar bridge over the Woonasquatucket River.——The question of asking the general assembly for permission to issue $320,000 in bonds for rebuilding the Weybosset St. bridge and the river walls is being considered by the council. Robt. E. Smith, Comr. Pub. Wks.; J. H. Shedd, Cy. Engr.

WESTERLY, R. I.—This place has been authorized to build a highway bridge over the breachway at Wards Pond.

WOONSOCKET, R. I.—Bids are asked until Oct. 20 for building abutments and pier for a new bridge on River St. Joseph J. McGee, Chn. Com., Woonsocket.

NEW HAVEN, CONN.—The supreme court has decided that a new bridge must be built on Chapel St. C. W. Kelley, Cy. Engr.

NEW YORK, N. Y.—The board of street openings, on Oct. 9, passed a resolution authorizing the commissioner of street improvements in the 23d and 24th wards to build a viaduct at 153d St. over the New York Central R. R. Co.'s tracks. Plans are reported to be prepared for viaducts at 168th and 171st Sts. L. F. Haffen, Comr.

WATERTOWN, N. Y.—A meeting will be held Nov. 6 in the office of Maj. W. S. Stanton, U. S. Engr., to consider the question of constructing a draw in the bridge over the Chaumont River at Chaumont, which belongs to the Rome, Watertown & Ogdensburg R. R. Co. Supt., E. G. Russell, Watertown.

HARRISON, N. J.—Bids are asked until Oct. 15 for constructing the north approach in Harrison to the proposed highway bridge over the Passaic River at South Fourth St., Harrison, and Jackson St., Newark. Engr., T. H. McCann, Jersey City; P. J. Cairns, Pres. Council, Harrison.

MERCHANTVILLE, N. J.—An overhead bridge 66 ft. wide will be built soon at Moorestown turnpike by the Pennsylvania & N. J. R. R. Co.

NEWARK, N. J.—The following bids were received Sept. 30 by the joint bridge committee of Essex and Hudson counties for a bridge over the Passaic River at Jackson St., as advertised in Engineering News; Thos. McCann, Engr. Hudson County, Jersey City; James Owen, Engr. Essex County, Newark; (1) being for Essex county approach, (2) for the superstructure:

	1.	2.
Edgemoor Bridge Wks., Wilmington, Del.	$20,750	$94,950
Fagan Iron Wks., Hoboken, N. J.	21,612	*78,194
M. T. Connolly, Jersey City	29,876	81,576
Boston Bridge Wks., Boston, Mass.	26,506	93,990
Millard & Lahey, Philadelphia, Pa.	27,000	97,000
Youngstown Bridge Co., Youngstown, O.	28,700	100,300
F. H. Riddle	.....	64,000
Norfolk & Sillery	.....	76,228
Holmes & Cogan, Jersey City	.....	73,000
P. Sanford Ross, Jersey City	.....	74,250
A. Spronks	.....	68,762
Sanford & Skillman, Jersey City	.....	61,975

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*Awarded contract.

Masonry: F. C. O'Reilly, $3,488; A. C. Sandford, $3,998; M. T Connolly, $6,820; Fagan Iron Works, $6,800; Norfolk & Sillery, $3,750. Ten bids were received for the Harrison approach, divided in separate bids each, for 60,000 cu. yds. of filling, 5,000 sq. yds. of paving, 16,000 sq. ft. of flagging, and 2,000 ft. of curbing.

COLUMBIA, PA.—It is reported that the Western Maryland R. R. Co. is considering the question of a bridge over the Susquehanna River at Columbia. J. M. Hood, Pres., and Gen. Mgr., Baltimore, Md.

HARRISBURG, PA.—The county bridge over the Conodoquinet Creek north of New Kingston, will be repaired. It was badly damaged by the recent storms.

MEDIA, PA.—It is reported that the grand jury has been petitioned to erect a new bridge over Lobbs Run, in Alden.

MERCERSBURG, PA.—The recent storm destroyed a county bridge near this place, according to reports.

PHILADELPHIA, PA.—The committee on plans and improvements of the Fairmount Park commission, in conjunction with councils committee on Fairmount Park, has adopted a resolution to direct the engineer to advertise for bids for the sale and removal of the old bridge over the ravine in the west park, and the finance committee has been recommended to apply for $5,000 to be used for a new bridge over Allen's Lane, Wissahickon Creek. Russell Thayer, Ch. Engr.

WRIGHTSVILLE, PA.—It is stated that the Pennsylvania R. R. Co. will erect a double deck drawbridge across the Susquehanna River, at Wrightsville. W. H. Brown, Ch. Engr., Broad St. Station, Philadelphia.

WYALUSING, PA.—The township commissioners are considering the question of rebuilding the 65-ft. bridge over the river which was recently destroyed; estimated cost, $2,000. E. C. Ingham and W. B. Dean are Commissioners.

LEXINGTON, VA.—The county supervisors are making arrangements for reconstructing and repairing the bridges recently destroyed by the storm.

MOUNDSVILLE, W. VA.—Press reports state that the Baltimore & Ohio R. R. Co. has surveyors at Moundsville, where plans are being prepared for the new bridge which is to span Litle Grave Creek. The old bridge was washed out during the late storms and since that time the company has been using a temporary structure. The company will have a larger structure than the old one and it is possible that the south abutment will be extended over to the Ohio River Co.'s track, who will also use it. J. E. Griener, Engr. Bridges, Baltimore.

ATLANTA, GA.—Bids were opened Oct. 10 for painting the Nelson St. bridge and the Grant St. bridge and the contract awarded to J. F. Snelling, agent. There were nine bidders, from $385 to $125. R. M. Clayton, Cy. Engr.

CLEVELAND, O.—It is probable that the construction of the proposed bridge at Willson Ave., by the New York, Chicago & St. Louis R. R. Co. will be put off until next spring. D. E. Wright, Dir. Pub. Wks.

YOUNGSTOWN, O.—At the election, Nov. 3, the question of building three county bridges over the Mahoning River in this city to cost a total of $150,000 will be voted upon.

INDIANAPOLIS, IND.—The county commissioners are considering plans for rebuilding the bridge over Williams Creek, on the Noblesville road.

GROSSE POINT, MICH.—It is stated that a number of bridges will be built here by the village, and that C. D. Waterman, of this place, with offices at 92 Griswold St., Detroit, will erect an iron bridge over the river at his own expense.

MENOMINEE, MICH.—It is stated that Menominee will build 352 ft. of the proposed bridge north of Stephenson Island, and Marinette, Wis., will build 95½ ft. more than was originally intended. By this arrangement Marinette will build a total of 821 ft. and Menominee 699 ft. Menominee's original proposition was to build 612 ft. The report of the two committees to their respective councils will likely be adopted. E. L. Shaw, Cy. Engr., Marinette, Wis.

CAIRO, ILL.—J. S. Rearden, Comptroller, 1101 Commercial Ave., Cairo, informs us that the following bids were received Oct. 6 for constructing a bridge over the Coche River:

J. T. Garrett, St. Louis, Mo.		$3,049
C. F. Hunt Co., Indianapolis, Ind.		2,900
Wrought Iron Bridge Co., Canton, O.		2,850
King Bridge Co., Cleveland, O.	$2,480 and	4,000
Massillon Bridge Co., Massillon, O.	$2,695 and	3,500
Indiana Brdge Co., Muncie, Ind.		3,075
St. Louis Bridge & Iron Co., St. Louis.	$2,680 and	2,580
Stutt Bros. Bridge & Iron Co., St. Louis.		2,896

The above bids were all rejected, and new bids invited on plan B of the St. Louis Bridge & Iron Co.

St. Louis Bridge & Iron Co., St. Louis, Mo.	$2,380
C. F. Hunt Co., Indianapolis, Ind.	2,420
King Bridge Co., Cleveland (awarded contract)...	2,174

JOLIET, ILL.—Bids have been asked by the commissioners for erecting a 100-ft. steel bridge and two stone abutments for the same, and also an arch culvert, according to reports. O. E. Cary, Comr. Highways.

MENASHA, WIS.—The citizens of this place have voted to build an iron bridge here at a cost of $14,800, according to reports. W. W. Reed, Cy. Engr.

WAUSAU, WIS.—C. W. Nutter, Cy. Engr., is reported to have prepared plans for a steel and iron bridge at this place.

DOUDS STATION, IA.—It is reported that the board of supervisors of Van Buren county has voted to appropriate $20,000 for erecting a bridge over the Des Moines River, between this place and Leando.

IOWA CITY, IA.—The supervisors are considering the question of a bridge over the Adar River, according to reports.

MASON CITY, IA.—Bids were opened recently for building the abutments for the Main St. bridge over Willow Creek. All were rejected, and the work will be done under the superintendence of the county commissioners. Two new trusses are to be added and the bridge widened to 66 ft. It is now about 30 ft. wide and 120 ft. long. The span will remain the same. The bridge when completed will have a 12-ft. space between the inside trusses for the street car line, an 18 ft. roadway on each side and 6-ft. sidewalks outside of the outer trusses. C. T. Dike, Cy. Engr.; O. E. Stanley, Asst. Cy. Engr.

ST. PAUL, MINN.—The city engineer has been directed to prepare plans for an iron bridge over the railway tracks at Raymond Ave.; estimated cost, $10,000. It is probable that the contract will be let about January 1. L. W. Rundlett, Cy. Engr.

NILES, CAL.—It is stated that a 2-span steel bridge is to be built at this place. The structure will be on masonry foundations and will have a 196-ft. span and a 100-ft. span. G. L. Nusbaumer, County Surv., Oakland.

OAKLAND, CAL.—The supervisors have been requested to repair the canal bridge.

VISALIA, CAL.—Surveys have been made for the Valley Ry. bridge over the Kings River at Reedley.

HOWICK, QUE.—It is reported that D. R. Hay is receiving bids for rebuilding the bridge at Riverfield in the parish of Tres St. Sacrement. The structure is to be 125 ft. long and 16 ft. wide. Plans are to be furnished by the bidders.

LOUISE, ONT.—W. Cranston, Clk., of Louise, is reported as receiving bids for repairing and extending the bridge at this place.

BUILDINGS.

BANGOR, ME.—Cope & Stewardson, 314 Walnut St., Philadelphia, Pa., are preparing plans for a $50,000 residence for Edgar Scott, of this city, according to reports.

ST. ALBANS, VT.—It is stated that this village will ask the legislature, which is now in session, for authority to issue about $35,000 of 4% town hall bonds, to be dated Jan. 1, 1897.——The St. Albans Academy and Graded School District is also about to issue school building bonds for $25,000.

GREAT BARRINGTON, MASS.—Press reports state that a fire here Oct. 12 destroyed the Hollenbeck Block, the Miller House, and a row of brick houses on Railroad St., causing a loss of $200,000. The brick row and the Kennedy House, which was also destroyed, were owned by E. D. Humphrey, Chas. Watson and Dr. Camp.

SOUTH HADLEY, MASS.—It is reported that arrangements are being made for re-erecting the buildings of the Mount Holyoke College, which were destroyed by fire Sept. 27. It is proposed to build eight cottage dormitories, at a cost of about $35,000 each; a gymnasium, to cost $35,000, and a chapel, to cost about $100,000. Mrs. E. Storrs Mead, Pres., South Hadley.

PROVIDENCE, R. I.—State Senator Eastman has introduced a resolution in the senate authorizing an appropriation of $40,000 to continue the construction of the state normal school.——This city has been authorized by the senate to spend $15,000 for erecting a casino at Rogers Williams Park, and $150,000 for park purposes.

NEW HAVEN, CONN.—The fire commissioners have decided to erect a new engine house in Edgewood Ave.

NEW LONDON, CONN.—Bids are asked until Nov. 5 for erecting a post office building and custom house in this city, as stated in our advertising columns. Wm. Martin Aiken, Supervising Arch., Washington, D. C.

NEW LONDON, CONN.—Sperry & Treat have been awarded the contract for erecting the new Osterweis building at a cost of $40,000.

BUFFALO, N. Y.—Bids are asked until Oct. 24 for the foundation of the new state armory on Niagara St., for the 74th Regiment. The building will be 530 × 240 ft. The appropriation immediately available for the work is only $25,000, but at the coming session of the legislature it is promised that an appropriation will be made sufficiently large to pay for the roofing in of the building. State Arch., I. G. Perry, Binghamton and Albany, N. Y.; Maj. H. P. Stacpole, Secy. State Armory Comn., Albany; Wm. Lansing, of Lansing & Beierl, 371 Pearl St., Buffalo, Supt. of Construction.

NEW YORK, N. Y.—Bids are asked until Oct. 20 for erecting an ambulance station and vaccine laboratory on 17th Street; two sureties of $25,000 each. C. G. Wilson, Pres. Health Dept., Criminal Court Bldg.——Bids are asked until Oct. 21 for erecting a school building in Fordham Ave., and improving six school buildings. Robt. Maclay, Chn. Com., 146 Grand St.——Geo. S. Morison, 1742 Monadnock Bldg., Chicago, Ill.; Prof. Wm. H. Burr, 151 West 74th St., New York; and Gen. Wm. P. Craighill, Washington, D. C., the consulting engineers of the department of docks, have submitted a report in which they recommend the construction of one ferry house for the accommodation of the ferry companies at the Battery.——The Church of the Divine Paternity, now at 5th Ave. and 45th St., has purchased from Slawson & Hobbs, agents, the property at Central Park West and 76th St., on which the church will erect a new building. The committee will ask for competition on the plans for the structure, which will cost about $200,000. W. J. Pingue, Pres. Bd. Trustees; Chas. H. Eaton, Pastor, 35 West 48th St.——It is stated that the Harmonie Club is considering the question of a site on Fifth Ave., for its proposed new club house. About $800,000 is to be spent on the purchase of the ground and the erection of the house. Henry Morgenthau, Tribune Bldg., Chn. Com.; Pres., J. W. Mack, 92 Liberty St.——Plans have been filed by the Roman Catholic Church of St. Joseph, 138 Waverley place, for a 5-story brick school building, to cost $50,000. Arch., G. H. Streeton, 287 Fourth Ave.; by W. G. Webber, 649 Amsterdam Ave., for two 5-story brick flats, to cost $56,000: by Joseph Cirrito, 167 West 80th St., for a 5-story brick flat, on 103d St., to cost $50,000; Archs., Neville & Bagge, 217 West 125th St.; by Chas. F. Rogers, 70 Fifth Ave., for two 5-story brick flats, to cost $90,000, Archs., Neville & Bagge, New York.——Albert C. Morris and Chas. H. Osborne are to erect a 10-story apartment house on 72d St., through to 71st St., on the east side of the retaining wall of the N. Y. C. & H. R. R. R.; estimated cost, $600,000.——The Chas. S. Kendall Co., 1368 Broadway, who has been awarded the general contract for erecting the 15-story Herald Square Hotel, at 36th St., Broadway and 6th Ave., is receiving estimates for sub-contracts; estimated cost, $1,000,000. Archs., Hill & Turner, 44 Broadway; D. H. Schneider, 1360 Broadway, is the owner.——Robinson & Wallace, 123 East 23d St., have been awarded the contract for erecting a 4-story brick and stone building at Morningside Park and 119th St., for Barnard College; estimated cost, $250,000; Archs., Lamb & Rich, 35 Nassau St.——J. E. Ware, 489 Fifth Ave., is preparing plans for a block of model tenements, 300 × 100 ft.——Thos. Cockerill & Son, 550 West 41st St., have the contract for erecting a $124,900 school building. Arch., C. B. J. Snyder, 146 Grand St.

CAMDEN, N. J.—J. C. Newson, 1001 Chestnut St., Philadelphia, Pa., has prepared plans for a church building, 140 × 82 ft., for the Broadway M. E. Church, to cost $60,000.

PASSAIC, N. J.—It is stated that the Erie R. R. Co. proposes to erect new passenger stations in Passaic, Rutherford, Middletown and Paterson, N. J. C. W. Buchholz, Ch. Engr., 21 Cortlandt St., New York.

ALLEGHENY, PA.—A. & G. Wilson have been awarded the contract for erecting an $80,000 residence for A. M. Byers, Ridge and Grant Aves. Archs., Alden & Harlow, Vandegrift Bldg., Pittsburg.

CORNWALL, PA.—The trustees of the Reformed Church are reported as about to erect a new building.

ERIE, PA.—It is stated that Alden & Harlow, Vandegrift Bldg., Pittsburg, Pa., have prepared plans which have been accepted for a new public building in this city, to cost $100,000.

WILMINGTON, DEL.—Addison Hutton, 400 Chestnut St., Philadelphia, Pa., has prepared plans for a 3-story school building for the Delaware School for Girls, to cost $20,000. Mrs. Samuel Bancroft, Chn., Wilmington.

BALTIMORE, MD.—Bids are asked until Oct. 20 for erecting an addition to the school building in South Baltimore. F. E. Wathen, Secy. Comrs.

WISE, VA.—Bids are asked until Oct. 27 for constructing a county court house; bond, $25,000. Archs., F. P. Milburn, Winston, N. C.; J. C. Wells, Chn. Bd.

NEW ORLEANS, LA.—Bids are asked until Nov. 2 for erecting a light tower at Barataria Bay, La. Maj. J. B. Quinn, Light-house Engr., New Orleans.

ATHENS, O.—Bids are asked until Oct. 26 for erecting an administration building at the Ohio University. Archs., Samuel Hannaford & Sons, Hulbert Block, Cincinnati; J. M. Welsh, Chn. Com., Athens.

COLUMBUS, O.—It is reported that the following submitted plans for making improvements to the state house: Owsley & Boucheree, Wicks Bank Bldg., Youngstown, O.; H. E. Siter, 3d and Walnut Sts., Cincinnati; Levi T. Schofield, 37 Case Bldg., Cleveland, O.; Yost & Packard, Y. M. C. A. Bldg., Columbus, O.; Hannaford & Sons, Hulbert Block, Cincinnati; M. S. Detweiler & Co., John Eisemann, The Arcade, Cleveland, O.; Knox & Elliott, Society of Savings Bldg., Cleveland; F. C. Cramer, 89 Euclid Ave., Cleveland; H. C. Lindsay, 173 Main St., Zanesville, O.

SPRINGFIELD, O.—Bids are asked until Nov. 12 for erecting an administration building for the Pythian home to cost about $18,000. Bids were received Oct. 7 but were rejected. Zachary Taylor, Secy. Bd. Trustees.

LOGANSPORT, IND.—It is stated that Michaels University in this city was destroyed by fire Oct. 6, causing a loss of $50,000.

LANSING, MICH.—The board of trustees of the state home for feeble minded has asked for an appropriation of about $400,000 for erecting several new buildings and making improvements.

CHICAGO, ILL.—Bids are asked until Oct. 16 for the steam heating, plumbing, sewerage, etc., of the bathhouse on Wentworth Ave. Joseph Downey, Comr. Pub Wks.——The following bids were received Oct. 5, for 10 elevator cars for the public library building, all bidders being residents of Chicago. W. B. Wickersham, Secy. Bd. Dir.: Wm. H. Warren Mfg. Co., Blackhawk St. and Smith Ave., $6,700; Crane Elevator Co., 218 South Jefferson St., $6,500; $5,000, lower bid based on specifications drawn up by bidder; D. M. Swiney, Polk and Canal Sts., $6,374; Alex. H. Revell & Co., Wabash Ave. and Adams St., $5,963; Edmunds Mfg. Co., Robey St. and Washburn Ave., $5,872; Baumann-Simon Co., 378 Fulton St., $5,084; and Clarence I. Wolfinger, Room 62, 164 La Salle St., $4,920.

CHICAGO, ILL.—L. Broadhag, 385 Wells St., is preparing plans for a 6-story building to cost $70,000.

JACKSONVILLE, ILL.—At the election, Nov. 3, the question of erecting a new county jail, to cost $35,000, will be voted upon.

SPRINGFIELD, ILL.—Bids are asked until Oct. 28 for erecting a new high school building. Archs., M. E. Bell, 84 Adams St., Chicago, Ill.; R. D. Lawrence, Pres. Bd. Education.

FORT LEAVENWORTH, KAN.—Bids are asked until Nov. 9 for constructing a hospital building and for heating, etc. M. I. Ludington, Ch. Q. M., Chicago, Ill.

ST. PAUL, MINN.—We are informed that the following bids were received Oct. 6 by the state capitol commissioners for the structural iron and steel work for basement floor of the new capitol building, which is to cost about $1,000,000. Arch., Cass Gilbert, Endicott Bldg., St. Paul; Channing Seabury, Vice-Pres. Comrs.:

Crown Iron Works Co., Minneapolis	$10,440
Gillette-Herzog Mfg. Co., Minneapolis	8,485
S. T. Ferguson, Minneapolis	9,872
Olof Hoff, Minneapolis	10,087
Universal Construction Co., Chicago (accepted)	8,188
St. Paul Foundry Co., St. Paul, Minn	8,700
Milwaukee Bridge & Iron Co., Milwaukee, Wis.	9,134
Wisconsin Bridge & Iron Co., Milwaukee	9,985
The Snead & Co. Iron Works, Louisville, Ky.	10,240
The Stewart Iron Works, Cincinnati, O.	12,449
The L. Schreiber & Sons Co., Cincinnati	10,131

BROOKINGS, S. DAK.—At the election, Nov. 3, the question of issuing $7,000 in bonds for a jail will be voted upon, according to reports.

KIRKSVILLE, MO.—The commissioners of Adair County are considering the question of issuing $50,000 in bonds for a new court house, according to reports.

COLORADO SPRINGS, COLO.—The question of issuing $84,000 in bonds for a new county court house will be voted upon at the election Nov. 3.

LOS ANGELES, CAL.—Bids are asked until Dec. 9 for erecting a building at the county hospital, according to reports. T. E. Newlin, County Clk.

SAN FRANCISCO, CAL.—The special administrators of the Fair estate are said to be planning the enlargement of the Lick House to cover the Builders' Exchange lot, adding 200 rooms to the hotel.

TORONTO, ONT.—V. Wyss Thallman, Bissell Bldg., Philadelphia, Pa., is reported to have had his plans accepted for a new capitol for the Province of Ontario; estimated cost, $3,000,000.

WATER-WORKS.

BOSTON, MASS.—The city engineer has prepared plans for a water supply from the harbor for fire protection, estimated to cost $50,000. The plans provide for 12-in. mains and four stations on the water front at which fire boats could be connected. William Jackson, Cy. Engr.; John E. Cheeney, Asst. Cy. Engr.

SHARON, MASS.—The town has authorized the water commissioners to spend $10,000 for extending and improving the water plant.

PROVIDENCE, R. I.—The aldermen have appropriated an additional $50,000 for water-works construction purposes.

DARIEN, CONN.—It is stated that the construction of a large dam across the valley was commenced Oct. 8 by J. B. Rider, Engr., South Norwalk.

PUTNAM, CONN.—The Putnam Water Co. contemplates adding a new 1,250,000-gallon Deane pump and a 60-HP. boiler next spring. Wm. Wheeler, Engr., 89 State St., Boston.

ALBANY, N. Y.—The council has voted to issue $52,000 in water bonds to construct a new intake, erect additional coal sheds and make extensions to the mains.

ARCADE, N. Y.—The construction of works will probably be commenced as soon as bonds can be sold, either this fall or next spring. G. N. Cowan, Engr.

BINGHAMTON, N. Y.—John Anderson, Secy., writes us that the following bids were received last month for a 12,000,000-gallon pumping engine, as advertised in Engineering News:

Holly Mfg. Co., Lockport, N. Y. (awarded contract)	$31,875
Henry R. Worthington, Brooklyn, N. Y.	32,900
Lake Erie Engineering Co., Buffalo, N. Y.	38,000
The Dickson Mfg. Co., Scranton, Pa.	44,750
Nordberg Mfg. Co., Milwaukee, Wis.	46,414

WILLARD, N. Y.—A. H. Eldridge, of Cornell University, is reported to have prepared plans and specifications for a new water supply system for the Willard State Hospital. Dr. William Mahon, Supt.

SHARON SPRINGS, N. Y.—The question of water-works is again being agitated.

SKANEATELES, N. Y.—The court has refused to grant an injunction restraining this village from constructing municipal works, for which contracts were recently awarded.

WHITE PLAINS, N. Y.—J. F. Daly, of Yonkers; John Berry, of Mount Vernon, and W. T. Emmett, of New Rochelle, have been appointed commissioners to appraise the local plant of the Westchester Water Co. It is understood that the company has refused to sell for less than $210,000.

CAMDEN, N. J.—The land for the well system is now being transferred to the city and subcontracts for tube wells are about to be let by George Pfeiffer, the general contractor. The 4% water bonds have been disposed of, as noted last week, money to be available Oct. 20.

EGG HARBOR CITY, N. J.—A contract for water-works has been awarded to Geo. Pfeiffer, of Camden, subject to a vote of the citizens at an early election.

BEAVER FALLS, PA.—The supreme court has made perpetual the temporary injunction restraining this borough from constructing works, and it is stated that a private company, recently organized, will build a plant as soon as a charter is secured.

COATESVILLE, PA.—The question of better water supply will be voted upon next month, according to reports.

DAWSON, PA.—D. J. Redding, Chn. Com., writes us that the following contracts have been awarded: Pipe and specials, National Foundry & Pipe Works, $1,473; valves and hydrants, Bailey & Farrell Co., Pittsburg. $360; pipe laying, F. L. Garrard, Dawson, $784; reservoir, P. Hickey, Mount Pleasant, Pa., $548. Taylor, Romine & Scott, Engrs., McKeesport, Pa.

HALIFAX, PA.—The council appointed a committee Oct. 5 to contract with any party who will agree to construct works, the borough to pay $300 a year annual rental. J. J. Rouch, Secy. Council.

LEBANON, PA.—The council has appropriated $5,000 for sinking a 10-in. well at South Mountain, six miles from the city, with a view to increasing the water supply.

HIGHLAND, PA.—A press report states that bonds have been voted for water-works, sewers, etc.

McKEESPORT, PA.—Bids are asked until Oct. 26 for furnishing and erecting two pumping engines, and also for sinking a system of wells, etc., as stated in our advertising columns. J. Schinneller, Engr., McClintock Bldg., Pittsburg; Edwin Soles, Supt.

MOUNT JOY, PA.—The borough authorities are said to be in the market for a new boiler, pumps, etc., for the water-works.

PENNSBURG, PA.—Efforts are again being made to organize a local company to construct works, estimated to cost $25,000, according to reports.

PHILADELPHIA, PA.—The water committee of councils has voted in favor of contracting with the Holmesburg Water Co. to supply the new county prison with 100,000 gallons of water a day for ten years at $3,000 a year.

WEST READING, PA.—The West Reading Water Co. has contracted with the Cumberland Mfg. Co., of Boston, for a $5,000 filter plant, according to reports. James Matz, Supt.

DELAWARE CITY, DEL.—It is reported that W. Taylor Leland and others, of Philadelphia, contemplate the construction of water-works at this place.

WASHINGTON, D. C.—Capt. Edwin Burr, Asst. Engr., Comr., has completed his annual report, in which he deals with the inadequate water supply of the city; an appropriation of $10,000 is recommended for sinking additional wells next year.

BERRYVILLE, VA.—O. W. Gardner and S. C. Callahan, of Hollidaysburg, Pa., are reported to have secured a 60-day option on the plant of the old Berryville Water Co., and it is thought that the plant will soon be completed.

SUMMERVILLE, GA.—It is reported that this city will issue bonds for water-works.

UNADILLA, GA.—The city council has awarded a contract for an artesian well.

OKOLONA, MISS.—At the election on Oct. 5 the citizens voted 165 to 15 in favor of issuing $30,000 in bonds for water-works and an electric light plant, for which plans will soon be ready. Address E. J. Ezell.

FRANKLIN, LA.—We are informed that no contract for water-works was awarded Oct. 1. L. B. Tarlton, Mayor.

CLOVERPORT, KY.—It is reported that A. A. La Heist is making plans for works and will try to organize a company to construct the plant.

BUCYRUS, O.—The Bucyrus Water Co. has purchased land for the construction of an 80,000,000-gallon reservoir. Frank P. Kaler, Supt.

CLEVELAND, O.—Bids are asked until Nov. 6 for the purchase of $300,000 in 4% water bonds, maturing Oct. 1, 1926. H. L. Rossiter, Cy. Audr.

DAYTON, O.—Several plans are being considered for a water supply for the asylum.

MARION, O.—The state board of health was investigating the water supply of this city last week; report not yet submitted.

HUNTINGTON, IND.—Bids are asked until Oct. 24 for sinking 12 8-in. tubular wells, rebuilding pumping station, erecting a 30 × 75-ft. stand-pipe, etc. Sturtevant & Todd, Consult. Engrs., Association Bldg., Chicago; E. Q. Drummond, Cy. Clk.

INDIANAPOLIS, IND.—The Indianapolis Water Co. has recorded a mortgage for $3,000,000. It is stated that the wells now being sunk will be tested before a filter plant is put in.

ZANESVILLE, O.—The bids for an 8,000,000-gallon pumping engine, published last week, have all been rejected and it is stated that new bids will soon be asked.

CHICAGO, ILL.—Bids are asked until Oct. 20 for laying water mains in 26 streets. Joseph Downey, Comr. Pub. Wks.

MINONK, ILL.—M. H. Pfaffle, Cy. Clk., writes us that the council has decided to reject all bids for a 60-ft. brick tower and a 3,000-bbl. steel tank, received Oct. 5, as advertised in Engineering News, and defer the building until spring; the bids were as follows:

	Tower.	Tank.
Joliet Bridge & Iron Co.	$3,350	$4,000
A. B. Kipp, Minonk	2,848	4,633
Reeves Bros., Alliance, Ohio	.....	2,413
E. P. Hodgkins, South Chicago	3,250	.....
Cobett & Stadler, Aurora	.....	2,438
Chicago Bridge & Iron Co.	.....	2,512
Heggie Bros., Joliet	.....	2,700
O'Brien Boiler Works, St. Louis	.....	2,341
Wm. Tunny, Lockport, Ill.	3,900	.....

Irregular Bids:

Martin O'Connell, Minonk (complete)	$7,629
Geo. C. Morgan, Chicago (own design)	6,000
Chicago Bridge & Iron Co. (own design)	6,000
Chicago Bridge & Iron Co. (all steel)	5,000
Joliet Bridge & Iron Co. (all steel)	5,500
Joliet Bridge & Iron Co. (stone tower and tank)	6,795

PARK RIDGE, ILL.—The contract for laying 7,000 ft. of water mains, etc., has been awarded to S. W. Robinson, of Park Ridge. Joseph Lalone, Village Clk.

BALDWIN, WIS.—Bids are asked until Oct. 20 for furnishing and erecting a water tank, 16 × 16 ft. of 3-in. staves, and a steel tower 60 ft. high. Chas. Settergren, Village Clk., writes us that $1,000 will probably be spent this fall and works constructed in the spring.

DULUTH, MINN.—Bids are asked until Oct. 30 for furnishing and laying about three miles of 42-in. riveted steel or cast-iron pipe, as stated in our advertising columns. W. B. Patton, Cy. Engr.; M. J. Davis, Pres. Bd. Pub. Wks.——The following bids were received Oct. 7 for new pump house; all local bidders:

Bidder.	Brick walls, brownstone trimmings.	Brownstone ashlr. facg. rubble bckg.	Broken range rubble.	Rubl. mas'ry from native trap rock.
Tullock Bros.	$22,410	$22,990	$20,490	$19,790
C. J. Fredrickson	18,900	18,318	16,400	16,500
Nils Nilson	23,897	25,657	20,354	.....
McLeod, Campbell & Smith	19.765	25,931	24,061	22,191

ST. LOUIS, MO.—The lowest bids received Oct. 6 are reported as follows: For 75 tons special castings, Howard-Harrison Iron Co., $2,395.60; 200 tons of castings, Harrison Iron Co., $6,388; 5,050 tons water pipe, Harrison Iron Co., $100,697; 77 stop valves, St. Louis Iron & Machine Works, $7,401; five stop and check valves, Michigan Brass & Iron Works, $3,090; 4,960 tons water pipe, Harrison Iron Co., $98,902; for laying 27,300 ft. of water pipe, George P. Prendergast, $24,241.

ROSEBUD, S. DAK.—Bids are asked for constructing a water and sewer system for the boarding school plant now in course of construction at the Rosebud Agency. Chas. E. McChesney, U. S. Indian Agt.

ANAHEIM, CAL.—The plans of C. S. Rogers, of Anaheim, include three 10-in. wells, about 135 ft. deep, and the erection of a 60,000-gallon tank, in addition to mains, etc. onds were to be sold this week, after which bids will be asked for constructing the plant.

REDDING, CAL.—It is reported that George Groves will petition for a franchise to construct works.——The new owners of the Mad Mule mining property, near Whiskytown, are reported about to erect a large pumping station on the Grizzly gulch and pump water about a mile over the mountain.

SAN DIEGO, CAL.—A local paper states that the stockholders of the Temesco Water Co. will soon vote on the issue of $175,000 in bonds for supplying water in Corona and for improving the pipe system.

SUSSEX, N. B.—The Sussex Water & Electric Light Co. has been organized.

PARRSBORO, N. S.—Prof. W. R. Butler, of Kings College, Windsor, is preparing plans and specifications for water-works, to be constructed in the spring. N. H. Upham, Town Clk.

CHAMBLEY BASIN, QUE.—Bids for constructing an aqueduct are reported as being received by this village and Chambly Canton. E. L. De La Vallee & Cie, Engrs., 17 Place d'Armes Hill, Montreal.

COWANSVILLE, QUE.—It is reported that works are being constructed.

BRIDGEBURG, ONT.—The Welland "Telegraph" states that John Galt, of Toronto, has prepared plans for works to cost $27,000; also that D. A. Coste will construct works if granted a franchise.

WELLAND, ONT.—It is reported that this city has been directed to invest $50,000 in water-works, or suffer a raise of 50% in insurance rates.

HUNTSVILLE, ONT.—Bids are being received for the construction of works, according to reports. William Rumsey, Clk.

LONDON, ONT.—The superintendent has reported that a separate system of water-works for street water would cost about $38,000.

VANCOUVER, B. C.—Bids are asked until Oct. 28, according to reports, for a quantity of steel riveted pipe and stop valves. T. F. McGurgan, Cy. Clk.

IRRIGATION.

EL PASO, TEX.—Wm. W. Follett, Engr., 233 East Maple St., Denver, Colo., writes us that no steps have yet been taken looking to the immediate construction of reservoir at El Paso, Tex. Some information is being collected as to use of water in the United States, the Mexicans claiming that the recently large increase of the use of water in Colorado has deprived them of it at El Paso. ——Press reports state as follows: A. Engledue, Chn. London board of directors of the Rio Grande Dam & Irrigating Co., accompanied by W. T. Johns, Secy., recently arrived in El Paso to open permanent offices here. The company they represent proposes to commence in a few days the construction of a dam and reservoir across the Rio Grande River in New Mexico, 90 miles above El Paso, and the irrigation canal will pass through El Paso to the valley below. About $2,000,000 has been subscribed to the capital of the company.

AMERICAN FORK, UTAH.—Press reports state as follows: The joint irrigation committee of American Fork, Pleasant Grove and Lehi met here Sept. 22 to consider the report of Civil Engineer McAllister concerning the proposed reservoirs at Silver Lake and Milkmaid flat. The plans and specifications show that the water in Silver Lake could be raised to a depth of 15 ft., and the water already in the lake, averaging about 8 ft. in depth, could be drained therefrom through the solid granite below for about $900. This would furnish enough extra water to irrigate 215 acres of land. It is also estimated that a reservoir could be built in Milkmaid flat to hold sufficient water to irrigate 578 acres for about $12,000; or that a reservoir to irrigate 949 acres, bringing the water to a 30-ft. level, could be built for about $19,000. The plan for the Silver Lake reservoir was adopted by the committee.

NEW COMPANIES.—Bridge Creek Irrigation Co., Coolidge, Hamilton county, Kan.; $150; it is stated that the company proposes to build a large canal; Pres., W. E. Brown; Secy., M. O. Clark; Treas., H. J. Laubach.

Crater Reservoir Co., Hotchkiss., Colo.; $7,200; it is proposed to construct a reservoir in Delta county in the vicinity of Bald and Crater peaks. The waters will be taken out of Leroux Creek. A. D. Simpson, N. D. Bennett, C. R. Miller, E. E. Hall, E. M. Houts, Percy Houts, R. O. Wilmont, H. R. Bennett, S. E. Ellington.

SEWERAGE.

ST. ALBANS, VT.—We are informed that the main outlet sewer is being built by the village. About 5,000 ft. will be built this year, but will not be let by contract. Chas. E. Collins, Engr. and Supt., Cambridge, Mass.

SPRINGFIELD, MASS.—Daniel W. Mellen, Springfield, has been awarded the contract for extending the Long Hill sewer into the Connecticut River, by the construction of 300 ft. of 18-in. cypress pipe outlet with a 24-in. storm water sewer, and also tile and cast-iron sewer pipe, at $4,825. McKenzie & Peterson, of Springfield, were the only other bidders at $4,969. Chas. M. Slocum, Cy. Engr.

PROVIDENCE, R. I.—Plans have been prepared for a sewage disposal plant by precipitation, the contracts for which will probably be let next spring. J. H. Shedd, Cy. Engr.

NEW HAVEN, CONN.—The committee has reported favorably on the construction of sewers in five streets. C. W. Kelley, Cy. Engr.

BROOKLYN, N. Y.—Bids are asked until Oct. 23 for furnishing 48-in. cast-iron pipe and special castings for the main relief sewer along the Clinton Ave. bulkhead wall, and for constructing sewers in two streets. Theo. B. Willis, Comr. Cy. Wks.

BUFFALO, N. Y.—Bids are asked until Oct. 16 for constructing a 12-in. pipe sewer in Pearl St. R. G. Parsons, Secy. Pub. Wks.

GENEVA, N. Y.—Walker & Robinson, of Tippecanoe, O., who had the contract to construct the 24 miles of sewers here, have failed and the work has been relet to John F. Dolan, of this place. About nine miles have been built. The new contract has about the same prices as the old. Work will be resumed at once.——Bids were submitted by Walker & Robinson June 5 at $39,800 with trenching, rock and embankment, and at $36,800 without rock and embankment, as stated in our issue of June 25. S. G. Gano, Engr. in charge, Geneva; J. J. R. Croes, Consult. Engr., 68 Broad St., New York; E. W. Herendeen, Pres. Comrs.

WALDEN, N. Y.—The following submitted bids Oct. 2 for pipe sewers in six streets: John J. Taylor, Cornwall; Syracuse Stone Co.; Costello & Dunn, Kingston; Frank G. Wood, Newburg; Taylor & Bateman, Walden; Samuel A. Wilson, Newburg; Morgan & McCartly, Kingston; Henry E. Weiner, Kingston; E. S. Sayre, Walden; Cornelius Daley, Poughkeepsie; John Duff, Newburg; John Mitchell, Kingston; Isaac Edwards, Cornwall. For digging trenches: E. H. Van Kueren, M. Depuy, E. Mitchell, G. M. Millspaugh, Wm. Tompkins, J. Fetherston, Stephen Stickels, of Walden. E. S. Sayre, Walden, was awarded the contract for furnishing 3,400 ft. of 15 and 12-in. sewer pipe, and G. H. Van Kuren, M. Depuy, Stephen Stickles, Wm. Tompkins and Edward Mitchell the contracts for constructing.

ROCHESTER, N. Y.—Bayer & Albaugh were the only bidders Oct. 7 for constructing a 24-in. pipe sewer 2,090 ft. in the Culver Road, at $12,228. E. A. Fisher, Cy. Engr.

TRENTON, N. J.—Bids are asked until Oct. 20 for constructing sewers in several streets, according to reports. C. Edward Murray, Cy. Clk.

ALLENTOWN, PA.—R. S. Rathbun, Cy. Engr., submitted a report Oct. 6 on the construction of a filtration plant to cost about $80,000, and of trunk and lateral sewers to cost about $141,000. The question will be voted upon at the next election.

PHILADELPHIA, PA.—Geo. S. Webster, Ch. Engr., informs us that bids for two small connections with the Manayunk intercepting sewer will be asked soon, estimated cost about $6,000.

SHARPSBURG, PA.—Bids are asked until Oct. 31 for the completion of the sewer system, consisting of about 1,665 ft. of brick sewer and about 16,500 ft. of pipe sewer, with the necessary manholes, catch basins and flush tanks. Bids will be received for the whole work or for one or more of the three sections into which the work is divided. E. C. Hulbert, Borough Engr., 1035 N. Canal St., Sharpsburg; G. D. McMorran, Pres. Council; C. A. Clowes, Clk.

YORK, PA.—Joseph L. Wickes, Atlantic City, N. J., has been selected by the council to prepare plans for a sewer system. About 30 engineers submitted bids Sept. 20 for preparing plans, as advertised in Engineering News. Sebastian Mayer, Chn. Com.

UNIONTOWN, PA.—Surveys are reported as being made for a sewer system for this place.

BALTIMORE, MD.—The Southwest Baltimore Improvement Association, at its meeting Oct. 8, at 712 South Warner St., discussed the question of a sewer in Stockholm St. Chas. A. Briscoe, Chn. Com.

BALTIMORE, MD.—Bids will soon be asked for a 36 and 30-in. cast iron pipe sewer in Charles St.; estimated cost, $8,000. Janon Fisher, Cy. Comr.

TAMPA, FLA.—J. H. Neff, Cy. Engr., writes us that no work can be done on the proposed sewer system until after Nov. 15. Des. Engrs., Waring, Chapman & Farquhar, 874 Broadway, New York.

LOUISVILLE, KY.—J. H. Pearson, Cy. Engr., writes us as follows in regard to projected sewer work: Our sewers are all built out of a general tax fund, whether new or reconstruction, and usually by city force. The system takes both surface and house drainage, and is becoming overtaxed. I have recommended for this new year several large sewers, but there is no probability that more than one of them will be built, which one I cannot say; approximate estimate is as follows:

	Diameter.	Estimate.
30th St., Bank St. and 34th St. (all one)	8 ft.	$154,200
Clay St. sewer	7 ft., 6 ft.	67,060
Christie and Barrett Ave., sewer	2 ft., 3 ft., 5 ft.	50,000
Enterprise No. 1	5 ft., 9 ft.	22,000

We have a large filthy stream running through our East End (Beargrass Creek), which takes all the East End sewage. I am in hopes of starting a scheme to improve it, making it 50 ft. wide, 5 ft. deep, between walls, and laying the bed invert in vitrified brick or cement, so as to give it a uniform grade, and straighten its course for about two miles; estimated cost, $550,000; work to be done in yearly installments, unless funds are raised for it by bonds. We cannot turn it around the city, and have to put up with it, but can improve it, and this will have to be done, no matter what it costs, some time. We also have a great deal of trouble in cleaning out our sewers, and I am getting up an elevator bucket arrangement for the purpose.

MANSFIELD, O.—L. E. Chapin, Cy. Engr., of Canton, O., has submitted a report on plans and specifications for the proposed sewage disposal works for this city, according to reports.

INDIANAPOLIS, IND.—The board has adopted resolutions for constructing about 4,700 ft. of 39 to 32-in. brick and 20 to 12-in. pipe sewers. B. J. T. Jeup, Cy. Engr.

HOLLAND, MICH.—The board of public works is considering the question of extending the sewers. Engr., A. L. Holmes.

LAURIUM, MICH.—Joseph R. Murphy, Clk., writes us that an election to issue $35,000 in sewer bonds to build a system was held Sept. 12, and resulted in a tie vote. Nothing further will be done for the present. Probably an effort will be made next year to again obtain permission to issue bonds.

SAGINAW, MICH.—It is proposed to build a system in the west side. and also a sewer to cost $3,120 in Michigan Ave. H. E. Terry, Cy. Engr.

LINCOLN, ILL.—Bids are asked until Oct. 19 for constructing about 7,800 ft. of 24 to 8-in. pipe sewers. T. S. Davy, Cy. Engr.; Frank Bollin, Cy. Clk.——In addition to the above there is 1,800 ft. of 18-in. pipe sewers to be built soon.

ROSEBUD, S. DAK.—Bids are asked for constructing a sewer system and water-works for the boarding school on the Rosebud reservation. Chas. E. McChesney, U. S. Indian Agent, Rosebud.

ARNPRIOR, ONT.—We are informed that probably no bids will be asked until next spring for constructing 20,000 ft. of 42 × 30-in. brick and 24 to 6-in. pipe sewers, to cost $25,000. J. L. Morris, Engr., Pembroke, Ont.

NAPANEE, ONT.—The council is considering the question of constructing sewers.

GARBAGE DISPOSAL—STREET CLEANING.

OSWEGO, N. Y.—A press report states that a local garbage company has been organized and began work Oct. 4, and that is hoped to have a small crematory soon. H. D. McCaffrey, Pres. Bd. Pub. Wks., can probably give information.

WASHINGTON, D. C.—The commissioners on Oct. 7 authorized the issuing of a permit to J. N. Warfield for a Smith garbage crematory near the old observatory grounds. It is said that the plant will cost $25,000 and be completed within 90 days.

CLEVELAND, O.—The council has appointed a committee of five to visit other cities and investigate garbage disposal plants before awarding the contract in this city.

ST. PAUL, MINN.—A committee of six is to be appointed to prepare plans and specifications for the garbage contract for 1897.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked until Oct. 16 for 10,500 sq. yds. of macadamizing, 6,800 sq. yds. of gravel sidewalks, 6,000 cu. yds. of gravel, grading, etc., in Boylston St. B. W. Wells, Supt. of Streets. b

QUINCY, MASS.—The question of appropriating $18,000 for paving Copeland St. is being considered by the council. C. F. Knowlton, Cy. Engr.

ROCHESTER, MASS.—It is stated that work will soon be begun on the macadamizing of a road from Rochester Centre to the Marion line, to cost $7,500.

DANIELSON, CONN.—At a recent town meeting it was voted to appropriate $30,000 for macadam roads. J. A. Atwood, of Wauregan, Conn.; W. D. Rouse, of Central Village, Conn., and Floyd Cranska, of Moosup, Conn., have been appointed a committee to take charge of the work.

HARTFORD, CONN.—The question of raising the streets along the water front, at a cost of about $300,000, is again being considered by the council and the citizens. Chas. H. Northam, Pres. St. Comrs.; C. C. Goodrich, Supt.; D. G. Stoughton, Chn. Com.; H. F. Smith, Cy. Clk.

SUFFIELD, CONN.—We are informed that E. Hennessy, agent, Suffield, bid Sept. 30 as follows for grading and macadamizing a road: For 2,000 ft., $1.10 per lin. ft.; for 600 lin. ft., $1.12½; for 500 lin. ft., $1.15; or so much as the selectmen may direct.

BROOKLYN, N. Y.—The grading and paving committee has reported favorably upon resolutions for paving portions of 18 streets with asphalt, at a cost of about $130,000; two with macadam at a cost of $25,000, and one with Belgian blocks, to cost $13,000.—The assessment committee is considering the question of grading and macadamizing Ocean Ave., at a cost of $25,000. Wm. S. Curtis, Jr., Chn.

BUFFALO, N. Y.—The following bids were received by the board of public works Oct. 9 for paving; R. G. Parsons, Clk.:

	Cazenovia St.	Asbury Alley.
P. B. McNaughton, brick	$13,442	$1,112
Standard Paving Co., asphalt	14,500	1,100
German Rock Asphalt Co., asphalt	16,797	1,297
L. H. Gipp, brick	13,558	1,115

NEW YORK, N. Y.—Bids are asked until Oct. 19 for asphalt paving in three streets and grading and curbing in Naegle Ave. C. H. T. Collis, Comr. Pub. Wks.——L. F. Haffen, Comr. St. Improvements for the 23d and 24th wards, has asked for $955,340 for street work in the north side.——The board of estimate, Oct. 6, appropriated $1,000,000 under the legislative act for the repaving of the city streets. The act provides that $3,000,000 may be used for repaving, but not more than $1,000,000 in any one year. Appropriations were also made for repairs and fences for the Boulevard.——E. W. Bloomingdale of Bloomingdale Bros.; P. H. Dugro, Hotel Savoy, and John D. Crimmins have petitioned the board of street opening to widen 59th St., from 5th Ave. to 3d Ave.

NEW YORK, N. Y.—Bids are asked by the department of parks, The Arsenal,, until Oct. 26 for 53,600 sq. ft. of cement walk at the Grant Tomb, Riverside Park. The work will include 55,000 sq. ft. of sod, 3,100 lin. ft. of granite coping, about 11,000 cu. yds. of excavation. filling, mold, etc.

NIAGARA FALLS, N. Y.—The board of public works has reported the following estimate for paving Third St.: asphalt, $22,200; brick, $20,400. W. W. Read, Cy. Engr.

PELHAM MANOR, N. Y.—It is stated that the board of estimate of New York city has appropriated $29,000 for improving the Pelham road.

SCHENECTADY, N. Y.—The council passed an ordinance Oct. 6 for sheet asphalt paving in Jackson Place. The work must be completed by Nov. 15. L. B. Sebring, Cy. Engr.

WHITESTONE (L. I.), N. Y.—The village trustees are considering the question of holding an election Oct. 23 to vote on the subject of issuing $50,000 in bonds for macadamizing. W. S. Overton and W. L. Watson are trustees.

CAMDEN, N. J.—Bids are asked until Oct. 23 for Belgian block paving in St. John St., according to reports. L. E. Farnham, Cy. Engr.

HACKENSACK, N. J.—N. J. Conover, of Freehold, N. J., has been awarded the contract for grading, etc., in several streets.

JERSEY CITY, N. J.—Bids are asked until Oct. 19 for 8,500 sq. yds. of granite and 2,230 sq. yds. of macadam paving. Geo. T. Bouton, Clk. Comrs.

NEWARK, N. J.—The commissioners have approved ordinances for asphalt paving in five streets. Wm. Stainsby, Pres. Bd.; W. E. Greathead, Clk., J. M. Seymour, Mayor.

PATERSON, N. J.—Bids are asked until Oct. 27 for macadamizing two roads. J. J. Van Noordt, Dir. Freeholders; A. B. Pearce, Clk.

UNION, N. J.—Bids are asked until Oct. 17 for 2,250 lin. ft. of stone sidewalks. A. M. Woodruff, Township Clk.; Address Wm. P. Bonnell, Roselle, N. J.

ALLENTOWN, PA.—R. S. Rathbun, Cy. Engr., has presented estimates for about 180,000 sq. yds. of paving with either brick, granite block or asphalt, to cost $320,000, $440,000 or $450,000, respectively. Of this work the Traction company would probably pay for 33,000 sq. yds.

GREENSBURG, PA.—It is stated that the contract will be let at once for constructing six miles of the Johnstown, Indiana & Westmoreland Turnpike. Engr., John E. Dye, Johnstown, Pa.

SEWICKLEY, PA.—It is reported that some of the streets of this borough are to be paved soon. Geo. H. Anderson, Burgess.

BALTIMORE, MD.—The question of making a speedway out of Pimlico Ave. is being considered; $25,000 has already been pledged. Dr. A. W. Clement is interested.

LOUISVILLE, KY.—J. H. Pearson, Cy. Engr., writes us as follows: Paving contracts are usually awarded in small blocks, costing $3,000 to $6,000. All new streets, alleys, sidewalks, fire cisterns, hydrants and wells, when first built, are paid for by the abutting property owners on warrants issued to contractors to collect themselves. Reconstruction of sidewalks is paid for in the same way, but reconstruction of streets, etc., is paid for out of the several funds raised by general taxation. We have tried a number of different kinds of brick for our streets, such as Bannon pavers (local), a yellow brick; Mack brick, Sciota blocks, McManagal blocks, Star blocks, Porter A, and new Ironton pavers. None of them have lasted in good order five years. We have used Barber asphalt, (Trinidad Lake asphalt), and find it rolls up very badly. We are now trying Kentucky natural rock asphalt, laid by the Breckinridge Natural Rock Asphalt Co., and have one block finished and so far we think it is good. The company has some ten miles in Buffalo under another name, I think. We use also Georgia granite blocks and they do well as to wear.

DAYTON, O.—The council has voted to issue $18,000 in bonds for paving in Richard St. F. M. Turner, Cy. Engr.

SPRINGFELD, O.—The board of public affairs will soon advertise for bids for grading and graveling, curbing and guttering five streets. S. J. Wilkerson, Cy. Clk.

WYOMING, O.—Bids are asked until Nov. 2 for the purchase of $4,370 of 6% street bonds. Engr., C. A. Ewing, Carlisle Bldg., Cincinnati; W. A. Clark, Clk.

INDIANAPOLIS, IND.—Bids are asked until Oct. 21 for about 20,000 sq yds. of graveling and 11,000 sq. ft. of sidewalks, and until Oct. 23 for graveling in a number of streets. B. J. T. Jeup, Cy. Engr.

OTTUMWA, IA.—Bids are asked until Oct. 21 for brick paving and curbing in district No. 53; check, $500. S. D. Baker, Chn. St. Com.

SIOUX CITY, IA.—The residents of Nebraska Ave. have petitioned the council to pave a portion of that avenue with asphalt. L. F. Wakefield, Cy. Engr.

ST. PAUL, MINN.—The park board is discussing the question of constructing a boulevard for the Bluffs on the West Side. John Copeland, Comr. Pub. Wks.

SEATTLE, WASH.—The board of public works has decided to ask for bids for wooden block paving in Cherry St. R. H. Thomson, Cy. Engr.

SAN FRANCISCO, CAL.—The supervisors propose to improve portions of about 110 streets with bitumen, macadam, etc. C. S. Tilton, Cy. Engr.

VALLEJO, CAL.—It is proposed to pave 2,310 sq. yds. with broken stone at a cost of $1,000. Engr., F. R. Simonton, Vallejo.

MANUFACTURING PLANTS.

CAMBRIDGE, MASS.—It is stated that the Damon Safe & Iron Works Co., which some time since removed its plant to Philadelphia, is to return to Cambridge, and an application for a permit to begin the construction of a factory building has been presented. It will be 84 × 198 ft., two stories high, part of wood and part of steel.

BROOKLYN, N. Y.—It is reported that Arbuckle Bros. have decided to erect a large sugar refinery adjoining their coffee plant.

KINGSTON, N. Y.—The Colonial Glass Co., which began business in Kingston last spring, is stated to want $10,000 or $12,000 with which to enlarge its plant and provide it with the capital necessary for the management of the business. Citizens are asked to take stock to the amount named. The company has two months' orders on hand.

CAMDEN, N. J.—With the rumor that Arbuckle Bros. will build a sugar refinery in Brooklyn, it is stated that an application has been made for a charter for the Standard Sugar Refining Co. to build a large refinery at Kaighn's Point, Camden, N. J. The capital stock is $2,000,000, and the incorporators are Joseph A. Baker, Charles Baker, W. S. Williams, Herman Hooper and Thomas B. Harned. Adolph Segal, 1304 N. Broad St., Philadelphia, Pa., is also said to be interested.

GUTHSVILLE, PA.—Peter Bros. will erect a shoe factory, and are in the market for a line of machinery.

PHILADELPHIA, PA.—Wm. H. Berry has purchased ground on Crosby St., Chester, and it is said that a large boiler manufactory will be erected on the site.

WILMINGTON, DEL.—On Oct. 8 the morocco factory of Garrett & Barr, on East 2d St., was destroyed by fire; loss about $30,000; the factories of Charles Baird & Co. and of Washington Jones & Co., on Walnut St., were badly damaged; loss estimated at $80,000 and $150,000 respectively.

ANNISTON, ALA.—Thompson Bros., of Birmingham, Ala., are said to have been awarded the contract for the erection of the buildings for the new mills of the American Net & Twine Co., of Boston, to be built in this city, and to be known as the Gold Medal Twine Mill.

KNOXVILLE, TENN.—A press report says that J. W. Patton, Secy. and Treas. of the Manchester Stove Works, of Manchester, O., is in Knoxville with a view of locating a branch stove manufacturing plant.

NEW ATHENS, ILL.—A new flour mill may be erected on Richland St. A company, consisting of Jos. Dietz, George Gross and Mrs. Mary Dietz, has been formed, with a capital stock of $12,000.

KANSAS CITY, MO.—A site is said to have been bought on which to erect a brewery, to cost $40,000, by the Leisy Brewing Co.

ANAHEIM CAL.—Press reports state that W. A. Clarke may build a beet sugar plant. It will cost about $400,000, making 15,000 tons of sugar in the four months of the season. He is also considering the erection of a sugar factory in Montana.

ONTARIO, CAL.—Fred and George Stamm are manufacturing a gas engine. Should the model prove successful they will add new machinery to their shop for the manufacture of these engines.

GAS PLANTS

READING, MASS.—O. E. Weller has been appointed receiver for the Citizens' Gaslight Co., of this place, and Stoneham; liabilities, $85,000, of which $50,000 is preferred.

AKRON, N. Y.—The Akron Light, Fuel & Power Co., has been organized with a capital stock of $10,000, to manufacture gas and electricity; directors, James W. Stearns, Irving D. Eckerson and Richard H. Bell, of Akron, and John S. Campbell and J. Henry Trautman, of Butler, Pa.

CANISTEO, N. Y.—The Canisteo gas works has been sold under mortgage foreclosure to Milo M. Acker, of Hornellsville, for $7,755. It is stated that arrangements will be made at once to improve the plant.

RICHMOND HILL, N. Y.—The Brooklyn & Queens County Gas Co. has asked for an extension of 60 days time in which to lay its mains, owing to the financial depression.

ROCHESTER, N. Y.—The Rochester Gas & Electric Co. has been granted permission by the executive board to lay gas mains in several streets.

NEW YORK, N. Y.—The Metropolitan Fuel Gas Co. has filed a petition for a franchise to lay mains in the streets of this city. It proposes to furnish gas at 50 cts. a thousand to householders, and at 35 cts. to large manufacturers. When the franchise is secured $100,000 is to be paid into the treasury, and at the expiration of five years the city is to receive 3½% on the net business done; also a bond for $500,000 is to be furnished.

ECHO, PA.—The Philadelphia Gas Co. is drilling a number of wells for gas in this vicinity with small success; oil has been found in some of the wells.——The People's Natural Gas Co. is erecting a large pump station near Glouster's Mills, and when completed, expects to increase the pressure on its mains.

MIDDLESEX, PA.—A press report states that the Mahoning Gas & Fuel Supply Co. will run a line to this place and West Middlesex, to compete with the Oil City Fuel Supply Co. It is hoped to have the work completed by Nov. 1, L. F. Barger, Mgr.

PITTSBURG, PA.—The State Line Natural Gas Co. has been incorporated to operate in Fayette county, Pa.; capital stock, $5,000, commencing with $500. Treas., W. F. Johnston, Pittsburg, Pa.——The Pintsch Compressing Co. has been given a permit for the erection of a brick gas house on 2d Ave., to cost $7,800.

BRUNSWICK, GA.—The plant of the Electric & Gas Light Co. is said to have been destroyed by a recent storm; loss estimated at $20,000.

FLORENCE, ALA.—The Florence Gas Light & Fuel Co. is proposing to extend its distribution system, provided the town will pledge itself to a sufficient consumption.

FINDLAY, O.—The city gas board has ordered the laying of mains along East High St.——The contract for drilling a new well was given to J. C. Curren, at 32 cts. a ft.

CINCINNATI, O.—The Cincinnati Gas & Coke Co. has applied for permission to open Montgomery turnpike, from the north corporation line to Deercreek road, and along that road to Smith, for the purpose of putting in mains, and also to open Carthage Ave., from the north line of Norwood to the corporation line of Carthage. This will enable it to supply gas to Norwood, Evanston and Carthage.

INDIANAPOLIS, IND.—The Consumers' Gas Trust Co., of this city, is reported about to add 60 new wells to its source of supply; already 33 have been completed and about 30 miles of field mains are being laid to connect these new wells with the city main. A 10-in. main, 26 miles long has been completed, connecting the field with the 16-in. main at Allisonville and a pumping station is being built in Hamilton county, seven miles southeast of Noblesville. The cost will be about $350,000.——The Indianapolis Gas Co. is also at work upon a number of new wells.

CHICAGO, ILL.—The Western Republic Construction Co. has permits for the erection of the following buildings for the Ogden Gas Co.: An office two stories high, 50x38 ft.; a two-story purifying house, 33x133 ft.; a two-story generating house, 73x40 ft.; and a boiler house one-story high, 73x32 ft.; cost, $35,000.

MILWAUKEE, WIS.—The Milwaukee Gaslight Co. has been awarded the contract, by the committee on street lights of the common council for lighting the streets for five years at the rate of $20 a lamp a year. The city has 2,700 lamps in use and now pays $22 a lamp. It is said that a limited number of Welsbach lights may be added later.

KANSAS CITY, MO.—The Kansas City Gas Co. is reported to be laying a new 16-in. gas main on Cherry St. to reinforce its main on Holmes St. Col. M. J. Payne, Pres. The gas consumption is said to have increased very much of late.

SACRAMENTO, CAL.—The Sacramento Gas & Fuel Co. was incorporated Sept. 29 with a capital stock of $500,000, commencing with $9,600, to manufacture and sell gas for illumination and fuel; incorporators, F. R. Bell, J. H. Lounge and R. C. Semmler, San Francisco; Elmer Reed, Oakland, and W. C. Wolfe, Los Angeles.

HALIFAX, N. S.—The Halifax Gas Co. is to sell its plant to the People's Heat & Light Co.; the latter, which supplies gas for illuminating and heating purposes, will use its own plant for one kind of gas and the newly acquired system for the other.

CONTRACT PRICES.

DRAIN.—Mount Vernon, N. Y.—John F. Fairchild, Engr., informs us that the contract for constructing the Midland Ave. drain, as advertised in Engineering News, has been awarded Bellew & Merritt Co., of Tuckahoe, N. Y. There will be about 5,000 ft. of open cement drains and about 17,600 ft. of tile drains, 2 to 36 ins. in diameter. The open drain consists of a trench 3 ft. 6 ins. wide and 25½ ins. deep, filled with concrete 10 ins. thick at the bottom and 9 ins. at the top of each side, the semicircular drain 15 ins. radius being formed in this and faced with a ½-in. coat of neat cement, this coat extending out on each side for 6 ins. over the top of the concrete to join the side slopes. The slopes are 1 to 1 to the surface. The average cutting of this drain is about 5½ ft.; the average cutting of the smaller drains about 3 ft., and the cutting of the 36-in. pipe, 17½ ft. in a sand cut. The bids were as follows:

Bids Received by the Midland Avenue Drainage Commission, Mount Vernon, N. Y., Oct. 2, 1896.

Quantities.		Bellew & Merritt Co.	Cortright & Kenlon.	H. P. McTague.	Smith Bros.	Malloy & Murray.	N. J. Conover.	Woolfolk& Sillery.	Edw. Berrigan.	Peter Fury.
36-in. pipe[1]	1,016 lin. ft.	$4.70	$5.50	$5.25	$5.55	$5.35	$5.75	$6.90	$6.25	$5.00
18-in. “	745 “ “	.66	.75	.57	.65	.85	.65	.58	.75	.75
12-in. “	112 “ “	.45	.29	.38	.43⅓	.60	.40	.47	.60	.60
10-in. “	690 “ “	.31	.28	.34	.39	.50	.33	.38	50	.58
8-in. “	1,203 “ “	.25	.25	.28	.35	.40	.22	.30	.45	.55
6-in. “	2,468 “ “	.21	.18	.25	.31	.20	.18	.23	.40	.50
4-in. “	1,250 “ “	.16	.17	.20	.20	.20	.15	.18½	.30	.45
2-in. “	10,124 “ “	.10	.12	.15	.12	.20	.09	.15	.20	.30
36-in. open drain[2]	630 “ “	.66	.55	1.25	1.29	1.26	1.70	1.45	1.00	1.95
30-in. “ “	1,283 “ “	.55	.49	1.10	1.17	1.08	1.40	1.10	.90	1.85
24-in. “ “	1,177 “ “	.45	.45	1.00	.94	.90	1.25	1.00	.80	1.65
20-in. “ “	1,300 “ “	.37	.44	.80	.79	.81	1.17	.90	.75	1.35
18-in. “ “	700 “ “	.34	.42	.75	.77	.54	1.15	.80	.70	1.35
15-in. “ “	122 “ “	.28	.40	.75	.72	.45	1.10	.70	.65	1.10
Earth excav., open drains	6,800 cu. yds.	.25	.18	.25	.22	.30	.25	.25	.40	.35
Rock excav., open drains	200 “ “	1.60	1.75	1.00	2.00	3.00	3.00	2.75	1.50	1.00
Manholes	7 each	39.00	25.00	30.00	37.00	60.00	45.00	31.50	30.00	40.00
Total		$12,260	$12,713	$15,901	$16,321	$17,515	$17,820	$18,223	$18,750	$21,840
Payments in		Certificates.	Cash.			Certficts.	Cash.		Certficts.	Cash.

[1] Furnished and laid, including trenching and backfilling. [2] Exclusive of excavation.

GRANITE PAVING.—Memphis, Tenn.—A contract for 2,700 sq.yds. granite paving on 7 ins. concrete was awarded Sept. 29 at $2.47 a sq. yd. A. T. Bell, Cy. Engr.

MACADAM ROAD.—Merchantville, N. J.—The contract for macadamizing 1,500 lin. ft. of macadam road for which bids were opened Oct. 6, as advertised in Engineering News, has been awarded to D. P. Regan & Bro., of Philadelphia, at 16 cts. a cu. yd. for grading, and 62½ cts. a cu. yd. for macadamizing. The curbing and guttering contemplated has been postponed indefinitely. F. S. Walton, Chn. Com.; A. W. MacCallum, Engr.

SEWERS AND ROCK EXCAVATION. — Coffeyville, Kan.—Jno. M. Walker, Cy. Engr., writes us that the following bids were received Sept. 30 for constructing pipe sewers, lump bid being submitted for sewers and price per cubic yard extra for rock work; quantities are: 15-in. vitrified pipe sewer, 2,350 ft.; 12-in., 700 ft.; 10-in., 5,450 ft.; 8-in., 25,300 ft.; 8 × 6 Y's, 660; 8 × 8 Y's, 4; 8 × 8 T's, 34; 10 × 6 Y's, 60; 12 × 6 Y's, 16; 15 × 6 Y's, 6; flushstands, 20; manholes, 20; lampholes, 32:

	Sewer.	Rock excav.
W. A. Myne, Coffeyville (accepted)	$18,000	$1.50
H. P. Selden & Co., Kansas City, Mo.	22,500	2.50
N. P. Glann & Co., Toledo, Ohio	17,985	1.50
W. P. Brown, Coffeyville, Kan.	19,865	2.00
Jas. Gilkerson, Lexington, Mo.	21,375	2.65

SEWERS.—Roselle, N. J.—H. M. Herbert, Ch. Engr., Bound Brook, N. J., writes us that the following bids were received Oct. 2 for constructing 8,500 ft. of 12 to 8-in. pipe sewers, as advertised in Engineering News; bid of E. C. Wells, of Philadelphia, was at first declared informal, but was afterwards found to be regular, prices being 76 cts., 93 cts., 80 cts., 31 cts., 78 cts., 33 cts., 40 cts., 44 cts., 19 cts., $24, 36 cts., $7.50, 34 cts., $62, $44, $45, $43.50 and $7.86 respectively for the items as given in the table; total, $7,977; contract was awarded Oct. 7 to Headley & Christie, 410 Clinton Ave., Newark, N. J.

Bids Received Oct. 2 for Constructing Sewers, Roselle, N. J.

Quantities.		E. D. Ruggles, New York.	Satchwell & Billingham, Newark, N.J.	Aetna Const'n Co., W. L. Beers, Mgr., Brooklyn.	Hillpot & Ayres, Bound Brook, N. J.	Fell & Costa, Orange, N. J.	P. T. Plunkett, Jersey City, N. J.	Headly & Christie, Newark, N.J.
8th Ave. 12-in. pipe, average cut 11 ft.	1,729 lin. ft.	$0.926	$0.70	$0.82	$0.75	$1.00	$1.10	$0.75
Chestnut St., 12-in. pipe, average cut 12 ft.	460 “ “	1.09	1.16	.85	1.00	1.00	1.43	.85
9th Ave., 10-in. pipe, average cut 11 ft.	1,103 “ “	1.13	.70	.76	.73	.95	1.15	.65
B. & N.Y. R.R., 10-in. pipe, average cut 5 ft.	810 “ “	.50	.30	.70	.65	.95	.47	.40
Pine St., 10-in. pipe, average cut 12 ft.	2,264 “ “	1.10	1.09	.95	.93	.95	1.40	.80
3d Ave., 8-in. pipe, average cut 7 ft.	770 “ “	.38	.44	.45	.47	.40	.35	.30
4th Ave., 8-in. pipe, average cut 8 ft.	770 “ “	.446	.44	.45	.65	.40	.35	.30
5th Ave., 8-in. pipe, average cut 8 ft.	770 “ “	.446	.44	.45	.73	.40	.35	.30
Sub-soil drains	5,000 “ “	.096	.22	.09	.15	.30	.18	.18
Hemlock flooring	5,000 ft. B.M.	20.00	18.00	16.00	14.00	15.00	30.00	20.00
Gravel filling	100 cu. yds.	.60	.60	.75	.50	2.00	.40	1.50
Concrete	10 “ “	5.00	6.00	6.00	4.75	5.00	7.00	3.00
Extra excavation	100 “ “	.40	.30	1.00	.40	1.00	.40	.50
Flushtanks	3	62.25	75.00	75.00	76.50	65.00	80.00	70.00
Circular manholes	6	52.60	33.00	35.00	66.50	40.00	38.00	35.00
Circular drop manholes	5	83.62	33.00	38.00	68.00	42.00	40.00	40.00
Elliptical manholes	10	49.00	30.00	35.00	52.50	35.00	40.00	28.00
Lampholes	14	5.44	8.00	8.50	9.50	5.00	10.00	8.00
Total		$9,440	$8,583	$8,263	$9,202	$10,071	$10,595	$7,475

LAYING WATER MAINS.—Boston, Mass.—The following bids were received by the metropolitan water board Oct. 6 for laying water mains, as advertised in Engineering News:

	Sections		
Bidder.	14.	16.	18.
Collins & Ham, South Boston	$8,209[1]	$7,497	$9,798[3]
R. J. Malone & Bro., Boston	9,096	7,700	14,001
H. A. Hanscom & Co., W. Medford	11,000	5,442	10,824
S. W. Frescoln, Reading, Pa.	11,263	7,983	12,845
Maney & Flaherty, Somerville	11,772	7,890	13,382
D. F. O'Connell, Boston	11,820	.....	15,232
Mitchell & Neff, Newark, N. J.	16,543	.....	.....
The C. H. Eglee Co., Boston	18,480	5,944	12,053
Craib & Trumbull, Winthrop	.....	9,460	.....
Francis Curnan, Rhinebeck, N. Y.	.....	6,550	11,528
J. H. McKnight, Everett	.....	6,852	.....
Joseph Bruno, East Boston	.....	7,220	13,524
George Goodhue, Concord, N. H.	.....	4,723[2]	.....
J. W. Howe, Cambridge	.....	.....	10,357
McCusker Bros., Waltham	.....	.....	11,042
P. H. Harrison & Sons, Hartford	.....	.....	11,640
Trumbull & Ryan, Boston	.....	.....	15,125

[1] Awarded contract at the following prices: Laying 30-in. cast-iron pipe, 7,330 ft., 92 cts. a ft.; 24-in., 50 ft., 85 cts.; 12-in., for blowoffs, 120 ft., 50 cts.; 6-in. for blowoffs, 30 ft., 40 cts.; rock excavation above grade, 220 cu. yds., $3; below grade, 10 cu. yds., $5; earth excavation, below grade 50 cu. yds., 60 cts.; setting air valves, 2, $2.50 each; chamber for 24-in. valve, $32,50; chamber for blowoffs, by passes and air valves, 6, $28; building 24-in. drain, 90 ft., $3; manhole for drain, $35; concrete masonry, 20 cu. yds., $5.

[2] Awarded contract: Laying 16-in. pipe, 10,000 ft., 45 cts.; 4-in., for blowoffs, 50 ft., 20 cts.; rock excavation, above grade, 10 cu. yds., $3; below grade, 10 cu. yds., $4; earth excavation below grade, 20 cu. yds., 45 cts.; setting air valves, 4, $1.50; valve chambers, 9, $12; concrete masonry, 5 cu. yds., $4.

[3] Awarded contracts: Laying 20-in. pipe, 14,400 ft., 62 cts.; 6-in. for blowoffs, 100 ft., 38 cts.; rock excavation above grade, 150 cu. yds., $2.50; below grade, 10 cu. yds., $4.50; earth excavation below grade, 50 cu. yds., 50 cts.; setting air valves, 7, $1.75; chambers for 20-in. valves, 2, $30; chambers for blowoffs, by passes and air valves, 11, $25; concrete masonry, 10 cu. yds., $4.

PIPE SEWER.—Scranton, Pa.—The following bids were received Oct. 8 for constructing a 10 and 12-in. sewer in Columbia St.; length, 1,900 ft.; depth, 15 ft.; 10 manholes, 5 street basins, and 85 house connections (average length 17 ft.) to curb line: **Peter F. Mulligan, $1.68 a lin.**

ft., complete; A. Menyetta, $2.01; P. J. Thornton & Co., $1.92; M. J. Gibbons, $1.73; Flanagan & O'Hora, $1.84; all of Scranton. Joseph P. Phillips, Cy. Engr.

DIKES, ETC.—Portland, Ore.—The following are the bids for constructing dikes, etc., in Tillamook Bay, Ore., opened by Capt. W. L. Fisk, Oct. 8, as advertised in Engineering News:

Quantities.		C. O. Nolan, Tillamook.	Paquet & Smith, Portland.	Wakefield & Jacobsen, Portland.
Piles,	12,400 lin. ft.	$0.08	$0.095	$0.085
Lumber	8,000 ft. B.M.	7.50	15.00	10.00
Bolts	100	.05	.15	.18
Spikes	700 lbs.	.02	.06	.045
Brush	2,200 cords	2.40	2.50	2.30
Wire	3.400 lbs.	.02	.04	.04
Stone	3,200 tons	.54	.59	.50
Excavation[1]	4,000 cu. yds.	.60	.375	.25
Excavation[2]	12,500 " "	.51	.375	.25
Total		$16,922	$15,066	$12,104

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[1] Bay City flat. [2] Trask River.

SEWERS.—Far Rockaway, N. Y.—The following bids were received Sept. 22 for constructing a sewer system, as advertised in Engineering News; Alexander Potter, Engr., 137 Broadway, New York:

Furnishing cast-iron and castings:

Bidder.	Pipe, 10-in., 55 lbs. per ft., 129.2 tons.	Pipe, 6-in., 29 lbs. per ft., 105.2 tons.	Manhole h'ds and covrs 30 tons.
F. B. Hawkins & Co.,	$17,95	$17.95	$23.99
M. J. Drummond	18.25	18.65	24.00
Jackson & Woodin Co.	19.08	19.08	25.00
Fox & Engel	18.65	18.65	29.00
Anniston Foundry Co.	20.80	20.80	.....

BIDS RECEIVED FOR CONSTRUCTING SEWERS, FAR ROCKAWAY, N. Y., SEPT. 22, 1896.

Quantities.		J. B. Sheets, Uhricksville, O.	John Marsdon, Utica, N. Y.	R. B. Mitchell & Co., Brooklyn, N. Y.	Headley & Christie, Newark, N. J.	J. A. Doolittle & Co., New Haven, Conn.	A. M. Thomas, Lock Haven, Pa.	P. T. Plunkett, Jersey City, N. J.	D. J. McNiece, New York.	E. A. Rudiger, Floral Park, N. Y.	Coon & Mooney, Wilkes Barre, Pa.	Acock & Son, Trenton, N. J.	S. W. Frescoln, Reading, Pa.	O'Grady & Hesterberg, Flatbush, N. Y.	Fell & Co., Orange, N. J.	P. F. Hawman, Reading, Pa.	Clinton Beckwith & Co., Herkimer, N. Y.	Peace Bros., Flushing, N. Y.
8-in. pipe, under 6 ft. deep	4,705 ft.	$0.23	$0.20	$0.25	$0.27	$0.26	$0.26	$0.27	$0.28	$0.23	$0.255	$0.28	$0.25	$0.26	$0.28	$0.32	$0.26	$0.37
8-in. " 6 to 8 ft. deep	15,075 "	.25	.26	.27	.28	.29	.28	.27	.30	.27	.30	.33	.30	.28	.34	.35	.36	.49
8-in. " 8 " 10 " "	14,005 "	.31	.35	.30	.33	.32	.30	.30	.35	.33	.39	.39	.41	.35	.40	.37	.56	.65
8-in. " 10 " 12 " "	2,000 "	.35	.50	.36	.36	.37	.33	.39	.40	.39	.50	.45	.48	.40	.45	.43	.66	.82
8-in. " 12 " 14 " "	45 "	.45	.65	.45	.46	.60	.36	.80	.50	.46	.75	.55	.62	.50	.95	.48	.82	1.11
10-in. pipe, under 6 ft. deep	4,600 "	.27	.25	.31	.31	.33	.32	.33	.32	.29	.295	.35	.30	.35	.30	.37	.32	.46
10-in. pipe, 6 to 8 ft. deep	2,945 "	.29	.30	.33⅓	.32	.36	.34	.35	.38	.34	.34	.38	.35	.37	.37	.39	.42	.58
10-in. " 8 " 10 " "	3,075 "	.35	.38	.35	.38	.39	.36	.40	.40	.40	.43	.45	.48	.45	.51	.42	.62	.73
10-in. " 10 " 12 " "	350 "	.39	.55	.45	.43	.42	.45	.45	.53	.47	.54	.52	.55	.50	.70	.48	.72	.91
10-in. " 12 " 14 " "	1,875 "	.47	.75	.52	.45	.48	.48	.65	.63	.55	.79	.58	.69	.60	.90	.53	1.50	1.19
10-in. " 14 " 16 " "	500 "	.52	1.15	.56	.55	.60	.66	.84	.70	.64	1.30	.68	.93	.75	1.20	.60	2.00	1.69
12-in. pipe, under 6 ft. deep	2,000 "	.31	.35	.44	.35	.30	.40	.39	.40	.36	.345	.43	.36	.40	.36	.40	.41	.53
12-in. pipe, 6 to 8 ft. deep	1,175 "	.33	.35	.44	.40	.40	.45	.40	.43	.41	.39	.46	.41	.45	.42	.42	.50	.65
12-in. " 8 " 10 " "	2,175 "	.39	.45	.46	.41	.43	.48	.47	.48	.47	.48	.52	.55	.50	.55	.46	.59	.81
12-in. " 10 " 12 " "	1,000 "	.43	.60	.56	.48	.50	.55	.53	.58	.55	.59	.59	.62	.55	.95	.52	.70	.98
12-in. " 12 " 14 " "	100 "	.46	.80	.635	.55	.65	.60	.75	.70	.64	.84	.67	.75	.60	1.00	.62	1.02	1.27
15-in. pipe, 6 to 8 ft. deep	100 "	.46	.50	.54	.50	.55	.50	.59	.50	.55	.48	.55	.52	.55	.75	.51	.63	.80
15-in. " 8 " 10 " "	1,030 "	.53	.60	.58	.60	.58	.60	.67	.55	.63	.57	.62	.66	.65	1.10	.55	.75	.95
15-in. " 10 " 12 " "	375 "	.63	.80	.65	.60	.65	.68	.77	.65	.72	.68	.70	.75	.70	1.25	.60	.84	1.13
18-in. pipe, under 6 ft. deep	50 "	.54	.50	.69	.60	.68	.60	.75	.55	.64	.545	.70	.58	.70	.65	.59	.62	.83
18-in. pipe, 6 to 8 ft. deep	700 "	.57	.60	.71	.65	.80	.66	.83	.63	.72	.59	.77	.64	.85	1.00	.61	.78	.95
18-in. " 8 " 10 " "	50 "	.64	.65	.77	.70	.90	.68	1.25	.70	.81	.68	.85	.81	.90	1.30	.64	.92	1.11
10-in. c. i. pipe, laying only	4,790 "	.20	.15	.21	.23	.25	.23	.22	.20	.20	.16	.17	.195	.25	.25	.24	.20	.30
6-in. c. i. pipe, laying only	7,250 "	.15	.12	.15	.19	.14	.15	.20	.18	.14	.16	.12	.14	.21	.18	.20	.15	.23
Drop manholes	20 "	.50	.50	1.75	2.00	2.00	.60	.50	3.00	1.00	.40	3.00	.50	1.00	3.00	1.00	1.00	.50
Deep-cut connections	400 "	.20	.07	.12	.14	.20	.75	.50	.25	.50	.30	.25	.50	.27	.35	.75	1.00	.20
Oak timber in foundations	2,000 "	.05	.01	.0345	.03	.04	.05	.04	.04	.04	.03	.04	.04	.05	.04	.03	.04	.06
Hemlock sheathing	8,000 "	.01	.01	.023	.015	.01	.015	.02	.02	.01	.02	.018	.015	.02	.02	.025	.016	.03
Oak piling,	200 "	1.00	.10	.30	.25	.20	.05	.30	.40	.45	.15	.25	.30	.30	.50	1.50	.50	6.00
8 × 6-in. Y's, each	1,400...	.23	.23	.52	.25	.22	.50	.34	.23	.30	.23	.25	.30	.97	.25	.25	.40	.35
10 × 6-in. " "	150...	.33	.32	.80	.38	.32	.60	.60	.33	.42	.33	.35	.42	1.17	.35	.35	.50	.47
12 × 6-in. " "	100...	.43	.42	1.035	.48	.43	1.08	.73	.45	.54	.43	.45	.52	1.47	.45	.45	.75	.59
15 × 6-in. " "	50...	.63	.63	1.50	.66	.67	1.90	1.00	.65	.78	.63	.65	.96	1.86	.65	.65	1.00	.83
18 × 6-in. " "	10...	.85	.85	2.07	.90	.84	3.00	1.25	.90	1.05	.86	.90	.98	2.30	.85	.90	1.35	1.11
Flush tanks	22...	35.00	18.00	20.00	30.00	35.00	20.00	30.00	27.00	55.00	40.00	25.00	39.00	50.00	60.00	70.00	40.00	25.00
Manholes, under 10 ft. deep	112...	15.00	18.00	15.00	17.00	24.00	30.00	23.00	24.00	35.00	20.00	20.00	29.00	25.00	22.00	45.00	35.00	20.00
Per ft. over 10 ft. deep	30 ft.	1.00	2.00	2.00	2.00	2.00	.40	2.00	3.00	4.75	2.00	3.00	5.00	2.50	2.50	5.00	5.00	3.00
Intersecting manholes		18.00	25.00	20.00	25.00	30.00	5.00	40.00	30.00	37.50	.....	30.00	45.00	50.00	40.00	40.00	50.00	5.00
Lampholes	30...	5.00	4.00	4.60	7.00	6.00	1.00	3.00	8.00	5.00	9.00	5.00	5.00	7.00	8.00	2.00	1.50	6.00
Rock excavation, cu. yds.	20...	1.50	.10	.35	.01	.01	2.25	1.00	2.00	.50	.10	.50	2.00	.01	.25	2.00	3.50	2.50
Concrete, cu. yds.	20...	...	...	...	...	...	...	...	...	.45	...	...	...	...	.50	...	...	...
Total		$23,629	$25,107	$25,501	$25,781	$27,073	$27,364	$27,691	$28,348	$28,506	$28569	$28,840	$30,348	$30,805	$33,128	$33,498	$38,517	$44,858

DREDGING.—Wilmington, Del.—Maj. Wm. F. Smith received the following bids Oct. 8 for dredging in Christiana River, Del., as advertised in Engineering News:

	Per cu.yd.
Haupt & Franklin, Philadelphia, Pa.	$0.285
Atlas Dredging Co., Wilmington, Del.	.23
American Dredging Co., Philadelphia, Pa.	.26
Virginia Dredging Co., Richmond, Va.	.24

BRIDGE PIERS.—Portland, Me.—The following bids were received by Geo. N. Fernald, Comr. Pub. Wrks, Oct. 9 for building five masonry piers at Tukey's bridge, as advertised in Engineering News:

Bids for Constructing Masonry Bridge Piers, Portland, Me., Oct. 9, 1896.

Bidder.	Piers 1, 2, 3 and 4				Center pier				All P'rs.	
	Piles, foundation, 408.	Spruce timber, 140 M. ft.	Port. cement concrete, 453 cu. yds.	Granite masonry, 808 cu. yds.	Piles in foundation, 185.	Spruce timber, 62 M. ft.	Port. cement concrete, 207 cu. yds.	Granite masonry, 591 cu. yds.	Dredging and riprap.	Total.
Ellis & Buswell, Woburn, Mass.	$11.00	$55.00	$6.75	$14.60	$11.00	$55.00	$6.75	$13.00	$7,820	$49,388
C. W. Blakeslee & Sons, New Haven, Conn.	12.50	44.00	6.50	14.95	12.50	46.00	6.50	14.75	9,600	51,111
Ward & Tank, Lowell, Mass.	7.50	53.00	8.00	18.00	8.00	60.00	8.00	20.00	14,000	61,324
W. S. White, Rockland, Me.	12.00	49.00	7.50	16.50	12.00	49.00	7.50	16.00	6,259	51,011
Trumbul & Ryan, Boston, (informal bid)	6.32	54.85	8.25	14.85	6.33	58.15	8.25	15.95	6,600	48,504
Mairs & Lewis, New York (awarded contract)	10.50	50.00	7.00	15.00	11.50	50.00	7.00	14.00	7,000	48,525
Thomas Dwyer, New York	6.00	40.00	7.00	25.00	6.00	40.00	7.00	25.00	18,000	69,233
Aaron Cleaves, Portland, Me.	14.72	63.18	7.68	20.51	14.72	63.18	8.00	20.51	8,000	63,320

BRICK PAVING, ETC.—Milwaukee, Wis.—The following bids were received Sept. 24 for paving Biddle St., from Market St. to Broadway, with vitrified brick, $1.86 was the lowest bid at a previous opening of bids for this work: J. P. Ryan, $2.09 a sq. yd.; G. J. Markey, $2.04; William Forrestal, $1.97; J. O'Donnell, $1.95; J. O. Jones, $1.78.——The board of public works let contracts Sept. 24 for improving Third Ave., from Lincoln Ave. to Clarence St., at 18 cts. a cu. yd. for grading and 57 cts. for graveling, and on Ninth St., in the Twenty-first Ward, at 14 cts. for grading and $1.03 for crushed stone. Contracts were also awarded for 22,000 lin. ft. of 4-in. stone curbing on various streets, at from 37 to 38 cts. a lin. ft. The price is said to be 5 cts. a ft. higher than was paid for the same work during the summer, but is still from 12 to 15 cts. below contractors' prices prevailing in previous years.

SUBWAY.—Boston, Mass.—The following bids were received Oct. 6 for constructing section 8 of the subway, as advertised in Engineering News; the Metropolitan Construction Co. was awarded the contract:

Bids Received Oct. 6 for Constructing Section 8, Boston, Mass., Subway.

Quantities.		Aab & Co., Waltham, Mass.	E. W. Everson, Providence.	S. W. Frescoln, Reading, Pa.	Shailer & Schniglau Co., Chicago.	Barber Asphalt Pav. Co., Boston.	Metropolitan Con. Co., Boston.
Earth excavation.	14,000 cu. yds.	$6.50	$2.35	$2.50	$2.50	$1.95	$1.95
Laying 6, 8, 10, 12 and 18-in. sewer pipe	900 lin. ft.	.50	1.00	.30	.50	.40	.70
Iron and steel w'rk in place and secured	310 tons	15.00	12.00	9.00	7.50	9,25	9.00
Brick masonry, Portland cement mortar	200 cu. yds.	15.00	16.00	16.00	14.50	15.75	16.75
Concrete mas., Rosendale cement mortar	100 " "	9.00	7.00	6.50	7.00	6.50	6.00
Concrete mas., Portland cement mortar	2,600 " "	10.00	8.75	8.25	8.75	8.75	8.50
Tiling for outside of subway walls	850 sq. yds.	1.20	1.00	1.00	.85	1.50	1.00
Plastering of Portland cement mortar	5,000 " "	.50	.50	.40	.30	.40	.40
Waterproof coating	6,000 " "	.50	.40	.45	.25	.40	.30
Total		$132,520	$69,920	$68,910	$67,847	$62,752	$61,420

DREDGING.—Philadelphia, Pa.—The following bids were received by Maj. C. W. Raymond Oct. 5 for 162,500 cu.yds. of dredging in Cooper Creek, N. J., as advertised in Engineering News: John P. Randerson, Albany, N. Y., 19¾ cts. a cu. yd.; American Dredging Co., Philadelphia, 24 cts.; Virginia Dredging Co., Richmond, 19.7 cts.; Hess & Co., Detroit, 24 cts.; Frank C. Somers, Camden, N. J., 17¾ cts.; A. M. Clegg, Washington, 13.7 cts.

SEWERS.—Washington, D. C.—The following bids were received Oct. 10 for constructing 640 ft. of 24-in. pipe sewer: James McCandlish, $1.35 a lin. ft.; John P. Largney, $1.75; E. G. Gummel, $1.39; all local bidders.

IMPROVING PARK ENTRANCE.—Philadelphia, Pa.—The contract for improving the Diamond St. entrance to the park to include grading for 12-ft. walks, etc., for which $10,000 was appropriated, has been awarded to David Anderson, whose prices were as follows: Excavation, 17 cts. a cu. yd.; cinder surfacing, 18 cts. a cu. yd.; sodding, 7¾ cts. a sq. yd.; and relaying sodding, 4½ cts. a sq. yd.

JETTY WORK.—New Orleans, La.—Maj. James B. Quinn received the following bids Sept. 30 for jetty construction for improving the mouth and passes of Calcasieu River, La.: Gulf Towing Co., Velasco, Tex., 13,000 sq. yds. brush mattress, $1 a sq. yd.; 15,000 tons riprap stone for hearting, $2.90 a ton; 2,000 tons granite capping stone, $4.25 a ton; total, $65,000; John A. Davis, Galveston, Tex., $1.05, $3.25, $4.50 and $71,400; Charles Clarke & Co., Galveston, Tex., 91 cts., $2.80, $4.50 and $62,830.

BRICK PAVING.—Memphis, Tenn.—The following contracts were awarded Sept. 29 for paving with brick on 7-in. concrete foundation: Beale St., Main to De Soto, 7,388 sq. yds., at $2 a sq. yd.; Madison St., Front to Bayou, 9,404 sq. yds., at $2; Monroe St., Front to Main, 1,726 sq. yds., at $1.98; Union St., Bayou to Wellington, 3,720 sq. yds., at $1.98. A. T. Bell, Cy. Engr.

PIPE SEWER.—Scranton, Pa.—The following bids were received Oct. 1 for constructing 420 ft. of 10-in. pipe sewer on Monsey Ave.; depth, 13 ft.; 3 manholes, 1 basin: Hart & Gibbons, Wilkes Barre, Pa., $1.40 per lin. ft. complete; P. J. Thornton & Co., Scranton, Pa., $1.28; P. F. Mulligan, Scranton, Pa., $1.15. Joseph P. Phillips, Cy. Engr.

GRANITE BLOCK PAVING.—Camden, N. J.—Several small contracts for paving with granite blocks, of good quality, on sand foundation, have been awarded at $1.22 a sq. yd. L. E. Farnham, Cy. Engr.

ASPHALT PAVING.—Schenectady, N. Y.—The following bids were received Oct. 6 for paving Liberty St. with sheet asphalt: Trinidad Asphalt Refining Co., New York, 5,000 sq. yds. asphalt, $2.82 a sq. yd.; 4 × 20-in. stone curb, 4,340 lin. ft., $1.01 a ft.; Metropolitan Paving & Construction Co., Schenectady, $2.69 and 69 cts., respectively. Lewis B. Sebring, Cy. Engr.

DREDGING.—Milwaukee, Wis.—Capt. Geo. A. Zinn received the following bids Oct. 6 for dredging:

Menominee River:	Clay, 59,400 cu. yds.	Hardpan, 10,600 cu. yds.	Total.
A. H. Vogel	$0.129	$0.129	$9,030
W. A. Starke	.09	.25	7,996
Green's Dredging Co.	.15	.25	11,560
Racine Dredging Co.	.09	.27	8,208

Green Bay Harbor (200,000 cu. yds.):	Per cu. yd.
Arthur H. Vogel, Milwaukee, Wis.	$0.087
Green Bay (Wis.) Dredge & Pile Driver Co.	.08
William A. Starke, Milwaukee, Wis.	.10
Green's Dredging Co., Chicago, Ill.	.13
W. A. McGillis & Co., Cleveland, O.	.085
Racine Dredging Co., Racine, Wis.	.066

GRADING.—New York, N. Y.—The following bids were received by Capt. C. A. Devol, Asst. Q. M., Oct. 12, for grading about 50 acres at Sandy Hook, N. J,, the site of the new post of Fort Hancock; approximate quantity, 180,000 cu. yds.:

	Per cu. yd.
W. B. Strang, Jr., & Co., 15 Wall St., New York.	$0.22½
Allston Gerry, Pelham Manor, N. Y.	.22
M. J. Fenton & Co., 137 Broadway, New York	.08½
J. Rufus Terry, 357 Webster Ave., Long Island City.	.22
Richd. H. Brodhead, Marlboro, N. J.	.29
Isaac T. Brown, 11 Pine St., New York	.17¼
James S. Rogers, Plattsburg, N. Y.	.39
Aetna Construction Co., 186 Remsen St. Brooklyn	.22
R. B. Mitchell & Co., 350 Fulton St., New York	.069
W. K. Ryan, 621 Broadway, New York	.16
Alex. Crawford Chenoweth, 41 E. 59th St., N. Y.	.16⅝
Joseph Johnson, 193 Broadway, New York	.41½

BRICK PAVING.—Evansville, Ind.—The following bids were received Sept. 26 for paving portions of two streets with brick; Bedford, Weikel & Nugent, brick, $1.61 a sq. yd.; for limestone curbing, dressed and set, 48 cts. a lin. ft.; for limestone circular corners, dressed and set. $1 a lin. ft.; for redressing and resetting old curbing, 20 cts. a lin. ft.; Eichel, Arnold & Co., $1.65, 50 cts., $1 and 20 cts., respectively.

ROCK.—New Orleans, La.—The bids received by Capt. Geo. McC. Derby Sept. 26 for 5,000 tons of rock for improving New Orleans Harbor, as advertised in Engineering News, are reported as follows, price being per ton:

Chas. G. Smith & Son, Washington, D. C.	$3.38
David V. Howell, New York city	3.38
John Barrett, Cincinnati, O.	2.40
William J. Bishop, Lithonia, Ga.	2.64
A. P. Birch, Blount Springs, Ala.	2.21
Charles Clark & Co., Galveston, Tex.	2.90
Allan A. Goodwin, Zimmerman, La.	4.00
D. & J. Trauchina, New Orleans (600 or 700 tons).	1.72
Lewis M. Dalgaru, Natchez, Miss.	2.45
A. A. Goodwin, Zimmerman, La.	3.00
Leo Gunning, Redwood, Miss.	3.35
L. J. Mestier & Co., New Orleans (only 3,000 tons)	2.40
W. R. Harteck, New Orleans, La.	2.60
The Georgia-Quincey Granite Co., Macon, Ga.	2.60
Frederick Hartweg, Cincinnati, O.	2.95
Silas C. Doby, Lithonia, Ga.	2.98
J. A. Andrews & Son, New Orleans, La.	2.71
Robert J. Connelly, New Orleans, La.	3.35
G. Herbert Ellerbe, New Orleans, La.	2.51

CEDAR BLOCK PAVING.—Port Huron, Mich.—F. F. Rogers, Cy. Engr., writes us that the contract for paving Pine Grove Ave. has been awarded to B. D. Bartow, who has deposited a $4,000 bond preparatory to beginning work; all blocks shall be cut from good, sound, live cedar timber, free from defects, and shall not measure more than 9 ins., nor less than 4 ins., in diameter, and shall be 7 ins. in length, and so placed to make as near as possible the spaces of uniform size; they shall be sawed perpendicular to the axis and of exact length. These shall be set on the end of the grain, and shall be selected and placed so as to make triangular spaces, each block shall have a close full depth contact with at least three other blocks; the paving will be on sand foundation with Medina stone curbing:

Bids Received at Port Huron, Mich., Sept. 19, for Cedar Block Paving.

Bidder.	Block excavation.	Earth excavation.	Medina curb.	Berea curb.	Oak curb, 4 × 12 ins.	Iron catch-basins.	Brick inlets.	Moving st'ne catchbasin.	8-in. sewer.	Medina stn. curves.	Berea stone curves.	Cedar block paving.	Total.
Kennedy & Campbell, Bay City.	$0.08	$0.13	$0.41	$0.29	$0.13	$37.00	$9.00	$10.00	$0.24	$0.60	$0.45	$0.47½	$14,802
R. M. Campbell, Port Huron..	.14	.18	.37	.30	.12	38.90	6.00	6.50	.23	.75	.58	.43½	14,086
Geo. Keith & Son, Lansing....	.12½	.15	.39	.29	.10	40.00	10.00	8.00	.19	.75	.65	.47½	14,862
W. F. Ernst, Port Huron......	.16	.16	.39	.32	.16	38.00	10.00	8.00	.25	.80	.80	.45	14,604
B. D. Bartow, Port Huron....	.07	.12	.36	.30	.13	39.00	5.25	5.00	.20	.75	.60	.37	12,274
Doe & DeLoyaa, Port Huron..	.09	.14	.37	.30½	.16	39.00	10.00	8.00	.17	1.19	1.06	.44½	14,172
Deuler & Scott, Port Huron ..	.08	.16	.37½	.30½	.15½	36.00	8.50	5.00	.20	.80	.80	.46	14,398
Hill & Co., Port Huron	.11	.14	37	.32	.17	38.00	8.00	8.00	.23	.80	.64	.43¾	13,986
Stephenson & Co., Port Huron.	.07½	.15½	.37¼	.29¼	.14	39.75	4.00	6.00	.15	.70	.62	.45⅜	14,197
Julius Kaumeier, Port Huron.	.11	.14½	.37¾	.30½	.13	38.00	4.50	4.00	.19	.87	.63	.49½	15,091

PIPE SEWERS.—New Brunswick, N. J.—The contracts for constructing pipe sewers, as advertised in Engineering News, has been awarded to James Gilligan, as stated last week. Asher Atkinson, Cy. Surv., writes us that the bids were as follows; all but Thos. McGovern, of Trenton, N. J., being local bidders:

Quantities.	James Gilligan.	T. H. Riddle.	Thomas McGovern.	Lyons & Corrigan.
8-in. iron outlet*....737 ft.	$26.00	$15.22	$28.00	$10.31
Pipe:				
10-in., cut 7.2 ft..500 ft.	.79	1.22	1.13	1.65
10-in., " 8.5 "..980 "	.92	1.22	1.13	1.65
10-in., " 8.9 "..480 "	.92	1.22	1.13	1.75
10-in., " 13.0 "..580 "	.92	1.22	1.13	2.15
10-in., " 11.3 "..780 "	.90	1.22	1.13	2.09
8-in., " 7.5 "..520 "	.55	1.22	1.13	1.07
8-in., " 8.2 "..430 "	.65	1.22	1.10	1.03
Manholes " 9.2 ".. 10...	32.50	41.00	40.00	36.75
Y-branches ....120...	1.50	.65	.51	.51
Total	$6,644	$7,219	$8,056	$8,619

*Laid under water in river.

BRIDGE TOWER FOUNDATION.—New York, N. Y.—The following bids were received by the New East River Bridge Commission Oct. 7 for constructing the New York tower foundation, as advertised in Engineering News; L. L. Buck, Ch. Engr.; O. F. Nichols, Prin. Asst. Engr.; the first two bids are for lump sum to datum plane; the last bid is for completed work below datum plane, 950 cu.yds.:

Bidder.	All granite.	Granite and limestn.	Per cu.yd.
P. H. Flynn	$410,000	$367,000	$17.00
Arthur McMullin & Co.	439,000	424,000	35.00
Union Bridge Co.	460,000	455,000	30.00
J. B. Westbrook	456,187	399,875	25.00
Tullock & Noble	456,000	....	27.00
McLean, Johnson & Bailie Con. Co.	470,000	460,000	25.00
Union Bridge Co. (steel caisson)..	467,000	462,000	30.00
Bernard Naughton	473,280	441,032	33.00
Sooysmith & Co.	499,795	470,800	29.00
Hart & Anderson	499,000	445,000	37.00
John Pierce	549,000	449,000	28.00
E. J. McKeever & Bro.	594,000	566,000	39.60

DREDGING.—Baltimore, Md.—The following bids were received by Col. Peter C. Hains, U. S. Engrs., Oct. 1 for dredging in Baltimore Harbor, as advertised in Engineering News; price is per cubic yard:

Work.	Va. Dredging Co.[1]	Am. Dredging Co.[2]	Baltimore Dr'd'g Co.[3]	Sanford & Brooks.[3]	R. R. Moore, Mobile.
Craighill Channel	$0.097	$0.062	.....	.....	$0.06
Cut-off Channel	.....	.156	.....	.....	.105
Brewerton Channel	.097	.072	.....	.....	.08
Ft. McHenry Channel..	.097	.087	.....	.....	.10
Alt. bid for whole work	.107	.....	.08⅞	.0873	.08

[1]Richmond. [2]Philadelphia. [3]Baltimore.

LEVEE WORK.—New Orleans, La.—The following contracts have been awarded for levee work: Bondurant (sections 1, 2 and 3), 45,000 cu. yds..; secs. 1 and 2 at 9.25 cts., and section 3, at 8.5 cts., to J. G. Boney, of Duckport, La. Cottage Home levee (sections 1 and 2), 25,000 cu. yds., at 10.49 cts., to C. D. Leeper, of Baton Rouge. Section 2 of Harper's levee, 16,500 cu. yds., at 14 cts., to Garbish & O'Neil, of Point Pleasant, La. Evergreen levee (sections 1 to 8), 127,500 cu. yds., at 9.43 cts. for river side enlargement and 9 cts. for land side enlargement, to Batt O'Brien, of Point Pleasant, La. At the office of the state engineers bids were opened for work on the parish line levee (between St. Charles and St. John parishes), about 70,000 cu. yds., and the contract was awarded to J. C. Hodge, at 13½ cts. a cu. yd.

MISCELLANEOUS CONTRACTS.

DREDGING.—Baltimore, Md.—Bids are asked until Oct. 26 for dredging ship channel leading to Baltimore Harbor. Col. Peter C. Hains, U. S. Engrs.

CHEMICAL ENGINE.—Sinking Spring, Pa.—The committee has recommended the purchase of a Babcock chemical fire engine. Samuel Field, Chn. Com.

ARTIFICIAL POND.—Oldtown, Me.—J. W. Sewall, Cy. Engr., has prepared plans for an artificial pond in the Forest Hill Cemetery. James Wentworth, Chn. Com.

WHARF.—Bangor, Me.—The Maine Central R. R. Co. is said to have received permission to build a wharf to cost $25,000, on the Penobscot River, at Bangor, Me.

MORTAR BATTERY.—Baltimore, Md.—Bids are asked until Oct. 26 for building a mortar battery at North Point. Col. Peter J. Hains, U. S. Engrs., 9 Pleasant St., Baltimore, Md.

CONDUITS.—Boston, Mass.—The aldermen have granted a franchise to the New England Telephone & Telegraph Co., to construct underground conduits for electric wires and cables in nine streets.

HYDRAULIC DREDGES.—St. Louis, Mo.—Bids are asked until Nov. 11 for furnishing two hydraulic dredges, as stated in our advertising columns. Capt. H. E. Waterman, Secy. Miss. River Comn.

CANAL IMPROVEMENTS.—Albany, N. Y.—Bids are asked until Oct. 29 for improving the Erie Canal from the head of the Lockport locks to station 328, near McDonald's culvert; also from station 83 × 10, near Ferry St., to Commercial slip, and on slips 1, 2, and 3 and Commercial slip, at Buffalo; also between station 328, near McDonald's culvert, to station 87 × 10 near Ferry St., Buffalo; also for building the Cartersville waste weir and spillway, all as advertised in Engineering News. The first three pieces embrace 28 miles of the Erie Canal, between the head of the Lockport locks, Ferry St., in Buffalo, including the Commercial slip and slips 1, 2, and 3 in that city. The fourth piece provides for a waste weir and spillway at Cartersville, Monroe county. These improvements will necessitate an outlay of $1,043,000. C. W. Adams, State Engr., Utica; R. G. Lay, Asst. Supt. Pub. Wks., Rochester; Geo. W. Aldridge, Supt. Pub. Wks., Albany.

DREDGING MACHINERY. — Portland, Ore.—Bids are asked until Nov. 10 for furnishing dredging machinery at Coos Bay, Ore., as stated in our advertising columns. Capt. W. L. Fisk, U. S. Engrs.

ELECTRIC POWER FOR BRIDGE.—Brooklyn, N. Y.—Bids are asked until Oct. 23 for equipping the bridge across Newtown Creek, at Metropolitan Ave., with electric motive power. T. B. Willis, Comr. Cy. Wks.

FILLING.—Boston, Mass.—Bids are asked until Oct. 19 for 160,000 cu. yds. of filling at the Standway, South Boston, for the department of parks. Edward C. Hodges, Chn. Bd. Park Comrs.. Room 509 53 State St.

BREAKWATER AND PIER EXTENSIONS.—Buffalo, N. Y.—Bids are asked until Nov. 30 for 12,500 ft. of breakwater extension and for sand-catch pier extension, as stated in our advertising columns. Maj. T. W. Symons, U. S. Engrs.

DAMS AND SHORE PROTECTIONS. — Rock Island, Ill.—Bids are asked until Nov. 10 for constructing dams and shore protections on Upper Mississippi River, as stated in our advertising columns. Lt. Col. W. R. King, U. S. Engrs.

MECHANICAL STOKERS.—Cleveland, O.—The following bids were received Sept. 22 for equipping six boilers at the city infirmary and city hospital with mechanical stokers: American Smokeless Furnace Co., $3,700; American Stoker Co., $3,600; Brightman Furnace Co., $2,740; Oehlstrom Stoker Co. (awarded contract), $2,425.

REPAIRING CRIBWORK.—New York, N. Y.—Bids are asked until Oct. 20 for the removal of about 306 lin. ft. of backing log and decayed facing timbers, and for 225 pine piles, about 8,000 lbs. bolts, nuts, washers, spikes, etc., for the cribwork at the foot of East 4th St., East River. E. C. O'Brien, Pres. Dept. Docks, Battery Place.

PARK WORK.—Newark, N. J.—Bids are asked by the Essex county park commission, 800 Broad St., Newark, until Oct. 19 for work at Branch Brook Park; the work to include 200 cu. yds. of rock excavation, 130,000 cu. yds. of earth excavation, 7,600 lin. ft. of curbing, 10,700 sq. ft. of flagging, etc. Bids for six different branches of work are asked for.

WHARF.—Sitka, Alaska.—The "Mining Record," Juneau, Alaska, is quoted as stating that the government is asking for bids for the construction of a new wharf at Sitka. The specifications, however, are so little in accordance with local circumstances, that it is not probable that any Alaskan contractor will care to do the work, which is to be commenced in about 60 days.

CANAL IMPROVEMENTS.—Albany, N. Y.—State Engineer Adams has sent to Supt. Aldridge plans and specifications for 31 pieces of work to be done upon the canals under the $9,000,000 appropriation. On the eastern division of the Erie and the Champlain canals the parts to be improved first are as follows: Eastern Division, Erie Canal—Between locks 18 and 19, 8.86 miles; between locks 20 and 21, 3.22 miles; between locks 27 and 28, 5.21 miles; between locks 28 and 29, 1.97 miles; between locks 32 and 33, 5.11 miles; between locks 33 and 34, 2.57 miles; between locks 42 and 44, 2.96 miles; between lock 22 and bridge No. 55, 3.29 miles; between locks 44 and 45, 1.24 miles. Champlain Canal—Twelve-mile level between Fort Edward and Fort Ann, 11.75 miles; between locks 6 and 7, 3 miles; between locks 4 and 5, 1.30 miles.

DRAINAGE.—Laporte, Ind.—It is stated that the projectors of the movement to reclaim the Kankakee region have determined to begin work at once, and a meeting was held Oct. 7 to confer with the engineers. The organization, perfected in four counties, now promises to be followed by action that will insure the drainage of the entire Kankakee region, and the reclamation of 500,000 acres of land. Pres., D. W. Place, South Bend, Ind.; Vice-Pres., Chas. A. Danielson, Hamlet, Ind.; Secy., H. C. Shannon, Laporte; Treas., H. L. Weaver.

PIER WORK.—New York, N. Y.—The following bids were received by the department of docks, Geo. S. Terry, Secy., Oct. 13, for repairing and extending pier at West 131st St. and North River:

John W. Flaherty, 510 Macon St., Brooklyn	$8,974
Barth S. Cronin, 85½ 3d pl, Brooklyn	8,740
Spearin & Preston, 67 E. 3d st, Bayonne, N. J.	9,289
P. Sanford Ross, 277 Washington St., Jersey City	10,144
Wm. H. Jenks, 130 Pearl St., N. Y. City	8,445
Gildersleeve & Rolf, 39 Cortlandt St. (accepted)	8,237
Henry D. Steers, 5 Bowling Green, N. Y.	8,352

DRAINAGE CANAL.—Chicago, Ill.—The county court has been petitioned by about 5,300 voters to form a new sanitary district for a drainage canal from the Calumet River to the Chicago Drainage Channel, which is now being constructed. The district which the petitioners desire to have made into a sanitary district comprises about 70 square miles, and has within it all that portion of the city south of 87th St., Blue Island, Morgan Park, part of Harvey, North Harvey, South Holland and the vilages of Riverdale, Dalton, West Hammond and portions of Worth, Thorrton, Calumet and Bremen. It is proposed to construct a canal to cost $3,000,000 to $5,000,000. The canal will start at the Calumet River and will connect with the great drainage canal at Sag.

INDUSTRIAL NOTES.

THE MICHIGAN PIPE CO., Bay City, Mich., has secured a contract from the Detroit Electric Lighting Commission for 50,000 lin. ft. of creosoted conduit.

McHOSE & LYON, Dayton, O., manufacturers of bridges and heavy castings for buildings, assigned Oct. 5. The assets are $37,000; liabilities about $50,000. Their shops have closed down.

THE BETTENDORF HOLLOW STEEL AXLE WORKS, Davenport, Ia., is figuring on manufacturing railway ties from steel, pressed cold. At present it is making its all-steel axle and gear and a patent brake beam from pressed steel.

THE BUDA FOUNDRY & MFG. CO., of Chicago, has recently shipped from its works at Harvey, Ill., a car load of hand cars to Mexico, to the Sierra Madre Construction Co., John P. Ramsey, Gen. Mgr. It reports that the Buda railway velocipede which it has had upon the market for about a year is giving good satisfaction, and that it will send it to responsible parties upon trial.

J. R. PATTERSON & CO., 84 Adams St., Chicago, have been awarded the contract for a considerable portion of the cement to be used in constructing the Melan concrete bridge over the Kaw River at Topeka, Kansas. The Diamond brand will be used. Mr. H. V. Hinckley is the superintendent of construction for the county. Mr. Patterson also states that 40 car-loads of Diamond cement were furnished by him for use in building the Century Building of St. Louis.

A. E. ROSENTHAL, 649 The Rookery, Chicago, has resigned as manager of the Chicago office of Joseph Joseph & Bros., which position he has held for 3½ years, to engage in business for himself. Mr. Rosenthal will make a specialty, as heretofore, of buying and selling all weights of relaying rails. He will also carry on a business in general railway supplies, including the purchase and sale of all kinds of railway scrap material, cotton and woolen waste, etc.

STEEL FOR SWITZERLAND.—A press dispatch from Washington announces that Consul Eugene Germain has written the department of state that American pig iron, steel and tools are wanted in Switzerland. One of the largest houses in Zurich requests him to let American dealers know that they want 40,000 tons of pig iron for foundry purposes, 55,000 tons of blooms, billets, wire rods, bars and sheets; 3,200 tons of pipes and tubes, and 2,000 tons of hardware goods, chains, bolts, nuts, screws, etc.

THE STREET SWEEPING & LOADING MACHINE CO., 2520 Bismarck St. (factory 3521 South 2d St.), St. Louis, Mo., has been organized to handle the patents owned by Mr. Henry Mueller, Jr., and to sell the Mueller street sweeping and loading machines which have been in use in St. Louis for several years. Mr. Mueller has recently shipped two of these machines to Memphis, Tenn., and advises us that his machines are now in use in Chicago, Ill.; Indianapolis, Ind.; St. Louis, Mo.; Memphis, Tenn., and several other cities.

GEO. P. NICHOLS & BRO., 1325 Monadnock Block, Chicago, have taken the agency for the western states for the J. H. McEwen Mfg. Co., of New York, manufacturers of the McEwen engines and the Thompson-Ryan dynamos. Mr. Nichols states that they now have the contract for a 100 K-W. direct-connected dynamo from A. M. Rothschild & Co., Chicago, and that this is the second order and the third Thompson-Ryan dynamo that this firm has installed. They have also recently completed the installation of the machinery for operating the draw span of the Rock Island-Davenport bridge.

THE NEW YORK FILTER MFG. Co., 145 Broadway, New York, informs us that on Friday, Sept. 18, suit was brought by it in the United States Circuit Court, at Utica, N. Y., against the Elmira Water-Works Co. for infringement of the Hyatt patent dated Feb. 19, 1884, which has heretofore been sustained in both the United States Circuit Court and the United States Circuit Court of Appeals. The suit grows out of the contract recently given by the Elmira Water-Works Co. to the Morison-Jewell Filtration Co., of New York and Philadelphia, for the erection of that company's filter plants for the Elmira company, and in due season it will be followed by an application to the court for an injunction.

NEW COMPANIES.—McAdams Engine Co., of San Francisco, Cal.; $50,000; Louis C. McAdams, Joseph Schwartz, J. B. Letter, Albert J. Lowenberg and Charles J. Ambruster.

Standard Valve Gear Co., Jersey City, N. J.; to manufacture locomotives, cars, coaches and vehicles; $500,000, commencing with $300,000; Wm. H. Cutler, Milburn, N. Y.; Chas S. Farnum, Philadelphia, Pa.; Chas N. King, Jersey City, N. J.

Wilmont Fire-Proofing Co., Baltimore, Md.; $100,000, commencing with $50; Wm. Montgomery, Jr., John M. Ingram, Sidney S. Frank, all of Baltimore.

NOTE:—The reader will observe that these last two pages of Construction News are numbered consecutively with the loose part of the Supplement. The leaf may be readily cut out and pasted thereto by those who keep the Supplement on file.

International Underground Electric Co., Camden, N. J., to manufacture electrical appliances; $250,000, commencing with $1,000; Simeon J. Martin, Ellery P. Ingham, Frank Battles, Philadelphia, Pa.

Mountain Springs Ice Co., Ogden, Utah; $5,000; Henrietta R. Griffith, G. O. Griffith, G. G. Griffith.

Hamilton Pressed Brick Co., Scranton, Pa.; $100,000; A. M. Atherton, Michael Baumgardner, Arthur Hitchcock.

Monarch Iron Co., of Duluth, Minn.; $200,000; S. W. Eckman, Arthur Howell and T. W. Wahl, all of Duluth.

Peerless Powder Co., San Jose, Cal.; to manufacture smokeless powder; $20,000; Rocca Salomone, P. Hariata, L. A. Spinelli, Robert Menzel and H. A. Gabriel.

Globe Stone Co., Cleveland, O.; to operate stone quarries and manufacture brick and tile; $250,000, commencing with $2,500; J. F. Harper, Frank Bradley, Tyron Bailey, Chagrin Falls, O.

Caldwell Lumber Co., Charleston, W. Va.; $100,000; Howell Smith, Walter Smith, Brooklyn, N. Y.; Fred. K. Fitch, David Fitch, New York city.

Templeton Mfg. Co., New York city; to deal in spring motors and machinery; Ed. R. Rollins, Wm. Lupton, Henry Klune, all of New York city.

Kankakee River Improvement Co., La Porte, Ind.; to improve the channel of the Kankakee River and tributaries.

NEW YORK STATE CANALS.

NOTICE TO CONTRACTORS.

OFFICE OF THE
SUPERINTENDENT OF PUBLIC WORKS.
ALBANY, N.Y. October 12,1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Thursday, October 29th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from Station 83 × 10, near Ferry Street, to Commercial slip, and on slips Nos. 1, 2 and 3, and Commercial slip, at Buffalo, N. Y.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works, in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS.—In the selection of cements to be used in the said work, those manufactered in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794, of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state. payable at sight to the Superintendent of Public Works, for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $21,500, and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract. $150,500; the amount of bond for the faithful performance of contract, on execution of contract, $215,000. All proposals for the above work must be addressed to the Superintendent of Public Works, at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal from Station 83 × 10, near Ferry Street, to Commercial slip, and on slips Nos. 1, 2, and 3, and Commercial slip, at Buffalo, N. Y." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
42-2t Superintendent of Public Works.

NEW YORK STATE CANALS.

NOTICE TO CONTRACTORS.

OFFICE OF THE
SUPERINTENDENT OF PUBLIC WORKS.
ALBANY, N. Y., October 12, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Thursday. October 29th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal by building the Cartersville waste weir and spillway at Station 721, Sec. 15.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works, in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS.—In the selection of cements to be used in the said work, those manufactered in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submited to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794, of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works, for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $500, and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract. $3,500; the amount of bond for the faithful performance of contract, on execution of contract, $5,000. All proposals for the above work must be addressed to the Superintendent of Public Works, at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, by building the Cartersville waste weir and spillway, at Station 721, Sec. 15." The right is reserved to reject any or all bids..

GEO. W. ALDRIDGE,
42-2t Superintendent of Public Works.

NEW YORK STATE CANALS.

NOTICE TO CONTRACTORS.

OFFICE OF THE
SUPERINTENDENT OF PUBLIC WORKS,
ALBANY, N. Y., October 12, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896. sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Thursday. October 29th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal on Sec. 21, from the head of the Lockport locks to Station 328, near McDonald's culvert.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works, in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS.—In the selection of cements to be used in the said work, those manufactered in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794, of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works, for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $15,500, and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $108,500; the amount of bond for the faithful performance of contract, on execution of contract, $155,000. All proposals for the above work must be addressed to the Superintendent of Public Works, at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, on Sec. 21 from the head of the Lockport locks to Station 328, near McDonald's culvert." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
42-2t Superintendent of Public Works.

NEW YORK STATE CANALS.

NOTICE TO CONTRACTORS.

OFFICE OF THE
SUPERINTENDENT OF PUBLIC WORKS,
ALBANY, N. Y. October 12. 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Thursday, October 29th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal between Station 328, Sec. 21, near McDonald's culvert, to Station 87 × 10, Sec. 23, near Ferry Street, Buffalo, N. Y.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works, in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS.—In the selection of cements to be used in the said work, those manufactered in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794, of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state. payable at sight to the Superintendent of Public Works, for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $14,500, and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract. $101,500; the amount of bond for the faithful performance of contract, on execution of contract, $145,000. All proposals for the above work must be addressed to the Superintendent of Public Works, at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, between Station 328, Sec. 21, near McDonald's culvert, to Station 87 × 10, Sec. 23, near Ferry Street, Buffalo, N. Y." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
42-2t Superintendent of Public Works.

WATER WORKS.

HUNTINGTON, IND.

Sealed proposals will be received at the office of the City Clerk at Huntington, Ind., until 6 p. m., of October 24, 1896, for the following work, to wit:

1st. For sinking and completing twelve (12) eight (8) inch tubular wells, and reconnecting the eleven (11) six-inch wells now in use for water supply.

2d. For rebuilding the pumping station, and resetting and connecting pumping machinery and steam plant.

3d. For furnishing all material and erecting a steel standpipe, thirty (30) feet in diameter and seventy-five (75) feet in height, on a brick or concrete masonry substructure, twenty-five (25) feet in height.

4th. For furnishing and laying, approximately, six (6) miles of cast-iron water mains with the necessary hydrants and valves; and for taking up and relaying ten (10) inch mains.

Plans and specifications will be on file at the office of the Superintendent of Water Works, at Huntington, Ind.; also at the office of the Consulting Engineers, room 506 Association Building, Chicago, Ill., on and after October 5, 1896.

Each proposal must be sealed, addressed to E. Q. Drummond, City Clerk, Huntington, Ind., marked "Proposal for Water Works Adfied check or surety company bond made payable to the City Treasurer of Huntington, Ind., for the sum of one thousand (1,000) dollars, as a guarantee that the bidder will enter into a contract for the construction of said work and furnish the required bond within five days from the date of award.

The City Council reserves the right to reject any and all bids.

Dated at Huntington, Ind., October 3, 1896.
E. Q. DRUMMOND, City Clerk.
STURTEVANT & TODD, Consult. Engrs.
42-1t

U. S. ENGINEER OFFICE, 106 Granby St., Norfolk, Va., Sept. 9, 1896.—Sealed proposals for DREDGING Western Branch of Elizabeth River, Va., will be received here until 12 o'clock, Oct. 26, 1896, and then publicly opened. Information furnished on application. THOS. L. CASEY, Capt. Engrs. 40-2teow

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TOWARDS THE SETTING SUN.

'Tis said that every land has its season a time when nature smiles in all her scenic beauty. Mexico and California have opened their doors for the winter travel that seeks a milder and more genial clime. The Southern Railway, "Piedmont Air Line," in connection with the Southern Pacific, via New Orleans, offers the most attractive route. Taking a southerly course, no snow or ice, where the winds are soft and mellow and the very air coaxes one to revel among the thousand charms of nature. The Southern Pullman Vestibuled Limited, operated solid between New York and New Orleans the year round, is one of the finest equipped vestibuled trains, carrying dining and sleeping cars, and, after November 9th, the Sunset Limited will resume its schedules to connect, thus giving the most superb service between New York and the Pacific coast. For further information call on or address General Eastern Office Southern Ry., 271 Broadway.

IT'S A GO.

Since October 1st, when the open season began, the influx of sportsmen to the "Wilds of Maine" has been generally increasing.

These annual shooting expeditions are to the hunter a source of great pleasure, and for a long time previous to his departure for the "Happy Hunting Ground," his time is occupied in elaborate preparation for the trip, which to him has no equal.

A day's time will carry one into the wildest of forests where Moose, Deer and other game reign supreme, and with the assistance of a guide and a good gun it will be no one's fault but your own if you don't have a good time.

In the remotest sections of the hunting region are well-equipped camps belonging either to hunting clubs or private individuals, which can be hired for short periods, and where the "Brown October Days" can be passed in bliss and happiness.

The through service of the Boston & Maine Railroad and its connecting lines to all hunting points is fully equipped, and every facility which will benefit the huntsman or the traveller will be inuagurated.

Information regarding trains, etc., may be obtained at the station ticket offices, or at the Boston City Ticket Office, 322 Washington St.

Contract Work Should Always be Advertised in a Paper Read by Contractors.

Nearly Every Prominent Contractor and Manufacturer of Contractors' Supplies in North America Reads Engineering News

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PERSONALS.

Mr. Edw. C. Lindner, contractor, died at Hamilton, Ont., Oct. 14.

Mr. C. F. Abernethy has been elected City Engineer of Circleville, O.

Mr. Otto G. Bleedorn has been elected City Engineer of Janesville, Wis.

Mr. Karl Capple, retired contractor, of Homestead, Pa., died Oct. 15, aged 58.

Mr. John T. Linn, Manager of the McKeesport (Pa.) Coal Co., died Oct. 14.

Mr. W. H. Parsons, Water Commissioner, of Forestville, N. Y., has resigned.

Mr. C. B. Beasom, Master Mechanic of the New Orleans & Western R. R., has resigned.

Mr. William P. Moore, at one time Water Commissioner of Kansas City, Mo., died there Oct. 15.

Mr. H. C. Adams, Jr., has been appointed Secretary of the Phillips Insulated Wire Co., of Pawtucket, R. I.

Mr. William Death, contractor, of Paterson, N. J., was killed in a runaway accident while driving, Oct. 14.

Mr. C. Sidney Shepherd has been appointed Receiver for the Lake Ontario & Electric Street R. R., of Syracuse, N. Y.

Mr. F. W. Fratt has been appointed General Manager of the Texas Midland R. R., with headquarters at Terrell, Texas.

Mr. S. T. Everett has been elected Vice-President of the Cleveland Terminal & Valley R. R., with headquarters at Cleveland, O.

Mr. Joseph S. Pollock, of Cleveland, O., has been appointed Superintendent of the Sheridan (Pa.) furnaces of the Sheridan Furnace Co.

Mr. W. Hale, Superintendent of the Montana Division of the Great Northern Ry. Line, with headquarters at Havre, Mont., has resigned.

Mr. L. W. Rundlett, City Engineer of St. Paul, Minn., has been engaged as Consulting Engineer for the new water-works system of Duluth.

Mr. W. C. Pond, Secretary and Treasurer of the Hyde Park Gas Co., of Chicago, Ill., has been elected Vice-President and General Manager.

Mr. Christopher L. Williams has been appointed Acting Commissioner of Public Works of Evanston, Ill., to succeed Mr. Mark Wymcnd, resigned.

Mr. W. S. Henning, Supervisor of Bridges and Buildings, of the New Orleans & Western R. R., with headquarters at New Orleans, La., has resigned.

Mr. J. P. Rogers has been appointed Assistant Superintendent of the Kalispell Division, of the Great Northern Ry. Line, with headquarters at Kalispell, Mont.

Mr. William Duncan, formerly Second Vice-President of the Baltimore & Ohio Southwestern Ry., has been elected President of the St. Louis Cotton Compress Co., St. Louis, Mo.

Mr. J. A. L. Waddell, consulting bridge engineer, of Kansas City, Mo., is at present delivering a course of lectures on "Bridge Designing," at McGill University, Montreal, Can.

Mr. J. W. Kendrick, Vice-President of the Lake Superior Terminal & Transfer Ry., has been elected President, to succeed Mr. W. F. Fitch, with headquarters at Marquette, Mich.

Mr. Walter C. Swindell, contractor, of Pittsburg, Pa., died Oct. 16. His death was due to blood poisoning resulting from washing blue prints when he had a small cut in his thumb.

Mr. George B. Post, architect, of New York city, has been elected President of the American Institute of Architects, and Mr. Alfred Stone, of Providence, R. I., has been elected Secretary.

Mr. C. D. Boyd, Vice-President and General Superintendent of the San Diego, Pacific Beach & La Joua Ry., with headquarters at San Diego, Cal., has resigned, and the office has been abolished.

Mr. Peter Ward, for many years Superintendent of the Willimantic (Conn.) gas light works, died Oct. 16, aged 61. He was in charge of the gas plant of the New York, New Haven & Hartford R. R., in New Haven, at the time of his death.

Mr. Thos. H. Wickes, Second Vice-President of the Pullman's Palace Car Co., with headquarters in Chicago, Ill., has been elected First Vice-President to succeed Gen. Horace Porter, resigned.

Mr. William Hainsworth, formerly President of the Hainsworth Steel Co., of Pittsburg, Pa., died at West Seattle, Wash., Oct. 12. He was the proprietor of iron and steel works at West Seattle.

Mr. J. J. Thomas, Jr., Master Mechanic of the Birmingham & Atlantic R. R., with headquarters at Talladega, Ala., has been appointed to a similar position on the Mobile & Birmingham R. R.

Mr. John Fogarty, contractor, of West Superior, Wis., was killed Oct. 15, by a train, while superintending some work for which he had the contract on the Chicago & Northwestern Ry., near Baraboo, Wis.

Mr. Frank Julian, formerly connected with the testing department of the Illinois Steel Co., Chicago, Ill., has been appointed Chief Chemist of the Great Northern Ry. line, to succeed Mr. P. H. Conradson, resigned.

Mr. W. C. Farrington, General Manager of the Eastern Ry. of Minnesota, with headquarters at Duluth, Minn., has been elected Vice-President of the Lake Superior Terminal & Transfer Ry., to succeed Mr. J. W. Kendrick.

Mr. D. F. Maroney, Superintendent of Car Service, of the Baltimore & Ohio R. R., with headquarters in Baltimore, has been promoted to be Superintendent of Transportation with headquarters at Camden Station, to succeed Mr. T. Fitzgerald.

Mr. D. H. Louderback, President of the Tri-City Ry. Co., of Davenport, Ia., has resigned. Mr. E. E. Cook, of Davenport, Ia., has been appointed to succeed him. The company operates 30 miles of street railway in Davenport, Rock Island and Moline.

Mr. Lefferts L. Buck, Chief Engineer of the New East River Bridge, has been appointed as a member of the board of experts which will report on the feasibility and practicability of the surface railway cars and the elevated railway cars, or either of them, crossing the New York and Brooklyn Bridge.

Mr. E. S. Whitney, civil engineer, of Allentown, Pa., formerly on the engineer corps of the Pennsylvania R. R. and the Philadelphia & Reading R. R., has been appointed Inspector to represent the latter road during the construction of the Pennsylvania Ave. subway and tunnel in Philadelphia.

Hon. James Shearer, died at Bay City, Mich., Oct. 14. He was born in Albany, N. Y., and moving to Detroit, became a member of the original Board of Sewer Commissioners of that city. He removed to Bay City in 1865 and was instrumental in organizing and building the waterworks there, besides being a member of the State Capitol Commission.

Mr. O. W. Beckwith, Chief Train Dispatcher of the Chicago Division of the Cleveland, Cincinnati, Chicago & St. Louis Ry., with headquarters at Kankakee, Ill., has been appointed Trainmaster of the Cincinnati Division, with office at Springfield, O., to succeed Mr. Thos. J. English, whose promotion to Division Superintendent was announced in our issue of Oct. 8.

The board to select the site for a harbor on the Pacific coast, for which $2,900,000 was appropriated by the last Congress, has been appointed by President Cleveland, and consists of Rear Admiral John G. Walker, U. S. Navy; Asst. Engr. Augustine F. Rogers, U. S. Coast and Geodetic Survey, and Messrs. William H. Burr and George S. Morison, of New York, and Ricard P. Morgan, of Illinois.

Mr. Lewis Kingman, Chief Engineer of the Mexican Central Ry., with headquarters in the City of Mexico, has been chosen as an expert to appraise the value of the Atlantic & Pacific Ry., from Isleta Junction, N. Mex., to The Needles, Cal. We have this on the authority of "The Two Republics" of the City of Mexico of the date of Oct. 16, and the same corrects our statement concerning Mr. Kingman, which appeared in our issue of the 15th instant.

Mr. J. M. Wallis, Superintendent of Motive Power of the Pennsylvania R. R., at Altoona, Pa., has been appointed General Superintendent of the Philadelphia & Erie and Northern Central Divisions, to succeed the late Mr. Robert Neilson, whose death was announced in our issue of Oct. 15. Mr. Wallis is also at present Acting General Superintendent of the Main Division, during the absence of Mr. F. L. Sheppard, as we noted in our issue of May 21 last.

Mr. Robert E. O'Brien, civil engineer and railway expert, died in New York city, Oct. 18, aged 63. He was born in Philadelphia, Pa., and entered the service of the Pennsylvania R. R. in 1849. He held the office at one time of Chief Engineer of the Atlantic & Great Western Ry., and was also General Superintendent of the same. In 1881 he became Assistant Manager of the Oregon Ry. & Navigation Co. and then successively Manager of the Northern Pacific Terminal Co. and Chief Engineer of the Oregon & Trans-continental Co.

Mr. Bertrand T. Wheeler, civil engineer, of Dorchester, Mass., has been appointed a member of the Metropolitan Sewerage Commission, of Boston, Mass., to succeed Mr. Alfred F. Noyes, whose death occurred on Oct. 12, as noted in our issue of the 15th inst. Mr. Wheeler is a graduate of Dartmouth College, Hanover, N. H., in the class of 1884, and was a Resident Engineer on the Old Colony R. R. from 1885 until its lease to the New York, New Haven & Hartford R. R. In 1895 he was appointed Superintendent of Streets of Boston, and held the office for a year.

Mr. J. G. Pinkerton, Master of Transportation of the Kansas City, Memphis & Birmingham R. R., was killed at Sulligent, Ala., Oct. 20, while attempting to board a train. He had just given the signal to move ahead and his foot slipping, fell beneath the train. He was born at Lancaster, Pa., April 6, 1850, and entered the railway service in 1873, with the Northern Pacific Ry. and became Train Dispatcher on this road, and afterwards on the Missouri, Kansas & Texas Ry., Denver & Rio Grande R. R., Kansas City, Fort Scott & Memphis R. R. and others. He had been Master of Transportation of the Kansas City, Memphis & Birmingham R. R. for ten years.

Mr. John H. Drake, President of the Drake & Stratton Co., contractors, of New York, Philadelphia and Pittsburg, died Oct. 20, in Philadelphia. He was born near Monticello, N. Y., in 1840, and with Mr. Stratton entered the employ of the Watson Mfg. Co., of Paterson, N. J., as a young man. In course of time he became Manager of the company and his future partner was the Superintendent. The two started the contracting firm of Drake & Stratton in 1870. In 1891 the Drake & Stratton Co., Ltd., was formed with Mr. Drake, President, and Mr. Stratton, General Manager. It built the foundation of the Statue of Liberty in New York Harbor, rebuilt the Johnstown (Pa.) bridge after the great flood, and constructed several bridges in the vicinity of New York. At present it is engaged on work for the Baltimore & Ohio, Pennsylvania and Erie railways. Mr. Drake was in charge of the Philadelphia branch of the company and his home was in Middletown, N. Y.

Mr. James Henry Greathead, M. Inst. C. E., and well known to engineers for his system of tunnel construction, died at Streatham, England, on Oct. 22. He is said to have been born about 50 years ago, and to have commenced his professional career as a mechanical draftsman in the employ of Isambard Kingdom Brunel. But as Brunel died in 1859, he must have been very young at the time, if his age is correctly stated. After some years spent in England, he followed the practice of his profession in India and Australia for about ten years and then returned home and adopted tunnel construction as a specialty. The work which first gave him prominence was the building of the tunnel under the River Thames, for the City & South London Electric Ry., completed in November, 1890. The so-called Greathead system, so successfully applied in this work, was one of details rather than of general methods. He built his tunnel in an iron cylinder, built up of segments, protected in front during the excavation by a shield; and he used compressed air in passing through water-bearing material and injected grout between the outer skin of the tunnel and the surrounding material so as to make the structure water-tight and assist in preserving the shell. Mr. Greathead also constructed the Waterloo & City Ry. tunnel and was engineer of the Central London Electric Underground Ry., lately commenced. With Sir Benjamin Baker, he was one of the consulting engineers of the Hudson River Tunnel, under the English management.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Nov. 2. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF WESTERN NEW YORK.
Nov. 2. Secy., Carleton Greene, Library Bldg., Buffalo.
COLUMBIAN ENGINEERING SOCIETY.
Nov. 3. Secy., F. W. Hart, 15th and H Sts., N. W., Washington, D. C.
WESTERN SOCIETY OF ENGINEERS.
Nov. 4. Secy., N. L. Litton, Monadnock Block, Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
Nov. 4. "Steel Frame Construction of High Buildings," by Julius Baier. Secy., Wm. J. Bryan, Turner Bldg.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Nov. 4. Secy., C. W. Hunt, 127 E. 23d St., New York.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Nov. 5. Secy., C. H. McLeod, Montreal, Can.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Nov. 6. Secy., O. Von Geldern, 819 Market St., San Francisco, Cal.
CHICAGO ELECTRICAL ASSOCIATION.
Nov. 6. "The Metric System in Electrical Industries," by F. S. Hickok. Secy., J. R. Cravath, 810 Old Colony Bldg.
ENGINEERS' CLUB OF PHILADELPHIA.
Nov. 7. "The Queen Lane Division of the Philadelphia Water Supply System," by Allen J. Fuller. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERS' CLUB OF KANSAS CITY.
Nov. 9. Secy., F. W. Tuttle, Baird Bldg.
DENVER SOCIETY OF CIVIL ENGINEERS.
Nov. 10. Secy., Walter Pearl, 36 Jacobson Bldg.
NORTHWEST RAILWAY CLUB.
Nov. 10. Secy., T. A. Foque, Soo Line, Minneapolis.
NORTHWESTERN SOCIETY OF ENGINEERS.
Nov. 10. Secy., D. W. McMorris, 635 Burke Block, Seattle, Wash.
RAILWAY SIGNALLING CLUB.
Nov. 10. Secy., Geo. M. Bashford, The Rookery Bldg., Chicago.
ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
Nov. 10. Secy., Daniel Carhart, 410 Penn Ave., Pittsburg.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Nov. 10. "Structural Steel for Ships," by J. R. Oldham. Secy., F. A. Colburn, Case Library Bldg.
WISCONSIN POLYTECHNIC SOCIETY.
Nov. 10. Secy., W. K. Means, Loan and Trust Bldg., Milwaukee, Wis.
NEW ENGLAND RAILROAD CLUB.
Nov. 11. Secy., Edw. L. Jones, P. O. box 1158, Boston.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Nov. 12. Secy., James K. Zollinger, Norton Bldg., Louisville, Ky.

ENGINEERING ASSOCIATION OF THE SOUTH.
Nov. 12. Secy., L. P. Brown, Nashville, Tenn.
CENTRAL RAILWAY CLUB.
Nov. 13. Secy., H. D. Vought, Buffalo "Courier," Buffalo, N. Y.
MONTANA SOCIETY OF ENGINEERS.
Nov. 14. Secy., Forrest J. Smith, Denver Block, Helena.
INDIANAPOLIS ENGINEERING CLUB.
Nov. 14. Secy., C. C. Brown, Indianapolis, Ind.
ENGINEERS' CLUB OF MINNEAPOLIS.
Nov. 16. Secy., Elbert Nexsen, 1620 S. E. 4th St., Minneapolis, Minn.
WESTERN RAILWAY CLUB.
Nov. 17. Secy., W. D. Crossman, The Rookery, Chicago.
ENGINEERS' AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Nov. 18. Secy., F. Van Vleck, Los Angeles.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Nov. 18. Secy., J. A. Pilcher, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Nov. 18. Secy., S. E. Tinkham, City Hall.
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Nov. 18. Secy., R. W. Pope, 26 Cortlandt St., New York city.
WESTERN FOUNDRYMEN'S ASSOCIATION.
Nov. 18. Secy., A. Sorge, Marquette Bldg., Chicago.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 19. Kimball House, Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
ENGINEERS' CLUB OF CINCINNATI.
Nov. 19. Secy., J. F. Wilson, P O. box 333.
NEW YORK RAILROAD CLUB.
Nov. 19. "Compressed Air Motors in Railway Service." Secy., W. W. Wheatley, 168 Montague St., Brooklyn, N. Y.
TACOMA SOCIETY OF CIVIL ENGINEERS AND ARCHITECTS.
Nov. 20. Secy., 201 Washington Bldg., Tacoma, Wash.
ENGINEERS' CLUB OF COLUMBUS.
Nov. 21. Secy., M. S. Hopkins, 14½ N. High St., Columbus O.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 1, 2, 3, 4. Meeting to be held at the Society House, New York city. Secy., F. R. Hutton, 12 W. 31st St., New York city.
NORTHWESTERN TRACK AND BRIDGE ASSOC.
Dec. 11. Secy., D. W. Meeker, St. Paul, Minn.
AMERICAN SOCIETY OF IRRIGATION ENGINEERS.
Dec. 11 and 12. Annual meeting to be held in Denver, Colo. Secy., John S. Titcomb, Room 36, Jacobson Bldg., Denver, Colo.
NATIONAL IRRIGATION CONGRESS.
Dec. 15, 16 and 17. Annual meeting to be held in Phoenix, Ariz. Secy., C. M. Heintz, Los Angeles, Cal.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Oct. 21, the President, Mr. T. C. Clarke, in the chair, there was a very large attendance of members and visitors to listen to the discussion of a paper on "Suspension Bridges," by Mr. Geo. S. Morison. A brief abstract of the paper was first presented by Mr. Morison, explaining his design for a bridge of 3,080 ft. span, having steel towers and a continuous stiffening truss extending beyond the towers. There are four cables, cradled (or not arranged in vertical planes), and attached to the tops of the towers, instead of being continuous; separate backstay cables extend from the towers to the anchorages. The cables are to be built up of twisted wire ropes.

Mr. Theodore Cooper did not approve of the use of twisted wire ropes, nor did he think clamps sufficient for the attachment of the suspenders, as it would be difficult to prevent them from slipping, unless secured so tightly as to possibly injure the cable. He presented a proposed plan for connecting the clamps by wires or cables attached to trunnions on the clamps. Mr. Spillsbury, who had made a number of test ropes of the style advocated by Mr. Morison, described a compound socket for the cable connections at the tower saddles, the purpose of which was to utilize the greatest possible percentage of the strength of the cable beyond the socket. Each layer of wires is longer than the one outside of it, and is attached to a sleeve socket resting against that of the next outer layer. Mr. Meyer considered it best to have the cables hanging in vertical planes, instead of being cradled, as in the design of the Union Bridge Co. for the New York & New Jersey bridge; he also preferred a deep stiffening truss, with central hinge joint to the continuous shallow truss proposed by Mr. Morison. Mr. T. C. Clarke did not approve of separating the cables at the towers, but considered it preferable to have them continuous between the anchorages. He referred to the system of vertically braced cables, as designed by Mr. Lindenthal for the North River bridge, and also pointed out the advantages of cradling the cables in keeping them outside the line of the bridge at the towers, so that the bridge could pass through the tower without interference with the roadway or the tower bracing. For a six-track railway bridge, however, he would prefer the cantilever type of bridge, with a center span of 1,600 ft.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The subject for discussion at the meeting of Oct. 21, was "Electric Traction Under Steam Railway Conditions." Dr. Chas. E. Emery, M. Am. Inst. Elec. E,, read a paper containing much data to show that the cost of installing electricity on steam railways is such that an increase in receipts of 12½% would be necessary to warrant the change. He emphasized the fact that notwithstanding popular opinion, electric locomotives do not run more smoothly nor with less wear on rails and track than steam locomotives. He believed that electric traction for long distance traffic had an advantage over the steam locomotive only in increased convenience and comfort to passengers.

A report was read from the Nantasket Beach division of the New York, New Haven & Hartford Ry. (described in Engineering News, Oct. 22). It was incomplete so far as drawing any comparison between the cost of steam and electric operation. One serious accident and a number of minor ones had resulted from workmen and others coming in contact with the live third rail. Steam locomotives had in some instances short circuited the third rail, touching it with the pilot, and tied up traffic until the locomotive could be removed from the line.

Mr. H. Ward Leonard, M. Am. Inst. Elec. E., believed the cost of installing electricity, with present methods, to be greater than steam, but the advantages of electricity might lead to its adoption. In pointing out some of these he showed that higher speed cannot be reached with steam locomotives due to the limiting velocity at which steam will pass into the cylinder; while there is practically no limit to the speed of electric motors. Electric locomotives may be built of any desired horse-power while it does not seem probable that the capacity of the present steam locomotive can be much exceeded. Electric locomotives have already been built with 230,000 lbs. on the drivers; the heaviest steam locomotives have only 170,000 lbs. Electric locomotives are now running at 60 miles an hour very smoothly and without vibration. Mr. Leonard thought 120 miles an hour possible without fear of injury to equipment. In order to reduce the cost of installation he proposed high tension alternating currents, with rotary transformers and storage batteries carried on the locomotives. In this way the cost of transmission would be greatly reduced.

It was the general opinion of the members present that electricity cannot be advantageously substituted for steam except for short distances, light weights and frequent service. Among those who took part in the discussion were Messrs. Chas. H. Davis and Geo S. Strong.

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CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work. Place.	See Eng. News.
Oct. 29.	Cast-iron pipe sewers, Baltimore, Md	Oct. 22
Oct. 29.	Brick paving, Cincinnati, O	Oct. 22
Oct. 29.	Stone arch culvert, etc., Kansas City, Mo	Oct. 22
Oct. 29.	Improving canal (28 miles), Albany, N. Y	Oct. 15
	Advertised, Eng. News, Oct. 15 and 22.	
Oct. 29.	Waste weir, etc., at Cartersville, N. Y	Oct. 15
	Advertised, Eng. News, Oct. 15 and 22.	
Oct. 29.	Sand, Philadelphia, Pa	Oct. 1
Oct. 29.	U. S. bldg. work, New York, N. Y	Oct. 8
Oct. 29.	Rock for jetty, Coos Bay, Ore	Oct. 8
	Advertised, Eng. News, Oct. 8 to 22.	
Oct. 29.	Iron and steel bridges, Cleveland, O	Oct. 8
Oct. 29.	Sewers, Marietta, O	Oct. 8
Oct. 30.	Electric wiring, heater, etc., Boston	Oct. 15
Oct. 30.	Steel water pipe (3 m.), Duluth	Oct. 15
	Advertised, Eng. News, Oct. 15 and 22.	
Oct. 30.	Steel dome for state house, Boston, Mass	Oct. 22
Oct. 30.	Public building work, New York, N. Y	Oct. 22
Oct. 30.	Removing piers (2), New York, N. Y	Oct. 22
Oct. 30.	Pipe sewers, Richmond, Ind	Oct. 22
Oct. 30.	Laying intake, Evansville, Ind	Oct. 22
Oct. 31.	Brick and pipe sewers, Sharpsburg, Pa	Oct. 15
Oct. 31.	**Extension to court house, Lancaster, Pa**	**Oct. 1**
	Advertised, Eng. News, Oct. 1 to 22.	
Oct. 31.	Pile bridge approach, Duluth, Minn	Oct. 29
Oct. 31.	Sewer bonds, Glenville, O	Oct. 29
Oct. 31.	Filling bridge approaches, Pittsburg, Pa	Oct. 29
Oct. 31.	Bridge, Yarmouth, Mass	Oct. 29
Nov. 2.	School building, Washington, D. C	Oct. 29
Nov. 2.	Street signs, Indianapolis, Ind	Oct. 29
Nov. 2.	Brick school building, Boston, Mass	Oct. 29
Nov. 2.	Removal of piers, New York	Oct. 29
Nov. 2.	Elec., gas and oil lights, Jersey City, N. J	Oct. 29
Nov. 2.	Stone, etc., Memphis, Tenn	Oct. 29
Nov. 2.	Sewers, New York, N. Y	Oct. 29
Nov. 2.	Macadam and brick pav'g, Brooklyn, N. Y	Oct. 29
Nov. 2.	Grading, Toledo, O	Oct. 29
Nov. 2.	Paving, New York, N. Y	Oct. 29
Nov. 2.	Paving, Kansas City, Mo	Oct. 29
Nov. 2.	**Chemical fire engine, etc. (2), Glenfield, Pa**	**Oct. 1**
Nov. 2.	Dredging plant, Wilmington, N. C	Oct. 8
	Advertised, Eng. News, Oct. 8 to 22.	
Nov. 2.	Pipe sewers, Sonora, Cal	Oct. 8
Nov. 2.	Light-house tower, New Orleans, La	Oct. 15
Nov. 2.	Street bonds ($4,370), Wyoming, O	Oct. 15
Nov. 2.	Improving canals, Albany, N. Y	Oct. 22
	Advertised, Eng. News, Oct. 22 and 29.	
Nov. 2.	Municipal buildings (2), San Francisco, Cal	Oct. 22
Nov. 2.	Steel bridge (220 ft.), Sacramento, Cal	Oct. 22
Nov. 2.	Wooden bridge (460 ft.), Concord, Cal	Oct. 22
Nov. 2.	Sewer blocks, Baltimore, Md	Oct. 22
Nov. 4.	Bridge, Pendleton, Ore	Oct. 22
Nov. 4.	Tunnel, drain, etc., New York	Oct. 29
Nov. 4.	Pier work, Brooklyn, N. Y	Oct. 29
Nov. 4.	Naval supplies, Washington, D. C	Oct. 29
Nov. 4.	Gas machinery, etc., Philadelphia, Pa	Oct. 29
Nov. 4.	Sewers, Chicago, Ill	Oct. 29
Nov. 4.	Painting bridges, Indianapolis, Ind	Oct. 29
Nov. 5.	Water meters, Philadelphia, Pa	Oct. 29
Nov. 5.	Dredging, Wilmington, Del	Oct. 29
Nov. 5.	City building work, New York, N. Y	Oct. 29
Nov. 5.	Steel bridge, Woonsocket, R. I	Oct. 29
	Advertised, Engineering News, Oct. 29.	
Nov. 5.	Sewers, Brooklyn, N. Y	Oct. 29
Nov. 5.	Bonds, Brooklyn, N. Y	Oct. 29
Nov. 5.	Pipe sewers, Buffalo, N. Y	Oct. 29
Nov. 5.	Sewers, New York, N. Y	Oct. 29
Nov. 5.	Asphalt paving, Buffalo, N. Y	Oct. 29
Nov. 5.	Paving, etc., New York, N. Y	Oct. 29
Nov. 5.	Reformatory building work, Mansfield, O	Oct. 22
Nov. 5.	Steel bridge, Providence, R. I	Oct. 22
	Advertised, Eng. News, Oct. 22 and 29.	
Nov. 5.	Post office building, New London, Conn	Oct. 15
	Advertised, Eng. News, Oct. 15 and 22.	
Nov. 5.	Lighthouse, Boston Harbor, Mass	Oct. 8
Nov. 5.	Street railway franchise, Santa Rosa, Cal	Oct. 8
Nov. 5.	**Hotel, theatre, etc., Washington, D. C**	**Oct. 1**
Nov. 6.	Water bonds ($300,000), Cleveland, O	Oct. 15
Nov. 6.	Plumbing, walls, etc., Providence, R. I	Oct. 29
Nov. 6.	Bridge planking, Cleveland, O	Oct. 29
Nov. 6.	Electric lighting, Big Rapids, Mich	Oct. 29
Nov. 7.	Bonds ($8,000), Arverne-by-the-Sea, N. Y	Oct. 29
Nov. 9.	Hospital building, etc., Fort Leavenworth	Oct. 15
	Advertised, Eng. News, Oct. 15 to 29.	
Nov. 9.	Lighthouse tower, New Bedford, Mass	Oct. 8
Nov. 9.	Electric plant for post office, New York	Oct. 22
Nov. 9.	Bonds ($16,045,951), New York, N. Y	Oct. 22
Nov. 9.	Reservoir at Morris Plains, N. J	Oct. 29
Nov. 9.	County jail, Hanford, Cal	Oct. 29
Nov. 9.	Park work, New York, N. Y	Oct. 29
Nov. 10.	Dredging (85,000 cu. yds.), New York, N. Y	Oct. 29
Nov. 10.	Paving brick, Nashville, Tenn	Oct. 29
	Advertised, Engineering News, Oct. 29.	
Nov. 10.	Bridge, Modesto, Cal	Oct. 29
Nov. 10.	River and harbor bonds, Cleveland, O	Oct. 22
Nov. 10.	Water-works, Milford, Ill	Oct. 22
	Advertised, Eng. News, Oct. 22 to Nov. 5.	
Nov. 10.	Residence, Stockton, Cal	Oct. 22
Nov. 10.	Tunnels, etc., for power, Los Angeles, Cal	Oct. 22
Nov. 10.	Canal improvements,, Albany, N. Y	Oct. 22
	Advertised, Eng. News, Oct. 22 to Nov. 5.	
Nov. 10.	Dams, etc., Rock Island, Ill	Oct. 15
	Advertised, Eng. News, Oct. 15 to Nov. 5.	
Nov. 10.	Dredging machinery, Portland, Ore	Oct. 15
	Advertised, Eng. News, Oct. 15 to Nov. 5.	
Nov. 11.	Hydraulic dredges (2), St. Louis, Mo	Oct. 15
	Advertised, Eng. News, Oct. 15 to Nov. 5.	
Nov. 11.	Hospital building, Hoboken, N. J	Oct. 22
Nov. 11.	Iron bridge, Knoxville, Ia	Oct. 29
Nov. 12.	Administration building, Springfield, O	Oct. 15
Nov. 13.	Steam heating, Richmond, Ky	Oct. 22
	Advertised, Eng. News, Oct. 22 and 29.	
Nov. 13.	Sewer bonds ($35,000), Cleveland, O	Oct. 22
Nov. 14.	Office building (four stories), Joliet, Ill	Oct. 22
Nov. 14.	Macadam roads, Somerville, N. J	Oct. 22
Nov. 14.	Pumping engines (6), Chicago, Ill	Sept. 24
	Advertised, Eng. News, Sept. 24 to Oct. 22.	
Nov. 14.	Grain elevators, etc. (2), Galveston, Tex	Sept. 24
Nov. 14.	Sewage pumping mach'y, Mexico, Mex	Aug. 27
Nov. 16.	Removing wreck, Norfolk, Va	Oct. 22
	Advertised, Eng. News, Oct. 22 and Nov. 5.	
Nov. 16.	Light station, Portland, Ore	Oct. 29
Nov. 16.	Dam and spillway, Ogden, Utah	Oct. 29
	Advertised, Eng. News, Oct. 29 to Nov. 12.	
Nov. 16.	Gun emplacements, Tybee Island, Ga	Oct. 29
	Advertised, Eng. News, Oct. 29 to Nov. 12.	
Nov. 17.	Heating and ventilating, Newburg, N. Y	Oct. 29
Nov. 17.	Light station, Cleveland, O	Oct. 29
Nov. 17.	Naval supplies, Mare Island, Cal	Oct. 29
Nov. 17.	Water bonds, St. Augustine, Fla	Oct. 29
Nov. 17.	Valves, etc. (66-in.), Brooklyn, N. Y	Oct. 22
Nov. 18.	U. S. building work, St. Paul, Minn	Oct. 22
	Advertised, Eng. News, Oct. 22 and 29.	
Nov. 18.	Hospital building, Cherokee, Ia	Oct. 8
Nov. 18.	School building bonds, Toledo, O	Oct. 29
Nov. 19.	Water-works, St. Augustine, Fla	Oct. 22
	Advertised, Eng. News, Oct. 22 to Nov. 12.	
Nov. 20.	Bridge bonds ($20,000), Cleveland, O	Oct. 29
Nov. 21.	Gun emplacements, Wilmington, N. C	Oct. 29
	Advertised, Eng. News, Oct. 29 to Nov. 19.	
Nov. 23.	Gun emplacements and wharf in Va	Oct. 22
	Advertised, Eng. News, Oct. 22 to Nov. 12.	
Nov. 24.	County jail and residence, Atlanta, Ga	Oct. 1
Nov. 25.	Electric or gas lighting, Lancaster, Pa	Oct. 22
Nov. 28.	Concrete battery, Sandy Hook, N. J	Oct. 29
	Advertised, Eng. News, Oct. 29 to Nov. 19.	
Nov. 28.	Gun emplacements, New London, Conn	Oct. 29
	Advertised, Eng. News, Oct. 29 to Nov. 19.	
Nov. 30.	Breakwater extension, Buffalo, N. Y	Oct. 15
	Advertised, Eng. News, Oct. 15 to Nov. 5.	
Dec. 1.	Franchise, gas and el. lights, Benicia, Cal	Oct. 22
Dec. 9.	Hospital building, Los Angeles, Cal	Oct. 15
Dec. 30.	Steel rails (150,000 tons), Sydney, N.S.W	Aug. 6
	Advertised, Eng. News, Sept. 3 and Oct. 1.	
Jan. 8.	Wooden bridge (220 ft.), Tillamook, Ore	Oct. 8

RAILWAYS.

East of Chicago.

BENTON HARBOR & SOUTHEASTERN.—A press report from Laporte, Ind., says that work has been begun on the construction of the Benton Harbor & Southeastern R. R., which will be built from Benton Harbor, Mich., to Nappanee, Elkhart county, Ind., where connection will be made with a line surveyed to be built to Cincinnati, thus opening direct communication between Cincinnati and Milwaukee via Lake Michigan. The projectors of the two roads, who are reputed to be eastern capitalists, propose to run a line of steamers to carry the freight and passenger traffic to Milwaukee, which will be the terminal point of the water route.

HAMILTON & DUNDAS.—Leather & Watson, of Hamilton, Ont., are said to have been awarded the contract for the material for renewing this line and work will be commenced soon. New 65-lb. rails will be laid on the entire line and steel culverts will take the place of the present structures.

LEHIGH & NEW ENGLAND.—The Deckertown, N. J., "Independent," says that a spur will be built from the main line to Deckertown, a distance of a little over one-half a mile. The line has been surveyed and it is the intention to complete it by Nov. 15.

PERRY, LIVINGSTONE & WYOMING.—This company was incorporated Oct. 27. It is proposed to construct a standard gage steam road about 12½ miles in length from a point on the Silver Lake Ry., in Perry, Wyoming county, N. Y., to a point on the Delaware, Lackawanna & Western R. R., at Greigsville, Livingstone county; capital stock, $125,000; directors, Arthur G. Yates, Frederick W. Yates, George E. Merchant, John F. Dinkey, George H. Clune, George L. Eaton, Robert W. Davis, Rochester; Harry Yates, Buffalo; William D. Page, Perry.

PITTSBURG & BROWNSVILLE.—This company was incorporated in Pennsylvania, Oct. 27, to operate a railway from Brownsville, Fayette county, Pa., to McClellandtown, Fayette county; capital stock, $150,000, commencing with $15,000. Pres., Geo. S. Davidson, Pittsburg, Pa.

Southern.

CAIRO, HOPKINSVILLE & CUMBERLAND GAP.—Hood Tucker, Ch. Engr., Franklin, Ky., writes us that the preliminary surveys of this proposed line have reached Pine Knoll, Ky., on the Cincinnati Southern. It is expected to finish the surveys next month. Estimates and maps are now being prepared, and it is expected to commence work early next spring. The line as now run commences at Cairo, Ill., thence to Mayfield, Hopkinsville, Franklin, Scottsville and Tompkinsville to Jellico and Cumberland Gap, Ky.; running entirely through the oil fields in Southern Kentucky. Length 330 miles.

FLORIDA WESTERN.—R. S. Burnett, Pres., Tallahassee, Fla., writes us that the projected length is 120 miles, touching Apalachicola, Carrabelle, Tallahassee, Centreville and Thomasville. The right of way is mostly obtained; capital secured. Hopkins & Damond were to have begun grading Oct. 20. Bridge building will begin about Jan. 1.

GEO. S. BAXTER.—A company of this name, manufacturer of crossties and other railway material, has been organized at Way Cross, Ga. It is composed of George S. Baxter and Walter Ferguson, of New York; A. H. Morgan, of Way Cross, and E. C. Long, of St. Paul, Minn. The capital stock is $50,000. The company, it is said, owns 55,000 acres of lumber land southeast of Dupont and is building a railway from the nearest point on the Plant system to the main body of timber, a distance of 25 miles.

KENTUCKY MIDLAND.—The Louisville "Journal" states that a representative of an English syndicate has been conducting an investigation of the affairs of the Kentucky Midland R. R. Co. The road is to be sold by order of court on Jan. 4, 1897, and the former upset price of $320,000 has been reduced to $150,000. If it becomes the purchaser, it is the company's intention to extend the road from Frankfort across Franklin county to Alton, where it will tap the Louisville Southern, and from Paris into Bath county, where it may tap the Chesapeake & Ohio.

LOUISVILLE & NASHVILLE.—R. Montfort, Ch. Engr., Louisville, Ky., writes us that he knows nothing of the reported extension to the Florida state line.

LINVILLE RIVER.—A. B. Camp, Vice-Pres. and Gen. Mgr., Montezuma, N. C., writes us that the projected length is 20 miles, touching Cranberry, Horse Creek, Old Fields, Montezuma and Pineola. Surveys are made and part of capital secured. Pres., W. W. Demming, Montezuma, N. C.; Ch. Engr., F. G. Phillips, Knoxville, Tenn.

WESTERN MARYLAND.—C. O. Vandevanter, Ch. Engr., Baltimore, Md., writes us that there is no foundation for the newspaper reports that this company is contemplating an extension.

Northwest.

CHICAGO, MONTELLO & NORTHWESTERN.—A press dispatch from Madison, Wis., states that this company has been incorporated with a capital stock of $2,000,000. The incorporators are James L. Pennifill, Chicago; Clarence E. Pierce, Germanie, Wis.; Elbridge W. Underwood and Samuel W. Stennor, Montello, Wis. The intention of the incorporation is the construction of a railway 120 miles in length through Green Lake, Adams and Juneau counties, Wis.

DULUTH, SUPERIOR & WESTERN.—A press dispatch from Bemidji, Minn., states that surveyors for the Duluth, Superior & Western, the Canadian Pacific's new line, are at work in that vicinity, pushing west from the end of track at Deer River as rapidly as possible. The road will cross the county somewhere between this place and Red Lake. It will pass through the heaviest oak timber in the county and also the best agricultural land of the Red Lake reservation. Another Beltrami county townsite is being located on the east side of Red Lake. A large sawmill will be put up and a steamer built to ply on the Black Duck and Turtle Lake country. The town will be about 16 miles north of Buena Vista.

KANSAS CITY & SOUTHERN.—A press report from Arkansas City, Kan., says that this projected railway between Arkansas City and Beaumont, Kan., has been abandoned. The property of the company will probably be sold within a short time.

MICHIGAN CENTRAL.—It is stated that plans have been prepared for new yards in Chicago. These yards are to be put in at Calumet Park and are to be operated in connection with the Michigan Central, Pennsylvania lines, the Chicago & Calumet Terminal and the Chicago, Hammond & Western. The plans show a series of store, switch and transfer tracks. Close traffic arrangements will be made with the Chicago, Hammond & Western, which circles Chicago. Work on the yards, the complete equipment of which will cost in the neighborhood of $500,000, will begin early next week and will be completed in 60 days. The Elgin, Joliet & Eastern has purchased a large tract of land just across the state line from Hammond, Ind., as noted in our issue of last week, on which to lay out extensive yards for switching and storing cars. The land lies along the right of way of the Western Indiana and extends from the state line to Burnham, Ill. It is rumored that a number of other roads are interested in the deal.

WISCONSIN & MICHIGAN.—The Superior, Wis., "Leader" says that it is now officially announced that the Wisconsin & Michigan Ry. will extend to Iron Mountain and Norway next spring, from Marinette. Track will be laid from the northern terminus of the line at Faithorn Junction. It will require only 15 miles of track to reach the Menomonee range. Ultimately the line will reach Ironwood and Bessemer, passing through Florence.

Southwest.

ATCHAFALAYA RIVER.—The New Orleans, La., "Picayune" states that a survey is being made from Port Allen, in West Baton Rouge parish, through Point Coupee to a point opposite Simmesport, on the Atchafalaya River, a distance of 60 miles. The company was organized by F. M. Welch, of Bunkie, La., and others.

KANSAS CITY, SHREVEPORT & GULF.—It is stated that this company has completed its southern extension to Many, La., a distance of 76 miles from Shreveport. It is preparing a time card, and freight and passenger trains will be started in the course of a few weeks.

ST. LOUIS & OKLAHOMA CITY.—As stated in our issue of last week, this line is surveyed, starting at Sapulpa, Ind. Ter., at the terminus of the St. Louis & San Francisco, extending in a generally southwesterly direction 109.4 miles to Oklahoma City, Okla. Ter., the terminus at the last-named town being beyond the tracks of the Choctaw, Oklahoma & Gulf, and of the Atchison, Topeka & Santa Fe. The line as laid out will require no grade greater than 1%, although at three or four places it will be necessary to do some heavy work in order to keep within this limit. The maximum curvature will be 4°. The first 41 miles from Sapulpa lies in the Creek Nation. Several tributaries of the Canadian River are here crossed, but the bridging is light, the longest span being 125 ft. There will be needed five plate-girder bridges 40 ft. long and trestle approaches. Ch. Engr., M. L. Lynch.

Rocky Mountain and Pacific.

ALUM ROCK.—A press dispatch from San Jose, Cal., says that a party of surveyors under A. T. Herrmann are at work on the extension of the Alum Rock Ry. into Alum Rock Park. The extension will be about three-quarters of a mile in length. The work of construction will commence as soon as the surveying is finished. The cost will be about $10,000.

LAKE PARK.—A press dispatch from Tacoma, Wash., says that Col. William Bailey and associates have completed arrangements for the purchase of the 12 miles of Lake Park Ry. Grading from Lake Park southward was commenced Oct. 13

STREET AND ELECTRIC RAILWAYS.

BANGOR, ME.—It is reported that the Bangor & Winterport Electric R. R. is soon to be built. Gen. Henry L. Mitchell, its chief promoter, is quoted as saying that the material has been ordered. Work will soon begin south of the Hampden line. The city council has passed an order giving the Public Works Co. permission to extend its tracks from its present terminus, about 600 ft. north of the tin bridge, to the Hampden line. The Public Works Co., will, it is understood, at once begin work on the extension. The work upon the Winterport line will be pushed through this fall as far as Stearns' mill if possible. The Bangor & Winterport Co. contemplates the laying out of a public park somewhere along the bank of the river between Bangor and the southern terminus of the road.

PORTLAND, ME.—It is stated that Worster & Wilson will soon begin the work of blasting out the ledge on Stevens Plains Ave. for the extension of the Portland R. R. Co.'s electric line to North Deering.

MANCHESTER, N. H.—The Manchester St. Ry. Co. has been granted permission to extend its lines provided that the extensions are completed before next January.

BURLINGTON, VT.—Mr. Smith, representative from Burlington, has introduced a bill into the Vermont house to incorporate the Burlington & Grand Isle Electric R. R. Co., to build an electric railway from Grand Isle to this city.

BURLINGTON, VT.—The Winooski & Burlington Horse R. R. Co. has petitioned the city council for authority to extend its trolley line to Winooski by way of Winooski Ave. and the river road. When the horse railway was first built the line to Winooski was by this route, but upon the adoption of electricity as motive power this route was abandoned and the track removed.

SPRINGFIELD, VT.—Fred T. Ley & Co., Springfield, Mass., write us that the projected length of the Springfield Electric Ry. is 7½ miles, from Springfield, Vt., to Charlestown, N. H. All grading finished; overhead work will be completed in about four weeks; most of the capital is secured. The General Electric Co., Schenectady, N. Y., has the contract for generators and motors; for cars, Jackson & Sharp Co., Wilmington, Del.; for power plant, W. H. H. Slack, Springfield, Vt.; track and overhead work, Fred T. Ley & Co. Pres., A. Brown; Ch. Engr., V. K. Nash.

BEVERLY, MASS.—The board of aldermen has granted the Lynn & Boston R. R. permission to equip the Cove branch with electricity.

BOSTON, MASS.—The Wellesley & Boston St. Ry. Co., it is stated, has been granted permission to build an electric railway.

BRIMFIELD, MASS.—N. S. Hubbard writes us that only the preliminary steps have been taken for a railway between Brimfield and Palmer. No survey has yet been made and no franchises yet secured.

HOLYOKE, MASS.—It is stated that a new electric railway company may be formed to build a line between Willimansett and Fairview. The line would be about three miles long, and the plans include a bridge at the Boston & Maine R. R. tracks at Willimansett and a power station in that village. C. C. Abbey, Chicopee, Mass., is said to be interested.

IPSWICH, MASS.—It is stated that the directors of the Georgetown, Rowley & Ipswich Electric Ry. met recently to talk over plans for this new line. The company's attorney is quoted as saying that work will be commenced on the road early next spring. The route will undoubtedly be the straight one through Rowley to Ipswich, over the regular road. This will make Ipswich the center of the main line from Haverhill to Gloucester.

SPRINGFIELD, MASS. — A report states that active steps will soon be taken toward an electric railway connection between this city and Westfield. The road is now under construction as far as Tatham hill in West Springfield and it would not take long to continue it to Westfield. The distance is about five miles.

NEW HAVEN, CONN.—Work is said to have commenced on the extension of the Congress Ave. branch of the Winchester Ave. road.

ALBANY, N. Y.—The Oneonta St. R. R. Co. has purchased the building formerly occupied by the Oneonta Mineral Paint Co. on Mechanic St., which will as soon as plans can be completed be converted into a car house and power station.

BROOKLYN, N. Y.—It is stated that President Baldwin, of the Long Island R. R., is considering the advisability of using electricity as a motive power. If the system is adopted there will be frequent trains over the line, and fares may be reduced.

BUFFALO, N. Y.—The Tonawanda Electric Ry. contemplates building extensions of its lines to this city and to Niagara Falls, a total distance of about 18 miles.

NEW YORK, N. Y.—The Third Ave. R. R. Co. has asked for permission to operate a trolley road in Broadway, from 162d St. to Spuyten Duyvil Creek.

OLEAN, N. Y.—An electric road, it is reported, is to be built between Olean and Bradford, Pa., at an estimated cost of $100,000.

PORT CHESTER, N. Y.—A press report states that the trustees of the village announce that they are ready to grant a franchise for an electric railway, providing a first-class system can be procured. The street railway company has agreed to a clause precluding the use of horse or steam power, and expresses its willingness to adopt any practicable motive power that may be selected by the trustees.

SAUGERTIES, N. Y.—The committee on the proposed electric railway from Palenville to the Long Dock met at the court room in the Russell block last week to discuss the matter. It was reported that the road had been surveyed, and a number of consents obtained. The meeting adjourned until Nov. 5.

WHITE PLAINS, N. Y.—R. E. Slade, Secy., writes us that the New York, Elmsford & White Plains Ry. Co. is projecting an extension of 4½ miles from Elmsford to Tarrytown. Surveys are completed, capital obtained and contracts will be let soon.

ATLANTIC HIGHLANDS, N. J.—The Atlantic Highlands, Red Bank & Long Branch Electric Ry. Co. is asking for a right of way from Eatontown through Oakhurst, Elberon and Deal Beach to Asbury Park.

BOUND BROOK, N. J.—Plans and surveys are said to have been made for an electric railway between Bound Brook and Trenton, N. J., contracts for which are soon to be let.

TRENTON, N. J.—It is stated that a trolley line will be put in operation from Willow Grove, Pa., to Trenton. The company will be known as the East Penn Traction Co. A. D. Cadwallader, of Yardley, Pa., is president, and David Hanley Stone, of this city, the secretary. Surveys have been made, and the company will endeavor to have cars running before Jan. 1, 1897.

ALTOONA, PA.—It is said that the Altoona & Logan Valley Electric R. R. will soon be sold by the sheriff of Blair county. The road was chartered in 1892 with an authorized capital stock of $500,000. The line is over 16 miles in length. The per cent. of operating expenses to total receipts for the 6½ months ending Dec. 31, 1893, was 39, for the year ending Dec. 31, 1894, was 45, and for 1895, was 49.

QUAKERTOWN, PA. — The Richlandtown Turnpike Co. is said to have leased the turnpike to C. Taylor Leland, of Philadelphia, for a trolley road. The promoters of the trolley road propose to lease the turnpike for 10% a year on the capital stock of the turnpike company, which is $5,000. The borough council of Quakertown has granted the trolley company a right of way in the streets of the town.

MINERSVILLE, PA.—The Minersville town council has annulled the franchises of the Schuylkill Electric Ry. Co., granted about 18 months ago. The company has failed to extend its line through Hickscherville Valley, as agreed to by the franchise.

MOUNT CARMEL, PA.—It is stated that the Shamokin-Mount Carmel Electric Ry. will soon extend a branch of its road to Ashland from Centralia. Another company has the right of way but it is thought the local corporation can secure these rights.

WASHINGTON, D. C.—It is rumored that the Eckington & Soldiers' Home and Belt Ry. Co.'s may adopt the overhead trolley if permission can be secured.

WASHINGTON, D. C.—Plans are now under consideration, it is reported, by the officials of the Great Falls Electric R. R. to build a double line of tracks from Georgetown as far as the District line. The work, it is stated, will shortly be begun; the construction may be started next month, and rapidly pushed through. The road has a number of sidings laid part of this distance, the aggregate of which is quite large, and which assist materially in the construction of another track.——The Glen Echo R. R. is also keeping up its work, and extending its terminals. The eastern end has been extended as far as Chevy Chase circle, the work being nearly completed. At the western terminal tracks have now been laid across the Conduit road, and are nearly ready to be connected with the main line of the Great Falls Electric R. R., which, from the point of the proposed junction to Cabin John bridge, is a double track.

BALTIMORE, MD.—It is stated that contract for constructing the extensions to be made by the Central Ry. Co. in East Baltimore has been awarded to David E. Evans & Co. Work is to be commenced at once. The feed-wires of the line will be placed underground in conduits. About six miles of double track will be built.

RICHMOND, VA.—The board of aldermen is said to have granted the Richmond Traction Co. permission to extend its Broad St. line to Hollywood.

CHARLESTON, S. C. — E. S. Jarrell and Chas. H. Draus, of New York, and J. B. Chastain and J. L. Lawrence, of Baltimore, were in Charleston last week in consultation with local street railway men concerning the proposed extensions to the trolley lines of the city. It is said that several miles of additional track will be laid and new rolling stock bought later on.

COLUMBIA, S. C.—The Columbia Street Electric Ry. Co. will make a considerable extension to its lines, and last week obtained a permit from the board of aldermen for that purpose. It is stated that additional rolling stock is also to be purchased soon.

FAIRPORT, O.—Citizens of this place, it is said, are trying to secure an extension of the Cleveland, Zanesville & Eastern Electric Ry. to this city. It is understood that a financial proposition will be submitted to the company.

NEWARK, O.—A petition has been filed asking for the appointment of a receiver for the Newark & Granville Electric St. Ry. Co. The company operates 13 miles of road, with a capital stock of $100,000, $73,000 of which has been issued.

TOLEDO, O.—The Traction Co. is said to have plans ready for extensive improvements.

DETROIT, MICH.—Work on the new electric line between the easterly and westerly limits of Springwells on Michigan Ave. has been suspended by the Detroit Ry. With the exception of paving between the tracks and the securing of the trolley wire the road is ready for traffic.

GRAND RAPIDS, MICH.—The Valley City Street & Cable Ry. Co. has been granted permission to construct a street railway.

CHICAGO, ILL.—The Chicago City Ry. Co. has been granted permission to lower its tracks 10 ins. below their present level under the Archer Ave. subway. The surface of the street must also be lowered and repaved.

CHICAGO, ILL.—A decision of the appellate court has left the Union Loop Elevated Ry. Co. free from any litigation which will prevent building in Van Buren St. The company now has nearly all the iron ordered, and a considerable portion of this is now ready for shipment. It is the intention of the company to begin the erection of iron the first week in November. Unless there are delays the Van Buren St. side of the loop will be completed so trains will begin running by Feb. 1. The Wabash Ave. side is now almost ready for the running of trains. All the ties are in place, the rails are laid, and a locomotive has been run over the road to carry the cables which are to serve as feeders for the third rail which furnishes power. The Metropolitan Elevated will begin the work of constructing its connection with the Union Loop at once. This will branch off from the present line at Franklin St., running south one-half block to Van Buren St., and east on Van Buren St. to a connection with the loop. The portion of the Van Buren St. line from Franklin St. to Halsted will not be built at once. One thing which may prevent the completion of the south side of the loop by Feb. 1 will be the stations. The iron for the three stations is not yet ordered, and after it is ordered it will take some time to complete it ready for erection.——The Chicago General Electric Co., which has franchises for constructing electric lines in the southern part of the city, will be enabled to prosecute its work. The injunction proceedings against the corporation have been denied. It is stated that the General Electric people are organizing their company in New York. The organization is expected to be effected some time this week, and considerable construction work may be done between now and March.

ST. LOUIS, MO.—A press report states that preparations will be made this fall for extending the Scullin system of street railways to Ferguson, Mo., and probably to the Chain of Rocks. All the suburban districts have street car facilities with the exception of the above-named suburb and the rails will be laid before the spring.

SEDALIA, MO.—It is stated that Edward Wood, of Chicago, who is interested in the Joplin-Webb City Electric Ry., is interested in a similar line from Sedalia to Monett. in Lawrence county, via Windsor, Clinton, Stockton, Greenfield and Mount Vernon. He will put the surveying corps in the field at once and complete the survey early in November. Mr. Wood is said to be backed by New York, Chicago and Boston capitalists.

JUNCTION CITY, KAN.—It is stated that an electric line will be built from Junction City to Fort Riley, at a cost of about $30,000.

NEW ORLEANS, LA.—It is reported that the Traction Co. will build a power plant to cost between $400,000 and $500,000. R. M. Wamsley, Pres.

CRIPPLE CREEK, COLO.—The work of construction on the Cripple Creek electric railway is reported to have been commenced. The main line will touch Victor, Gillett and Cripple Creek. Hills & Sharp are interested.

DENVER, COLO.—Judge Hallett has issued an order on petition of Frank Trumbull, receiver of the Denver & South Park Ry., permitting the South Park road to assist in the construction of the Denver, South Park & Hill Top Ry., from Fairplay to the Hill Top mines, by the use of second-hand rails and fastenings, and also allowing the South Park road to enter into a traffic agreement with the new road to furnish the rolling stock.

LOS ANGELES, CAL.—An ordinance has been adopted by the council granting to J. W. Hinton the right to construct and operate an electric street railway in the city of Los Angeles.

MIDDLETOWN, CAL.—Col. O. E. Moore, Mgr. Clear Lake Electric Co., with Dr. Wylie, Mr. Raymond, and Mr. Wallace, are stated to be on their way to Lower Lake in the interest of the proposed electric railway from that place to Napa.

MODESTO, CAL.—F. T. Knewing, J. W. Woodside and J. W. Dunlap, of Oakdale, have petitioned the supervisors for a franchise from Oakdale to the Tuolumne county line for an electric railway to Sonora.

REDLANDS, CAL.—It is reported that A. H. Smiley has ordered a preliminary survey for an electric railway to Fregolda Park. It is proposed to make it a mountain road, and Engineer McPherson, who built the Mount Lowry R. R., is at present making the survey. A portion of the power for this road is to be obtained from the canyon along the route and the remainder will be taken from the Redlands plant.

NIAGARA FALLS, ONT.—It is stated that the Niagara Falls Park & River Electric Ry. will be extended from Chippewa to Fort Erie, and from Queenstown to Niagara-on-the-Lake. The company may also develop and sell power.

LIVERPOOL, N. S.—An electric railway may soon be built from Liverpool to the pulp mill at Milton, to connect the mills with the seaport.

ELECTRIC LIGHT AND POWER.

GARDINER, ME.—The council has appointed a committee to employ an electrical engineer to prepare plans, specifications, etc., for a new electric light plant; and also to advertise for bids for lighting the city by private companies. The committee is to report before the meeting in December. The committee consists of Alderman Willey, Councilmen Foster and McCausland.

PAWTUCKET, R. I.—The electric light committee has postponed action in regard to the proposed city plant until after the municipal election. L. G. Ladd, Comr. Pub. Wks.

ITHACA, N. Y.—It is stated that the Elmira Electric Co. is considering the question of erecting a separate incandescent light plant on East State St. It is now furnishing about 6,000 incandescent lights.

JAMAICA, N. Y.—The Jamaica Electric Light Co. has purchased a plot of land adjoining the railway near Van Wyck Ave., on which it is proposed to erect an additional plant; estimated cost, $15,000.

JAMAICA (L. I.), N. Y.—The Jamaica Electric Light Co. has increased its capital stock from $20,000 to $200,000.

NEW BRIGHTON (S. I.), N. Y.—The village trustees have been petitioned by a new electric light and power company for a franchise in this place and West Brighton. Supervisor Doyle and John J. Kennedy are interested.

JERSEY CITY, N. J.—Bids are asked until Nov. 2 for lighting the streets with electricity, gas or oil for one, three or five years. The minimum number of lights that will be required is 900 arc, 100 gas, with Welsbach lamps, and 700 oil lights. This year there are 782 electric lights, 1,000 oil lamps and 550 gas lamps. Next year there will be from 900 to 1,000 electric lights, 700 oil lamps, 300 gas lamps, and there will be introduced a new feature—100 Welsbach lights. The board has $13,800 more to spend for lights next year than it has this year. Ferdinand Heintze, Chn. Com. Municipal Lighting; Geo. T. Bouton, Clk. Bd. St. and Water Comrs.

NEWARK, N. J.—The market committee, composed of Aldermen Virtue, Schreihofer and Waldron, are considering the question of erecting an electric light plant for the use of the market.

SEA ISLE CITY, N. J.—The residents of this city are agitating the question of better lights. It is said that the local electric light company, which is paid $2,500 a year for supplying lights, is giving unsatisfactory service.

FOREST CITY, PA.—The Forest City Electric Light & Power Co. has been granted a franchise for constructing a plant and for furnishing the city with 12 arc lights. Work will be begun at once, according to reports. Pres., A. R. Raub, Scranton, Pa.; Treas., W. D. Boyer, Scranton; Secy., A. D. Kehrens, Forest City.

PHILADELPHIA, PA.—An ordinance will probably soon be introduced in the councils to advertise for bids for electric lighting in time to allow free field for competition. ——The citizens' municipal association has petitioned the councils to appropriate $500,000 for a city electric light plant. Jacob J. Seeds, Chn. Com.

PITTSBURG, PA.—It is reported that new bids will be asked for an electric light plant of 200 HP. capacity for the public safety building; estimated cost, about $12,000. J. O. Brown, Dir. Pub. Safety.

WASHINGTON, N. C.—It is reported that plans are being prepared by Thomas & Hunter, of Richmond, Va., for an electric light plant for this place. Bids will probably soon be asked.

PAOLA, FLA.—Press reports state that bids are being asked for the construction of a 2-story brick building for the electric light plant, plans for which were prepared by the Royal Electric Co., Peoria, Ill. R. G. Blake, Cy. Clk.

BARNESVILLE, GA.—It is reported that this place will issue in a short time $7,000 in bonds for an electric light plant and $8,000 for a new school building.

CINCINNATI, O.—Local papers state that a new electric light plant will be erected in this city for the Edison company.

BAY CITY, MICH.—The electric light commissioners have directed the secretary to advertise for bids for a new boiler and engine for the power station and for furnishing three new arc lights for the city hall. Wm. Keith, Comptroller.

BIG RAPIDS, MICH.—Bids are asked until Nov. 6 (postponement from Oct. 19) for lighting this city with at least 50 arc lights for one, three, five or ten years. J. W. Morton, Cy. Clk.

MARLETTE, MICH.—An election will be held Nov. 9 to vote on the question of issuing $4,000 in bonds for an electric light plant, according to reports.

STORM LAKE, IA.—It is stated that a fire at this place recently destroyed the electric light plant, causing a loss of about $5,000. E. E. Mack and E. C. Cowles are interested.

ST. PAUL, MINN.—The council has granted a franchise for an electric light and power plant in Wards Nos. 10 and 11, to Brooks Bros., St. Paul.

MILES CITY, MONT.—It is reported that Supt. Hayden of the electric light plant will probably soon purchase a 1,500-light dynamo and other machinery for the additions to the plant.

MEXICO, MEX.—It is stated that a Boston syndicate proposes to furnish this city with electric power to be secured about nine miles from the city. Robt. Gayul, Cy. Engr.

BALLARD, WASH.—Mr. Olson, an electrical engineer, and Falcon Joslyn, of Seattle, Wash., have applied to the council for a franchise for an electric light plant, according to reports.——The council proposes to erect a plant of its own.

ANAHEIM, CAL.—The committee is considering the propositions of electrical engineers for preparing plans for an electric light plant, according to reports.

AUBURN, CAL.—Bids are asked until Dec. 19 for furnishing and placing the fixtures and electric wiring the county court house, jail and hall of records; deposit, $1,500. Wm. I. May, Clk.

OGDEN, UTAH.—Bids are asked until Nov. 16 for constructing a masonry dam and spillway, about 400 ft. long and 60 ft. high, as described in our advertising columns; bond, $50,000. C. K. Bannister, Ch. Engr. Pioneer Electric Power Co., Ogden.

RAT PORTAGE, ONT.—Press reports state as follows: The Keewatin Power Co. is preparing to utilize the water power at its dam at Keewatin by making a contract for the transmission of at least 5,000 HP. 120 miles to Winnipeg, Man. It has for some time been investigating the possibility of making this transmission, which has resulted favorably, and the company is now prepared to enter into a contract with a construction company. The right of way has already been partly secured.

RENFREW, ONT.—The electric light companies of this city have been consolidated, and it is reported will erect a new power plant at once to supply over 500 HP. Mackay & Guest and A. A. Wright & Co. are interested.

NEW COMPANIES.—Beacon Electric Co., Chester, Pa.; $120,000, with $12,000 paid in; Treas., J. Engle Cochran, Jr., Chester.

West Side Electric Co., New York, N. Y.; $25,000; to light the west side from 49th to 125th St.; subways are now being built; William A. Mitchell, of Brooklyn; Egbert C. Simonson, 146 Broadway; and Charles V. E. Gallup, New York city.

Beatrice Heat, Light & Power Co., Beatrice, Neb.

Grindley Electric Light & Power Co., Grindley, Cal.; $3,000, with $2,110 paid in; L. K. Vaughan, R. A. Norman, Wm. Moore, C. H. Brown, Grindley.

New York Lighting Co., Camden, N. J.; $10,000, with $1,000 paid in; to supply light, power, heat, etc.; John S. Parker, Geo. W. Mark, 27 Pine St., New York, N. Y.; Clifford W. Perkins, Orange, N. J.

Sunapee Electric Light & Power Co., Sunapee, N. H.; $4,000.

BRIDGES.

WOONSOCKET, R. I.—Bids are asked until Nov 5 for constructing a steel bridge over the Blackstone River at River St., as stated in our advertising columns. Jos. J. McGee, Chn. Com.; Frank H. Mills, Cy. Engr.

BLACKSTONE, MASS.—The question of widening and altering the bridge over the New York & New England R. R. is being considered by the selectmen and the railway officials; estimated cost, $20,000.

YARMOUTH, MASS.—Bids are asked until Oct. 31 for building a bridge in this town. The work will include 200 cu. yds. of rubble masonry; 150 lin. ft. of railing, 3,213 ft. B. M. pine and spruce, etc. Chas. Mills, Engr., 4 Mount Vernon St., Boston, Mass.

WOONSOCKET, R. I.—T. W. Reilly, of Providence, R. I., has been awarded the contract for the masonry work for the River St. bridge at $6,000. The other bidders were Ross & Fowler, F. L. Allen and J. H. Leavitt.

HARTFORD, CONN.—James J. Goodwin, Asylum Ave. and Woodland St., has been awarded the contract for constructing a masonry bridge over Park River at Asylum Ave., at about $10,000.

BINGHAMTON, N. Y.—We are informed that nothing has been done regarding the Ferry St. bridge, which is estimated to cost about $50,000. Nothing is likely to be done until next spring. S. E. Monroe, Cy. Engr.

NEW YORK, N. Y.—The new East River Bridge Commission on Oct. 21 awarded the contract for building the New York tower of the bridge, as advertised in Engineering News, to Patrick H. Flynn, of Brooklyn, at $383,150. The facings of the tower are to be of granite and the backings of limestone. Mr. Flynn was the lowest of 12 bidders, his bid being $426,150 for all granite and $383,150 for granite and limestone. The itemized bids were published in our issue of Oct. 15.

SYRACUSE, N. Y.—The bids received last week for the steel girder bridge over Onondaga Creek at Cortland Ave. have been rejected, and new bids will be asked for at once; estimated cost, $10,000. R. R. Stuart, Cy. Engr.

WATERTOWN, N. Y.—It is reported that a new bridge is to be built soon at Mill St., to take the place of the one which recently was partly destroyed. C. O. McComb, Cy. Engr.

PITTSBURG, PA.—Bids are asked until Oct. 31 for filling approaches to four county bridges. James A. Grier, County Controller, Pittsburg.——Plans for a bridge over Spruce Creek at Ben Avon, Pa., have been prepared by Gustave Kaufman, 813 Hamilton Bldg., Pittsburg. The length will be 520 ft., roadway 18½ ft. and sidewalks 8 ft.

RIVERTON, MD.—It is stated that the Wrought Iron Bridge Co., of Canton, O., has been awarded the contract for replacing a span of the bridge over the North River at this place at $2,100.

BAYARD, W. VA.—The county court, it is stated, has appropriated $1,000 to aid in the construction of a steel bridge over the Potomac River at this place, which is estimated to cost $2,000, the other half of which will be paid by the town.

SUTTON, W. VA.—Bids are asked by the county court for erecting a 53-ft. iron bridge over Granny's Creek, according to reports.

AMERICUS, GA.—The construction of a bridge over the railway tracks at Lee St. is being considered by the council and the Georgia & Alabama R. R. Co.

COLUMBIA, MISS.—It is reported that bids will probably be asked in December for building an iron bridge over Pearl River in Marion county, plans for which will be submitted about Nov. 2. Engr., Maj. Belton Mickles, West Point, Miss.; C. J. Meyson, County Clk., Columbia.

CLEVELAND, O.—Bids are asked until Nov. 20 for the purchase of $20,000 of 4% bridge bonds. H. L. Rossiter, Cy. Audr.

CLEVELAND, O.—Bids are asked until Nov. 6 for furnishing and delivering for the Kingsbury viaduct about 67,000 ft. of planking. D. E. Wright, Dir. Pub. Wks.

CINCINNATI, O.—Frank S. Krug, County Engr., Cincinnati, has been instructed to prepare plans at once for building an iron bridge over the Baltimore & Ohio Southwestern Ry. Co.'s tracks at Norwood.

GREEN BAY, WIS.—It is reported that the council is considering an ordinance authorizing the issue of $12,000 in bonds for rebuilding the draw in the bridge at Main St.

MENASHA WIS.—We are informed that this city has just awarded the contract for an iron and steel bridge with stone substructure to the Chicago Iron & Bridge Co., at about $15,000. The structure will be 633 ft. long, with an 18-ft. roadway and two 7-ft. sidewalks. W. W. Reed, Cy. Engr.

WAUSAU, WIS.—C. W. Nutter, Cy. Engr., on Sept. 7, was directed by the council to prepare plans for a steel and iron bridge. The plans were submitted Oct. 5, but action on the same was postponed until Nov. 2. The plans call for a 4-span bridge of 125 ft. each, and 100 ft. of iron trestle approach, a 14-ft. roadway and 6-ft. sidewalks. Iron cylinder piers 4 ft. in diameter and 5-16-in. metal are to be used for the foundation.

INDIANAPOLIS, IND.—Bids are asked by the board of public works until Nov. 4 for painting the bridge over Fall Creek at Floral Ave.; also for the Virginia Ave. viaduct, etc.——The contract for steel girders under bridge across canal at East West St. has been awarded to the Haugh-Noalke Iron Works at $693.

INDIANAPOLIS, IND.—The following bids were received by the board of public works Oct. 17 for constructing a plate girder bridge over Pleasant Run at Beecher St.:

Shiffler Bridge Co., Pittsburg, Pa.	$2,873
Bellefontaine Bridge Co., Bellefontaine, O.	2,820
Variety Iron Works, Cleveland, O.	2,714
Peter Fritz	2,673
Massillon Bridge Co., Massillon, O.	2,652
American Bridge Works, Chicago, Ill.	2,577
Lafayette Bridge Co, Lafayette, Ind.	2,490
Toledo Bridge Co., Toledo, O.	2,484
Chicago Bridge & Iron Co., Chicago, Ill.	2,449
Wrought Iron Bridge Co., Canton, O.	2,350
Wisconsin Bridge & Iron Co., Milwaukee	2,350

KNOXVILLE, IA.—Bids are asked until Nov. 11 for constructing an iron bridge over the Des Moines River at Red Rock, Ia., bidders to furnish plans. A. A. Davis, Chn. Bd. Supervisors; H. Shivvers, Audr., Knoxville.

MASON CITY, IA.—N. M. Stark & Co., of Des Moines, have the contract for remodeling the Main St. bridge. The old structure was 120 ft. long, with an 18-ft. roadway and two 6-ft. walks. When rebuilt it will have a motor roadway 12 ft. wide, two highways 18 ft., and two 6-ft. 6-in. walks; two new trusses will be added. New trusses designed for an equivalent load of 2,000 lbs. per ft.

LE MARS, IA.—Goodrich & Robson, of Sioux City, Ia., are reported to have been awarded the contract for constructing two bridges over the Big Sioux River, between Union county, S. Dak., and Plymouth county, Ia., at $1,725.

DULUTH, MINN.—Bids are asked until Oct. 31 for constructing a pile and timber approach to the Duluth-Superior Bridge at Spruce St., according to reports; check, $700. R. Murchison, Clk. Bd. Pub. Wks.

PLATTSMOUTH, NEB.—The citizens of Eight Mile Grove precinct are to vote on the question of building a bridge over the Platte River at Cedar Creek; estimated cost, $8,000.

GRAFTON, N. DAK.—It is stated that the county commissioners have ordered the construction of a 54-ft. wooden and iron bridge over Park River.

GLENWOOD SPRINGS, COLO.—It is reported that the county commissioners are considering the question of building a new bridge over the Grand River, at Rodericks Ferry.

ST. LOUIS, MO.—M. L. Lynch, Ch. Engr., St. Louis & Oklahoma City Ry. Co., has submitted a report to the directors on the construction of the proposed railway to Sapulpa, Ind. Ter., and Oklahoma City, Okla. Ter. It is stated that five plate girder bridges, each 40 ft. long, will be needed, two of 50 ft. each and one of 125 ft.

MODESTO, CAL.—Bids, plans, etc., are asked by the county clerk until Nov. 10 for a bridge over Puerto Creek, according to reports.——The supervisors are considering the question of a bridge over the Stanislaus River at Burneyville.

SACRAMENTO, CAL.—The supervisors have rejected the bids for constructing a steel bridge at Mormon Island; estimated cost, $5,500. New bids have been called for. Engr., G. A. Stoddard; W. B. Hamilton, Clk. Bd. Supervisors.

BUILDINGS.

BOSTON, MASS.—The state armory commissioners are discussing the question of appropriating $120,000 for making improvements to the armory building of the Ninth Infantry.

BOSTON, MASS.—Bids are asked until Nov. 2 for erecting a brick school building at Chambers and Poplar Sts. J. L. Faxon, Arch., 7 Exchange Place; Edward H. Dunn, Chn. Com. on Schoolhouses.

PROVIDENCE, R. I.—Bids are asked until Nov. 6 for constructing the retaining walls and steps and for the plumbing for the state normal school; check, $500; Archs., Martin & Hall, 502 Industrial Trust Co. Bldg., Providence; Thos. B. Stockwell, Secy.

NEW LONDON, CONN.—Press reports state that Frank A. Munsey, the publisher of Munsey's Magazine, has decided to erect a new 5-story brick building on State St. Arch., Wm. B. Tuthill, United Charities Bldg., New York.

BUFFALO, N. Y.—The following were the lowest bids received for work at the state hospital by the board of managers: Heating and ventilating, Edward P. Bates & Co., Buffalo, $32,500; plumbing and sewerage, Edward Joy, Syracuse, N. Y., $28,180; boiler house, laundry and chimney stack, Mosier & Fitzpatrick, Buffalo, $26,740. The contracts were awarded to the above bidders.——The following bids were received Oct. 24 for the foundation for the new armory for the 74th Regiment: Joseph A. Churchyard, $40,969; Henry Rumhill & Co., $56,027; Brown & Stable, $31,447; F. W. Carter, $36,100; Charles Mosher, $70,400; James Stewart, $40,516; W. R. Haven, $49,000; Henry Shaffer's Sons, $33,504; John F. Berrick, $33,224; George W. Flynn, $30,994. All of the bidders are from Buffalo. The last legislature appropriated $25,000 to commence the construction of the building, which is estimated to cost $400,000. The county has agreed to pay that portion of the bids which may be for excavating estimated at one-third. The structure will be 530 × 240 ft., as stated in our issue of Oct. 15. I. G. Perry, State Arch., Binghamton and Albany, N. Y.; Maj. H. P. Stackpole, Secy. State Armory Comn., Albany.

BUFFALO, N. Y.—Green & Wicks, 110 Franklin St., have been directed to prepare plans for a church for the Parkside Unitarian Congregation.

MOUNT VERNON, N. Y.—At the election Nov. 3, the question of issuing $200,000 in bonds for a new city hall will be voted upon. T. E. Fletcher, Alderman, and H. T. Jennings are interested.

NEW BRIGHTON, N. Y.—An election will be held Nov. 10 to vote on the question of issuing $75,000 in bonds for erecting a new school building.

NEWBURG, N. Y.—Bids are asked until Nov. 17 for furnishing a low pressure return circulation steam heating and ventilating apparatus. Wm. Martin Aiken, Supervising Arch., Washington, D. C.

NEW YORK, N. Y.—Bids are asked until Nov. 5 for additional work for the building to be erected in Crotona Park, near Third Ave. Arch., G. B. Post, 33 East 17th St.

Wm. L. Strong, Mayor; and until Nov. 5 for altering the alcoholic ward building, Bellevue hospital. S. C. Croft, Pres. Dept. Pub. Charities, 66 Third Ave.——It is reported that Henry Clews, Broad St., proposes to erect a 10-story office building at 9 West 34th St.——The Standard Structural Co., 7 Broadway, has been awarded the general contract for erecting the 16-story building, at 32 and 34 Broadway, for the Hudson Building Co.; Pres., A. W. Cruikshank, 176 Broadway, New York; Arch., A. F. Leicht, 97 Cedar St.; Engrs., H. W. Hodge and W. H. Burr, 71 Broadway. R. P. Bolton, 35 Nassau St., is the engineer for the heating, plumbing, elevators, etc.——It is reported that F. H. Mela, 13 Astor Place, will probably erect an 11-story building, at 830 Broadway, next year. ——The board of estimate has voted to appropriate about $500,000 for the proposed additions to the American Museum of Natural History. E. E. McLean, Engr. Park Dept.——Plans have been filed by Chas. F. Rogers, 305 West 55th St., for two 5-story brick flats, to cost $130,000.

NEW YORK, N. Y.—Press reports state that plans to enlarge the Tombs prison in New York were to be approved by the state prison commission at Albany Oct. 28. There has been much complaint of overcrowding in the Tombs, sometimes three and four persons being placed in a cell. It is proposed to rebuild the Tombs by doubling its height and in other ways to provide for 320 additional cells at a cost of $500,000. Archs., Withers & Dickson, 54 Bible House, New York.——Warden Pillsbury, of the Blackwell's Island Penitentiary, appeared before the commission Oct. 27 with George M. Walgrove, Arch., 42 East 23d St., New York. They had plans for improvements on Blackwell's Island which contemplate a separate prison, with 112 cells, for women, and an addition to the present penitentiary building so as to provide 416 more cells, at an expense of $5,000,000. These expenditures were authorized by the legislature.——Plans have been filed by the Market and Fulton National Banking Co., 81 and 83 Fulton St., for alterations to its 7-story office building, at Fulton and Gold Sts., to cost $150,000.

NIAGARA FALLS, N. Y.—Arrangements are being made by Mayor Schoellkopf, W. Caryl Ely, W. B. Rankine and J. C. Morgan for the erection of a large convention hall in this city, in which it is proposed to hold an electrical convention and exhibition of machinery.——The same men are reported as interested in a projected hotel.

PRINCETON, N. J.—It is reported that estimates will be received until about Nov. 3 for constructing a new brick hall and dormitory for the University. The structure will be a 3-story building 710 ft. long. Archs., Cope & Stewardson, 520 Walnut St., Philadelphia, Pa.

TRENTON, N. J.—On Oct. 18 the corner stone of the new Catholic Orphanage at Hopedale was laid. A machine shop, carpenter shop and other mechanical departments are to be connected with the orphanage; estimated cost, $100,000. Bishop McFaul, Trenton, can be addressed.

ALLEGHENY, PA.—The following bids were received Oct. 20 for placing a low pressure return circulation steam heating and ventilating apparatus in the public building; Wm. Martin Aiken, Supervising Arch., Washington, D. C.:

		Time days.
Thompson & Washburn, Detroit, Mich.	$3,959	70
Blake & Williams, 186 South 5th Ave, N. Y.	4,444	70
Iron City Heating Co., Pittsburg	4,100	60
E. Rutzler, 178 Centre St., New York	4,800	60
Maginn & Lewis, Pittsburg	4,645	60
Ellicott Machine Co., Baltimore, Md.	4,880	60
Bayley Heating Co., Milwaukee, Wis.	3,814	70
Shook-Anderson Mfg Co., Pittsburg	4,703	70
Samuel I. Pope & Co., Chicago, Ill.	3,879	70
Chafer & Becker, Cleveland, O.	4,369	60
McGunnis-Smith Co., 93 Water St., Pittsburg.	3,684	60
Pittsburg Heating Supply Co., Pittsburg	3,273	60
John T. Bealor & Co., Ellenton, Pa.	4,250	45

HIGHLANDS, PA.—A second election is about to be held to vote again on the question of issuing $100,000 in bonds for a court house.

PHILADELPHIA, PA.—Local papers state that Henry G. Freeman, Jr., will begin the construction in about 80 days of a 16-story office building at Chestnut and Broad Sts.; estimated cost, $500,000.——Arrangements are being made by a syndicate for the purchase of the property at Broad and Chambers Sts. from the Chambers Presbyterian Church. The syndicate proposes to erect a 13-story office building on its site. Arch., Joseph M. Houston, 604 Provident Bldg., Philadelphia.——F. M. Day & Bro., Archs., 927 Chestnut St., have awarded the contract for constructing an office, store and factory building at 1420 Chestnut St., for the American Baptist Publishing Co., to Geo. F. Payne & Bro., 401 South Juniper St., to cost about $400,000.

PHILADELPHIA, PA.—Plans are about completed for the new mint building in this city. The structure will be three stories high and 300 × 170 ft.; estimated cost, $6,650,000. It is probable bids will be asked in a short time. W. M. Aiken, Supervising Arch., Washington, D. C.; Herman Kretz, Supt. Mint, Philadelphia.——It is reported that plans are being prepared for a new building at 11th and Filbert Sts. for the Bell Telephone Co.

PITTSBURG, PA.—Local papers state that E. M. Bigelow, Dir. Pub. Wks., has been directed by the council to prepare plans for adding two new stories to the city hall. It will take about two years to complete this work.

PITTSBURG, PA.—Building permits have been issued to J. C. Patch for a warehouse on Second Ave., to cost $26,000; to Jacob Friday, for dwellings on Stratford Ave., $6,500.——E. J. Carlisle & Co., 605 Smithfield St., have prepared plans for a school building at Duquesne to cost $20,000, and at Wall, to cost $13,000.——Bartberger & East, Westinghouse Bldg., are making plans for a hotel at Zelieuople to cost $20,000.——W. H. Sims, 502 Penn Bldg., is preparing plans for a dwelling on North Wegley Ave., to cost $20,000.

WASHINGTON, D. C.—Bids are asked by the district commissioners until Nov. 2 for constructing an 8-room school building at 5th and K Sts.

WASHINGTON, D. C.—The corner stone of the Hall of History was laid Oct. 21. The building is to be 170 × 70 ft. and is estimated to cost $200,000. Archs., W. M. Poindexter, 806 17th St., N. W., Washington, and Van Brunt & Howe, 1214a Main St., Kansas City, Mo.; John E. Andrews, Pres. Bd. Trustees, Washington.

JACKSONVILLE, FLA.—The Knoxville Building & Construction Co., Jacksonville, has been awarded the contract, at $63,550, for erecting the Gardner building on Bay St., between Main and Laura Sts.

JACKSONVILLE, FLA.—A hot water furnace, with sufficient pipe and radiators to properly heat all the offices in the new city market is proposed. A. F. Harley, Cy. Engr., would be glad to correspond with manufacturers of such plants.

FORT MONROE, VA.—The following bids were received Oct. 19 for constructing a hospital at Fort Monroe. J. W. Pullman, Q. M., U. S. A.; (1) being for the construction; (2) for plumbing; (3) heating:

	1.	2.	3.
T. D. Sipes, Portsmouth, Va.	$19,900	.....	.....
T. B. Bartlett, Newport News, Va.	19,718	.....	.....
W. W. Winfree, Bladensburg, Md.	21,476	$1,350	$3,771
J. R. Shehan, New Rochelle, N. Y.	21,940	.....	.....
E. Hart, Norfolk, Va.	18,347	.....	.....
J. H. Brinson, Hampton, Va.	17,842	.....	.....
Holtzclaw Bros., Hampton, Va.	17,684	.....	.....
R. C. Bristow & Co., Richmond, Va.	22,792	.....	.....
W. W. Biggs, Washington, D. C.	.....	3,773	.....
John Buvers, Richmond, Va.	.....	.....	2,741
C. Bargman & Co., Newport News	.....	3,305	.....
J. C. Cuttimore, Baltimore, Md.	24,888	.....	.....
W. C. Caldwell, Baltimore, Md.	25,800	.....	.....
Healey & Bros, Baltimore, Md.	.....	1,099	.....
J. A. Pandergreft, Newport News, Va	.....	1,373	3,734
J. T. Copeland, Hampton, Va.	.....	1,275	.....
Bossieux & Baptist, Richmond, Va.	.....	931	.....
John Bowers, Richmond, Va.	.....	847	.....
Thos. M. Landers, Richmond, Va.	.....	1,049	.....
Newport News (Va.) Plumbing Co.	.....	1,155	.....
Whitehurst & Riley, Portsmouth, Va.	.....	1,618	.....

CLEVELAND, O.—Bids are asked until Nov. 17 for erecting the iron tower and pile foundation for the Maumee Light Station, O. Lt.-Col. J. A. Smith, U. S. Engr.

TOLEDO, O.—Bids are asked until Nov. 18 for the purchase of $125,000 of 5% bonds for erecting a high school building. H. W. Compton, Clk. Bd. Education.

INDIANAPOLIS, IND.—W. P. Jungclaus has been awarded the contract for erecting a new school building at Park Ave. and 15th St., at $31,000, the Fuller & Warren Co. getting the contract for the heating and ventilating apparatus at $2,247.

RICHMOND, IND.—The school board has decided to erect a new school building to cost $15,000. Daniel W. Surface, Pres. School Bd.; John A. Hasecoster, Arch., 30 Kelly-Hutchinson Block, Richmond.

CHICAGO, ILL.—It is reported that the Northern Pacific R. R. Co. is about to erect a new 30-stall round house at 56th and Taylor Sts., to cost $28,000. W. L. Darling, Ch. Engr., St. Paul, Minn.

CHICAGO, ILL.—Press reports state that the two large grain elevators of the Chicago & Pacific Elevator Co., at Cherry St. and the North Branch of the Chicago River were destroyed by fire on Oct. 26, causing a loss of over $1,000,000, which includes the loss of over 1,250,000 bushels of grain.——The normal school committee of the board of education is considering plans for a new normal school building at 69th St. and Stewart Ave.; estimated cost, $125,000.

LEWISTOWN, ILL.—It is stated that the contract for constructing a brick court house for Fulton county will probably be let in December. The structure will be 112 × 68 ft., and is estimated to cost $60,000. Archs., Bell & Kent, 232 Merriam Block, Council Bluffs, Ia.

MINNEAPOLIS, MINN.—The Minneapolis Mortgage & Redemption Co. has been granted a permit to erect a 5-story brick building, to cost $40,000, at Second and N Sts.

PORTLAND, ORE.—Bids are asked until Nov. 16 for the metal work for the Grays Harbor Light Station, Wash. Capt. W. L. Fisk, U. S. Engr., Portland.

HANFORD, CAL.—Bids are asked by the county clerk until Nov. 9 for constructing a county jail to cost not less than $10,000.

WATER-WORKS.

NEW CASTLE, ME.—An election was called for Oct. 28 to vote on uniting with Damariscotta in the construction of water-works. The trenching at Damariscotta is said to be nearly completed.

BELMONT, MASS.—Bids were asked until Oct. 27 for laying 4,400 ft. of 6-in. water pipe. E. A. W. Hammatt, Engr., 29 Pemberton Square, Boston.

MARLBORO, MASS.—It is reported that extensive additions are to be made.

NEW BEDFORD, MASS.—A local paper states that bids are to be opened this week for two 10,000,000-gallon pumping engines. R. C. P. Coggeshall, Supt.

SALEM, MASS.—The water board is considering the purchase of a new pump. The Nordberg Mfg. Co. has invited the board to inspect some of its pumps in Western cities. John F. Hurley, Pres. Bd.

PAWTUCKET, R. I.—The Marieville fire district has been organized and has voted to contract with this city for water-works. About a mile of pipe will be required, for which the city will receive about $400 a year. Wm. T. Smith, Village Clk., address North Providence.

SOUTHINGTON, CONN.—The water company is said to have voted last week to build a small reservoir above the distributing reservoir in the spring.

ATTICA, N. Y.—It is reported that a filtration plant is to be put in.

ELMIRA, N. Y.—The construction of the plant of the Elmira Heights Water Co., noted last week, was commenced, but owing to trouble over the employment of Italians it is stated that no more work will be done till next year.

LOCKPORT, N. Y.—The Hall Iron Works has been awarded the contract by the council for furnishing the necessary apparatus for raising water from the lower level of the canal into the reservoir above. J. Milton Woodward, Pres. Water Bd.

MORRISTOWN, N. J.—Bids are asked until Nov. 9 for constructing a 5,000,000-gallon storage reservoir, with filter basins, etc., at Morris Plains, for the state hospital at that place. Geo. W. Howell, Engr.; Chas. H. Green, Secy. Bd., 21 Washington St., Morristown.

WILLIAMSTOWN, N. J.—Press reports state that there is scarcity of water at this place; springs are unusually low and fully one-half of the wells are dry.

McKEESPORT, PA.—The following bids were received Oct. 26 for the work advertised in Engineering News Oct. 15. Edwin Soles, Supt.; J. Schinneller, Engr., McClintock Bldg., Pittsburg:

Sinking wells, etc.:

Bowman Bros., McKeesport (accepted)	$4,250
Allen Bros., Allegheny, Pa.	6,975
John McKay, Titusville, Pa.	9,000
Wagner Well Supply Co., Dayton, O.	5,750
Hocker & Shaw, McKeesport, Pa.	7,200

Pumping engines:

Hall Steam Pump Co., Pittsburg, Pa.	$4,025
Snow Steam Pump Co., Buffalo, N. Y.	4,913
Wilson Snyder Mfg. Co., Pittsburg, Pa.	5,750
Henry R. Worthington, New York (accepted)	4,390

JERMYN, PA.—The injunction noted last week is reported not to have decreased the intention of this borough to have municipal works, and another election will probably soon be held.

LEBANON, PA.—The mayor has vetoed the ordinance appropriating $5,000 for a 10-in. well at South Mountain.

MIFFLINTOWN, PA.—B. G. Coon, of Kingston, Pa., has been awarded the contract for constructing a 450,000-gallon masonry reservoir, with pipe line extensions, for the Mifflintown Water Co. S. W. Cooper, Engr.

MILLERSTOWN, PA.—This borough is agitating the question of water-works.

PHILADELPHIA, PA.—Bids are asked until Nov. 5 for water meters. Thos. M. Thompson, Dir. Pub. Wks.

REYNOLDTON, PA.—The town council is negotiating with the Elizabeth Water Co. for a water supply from the Monongahela River. The company proposes to lay a main from Elizabeth to Blair station, across the river to the town line where connection would be made with the existing mains. The water is now purchased from McKeesport, at $100 a month, and is not satisfactory.

TYRONE, PA.—The Fayette Water Co. was incorporated Oct. 26 with a capital ctock of $2,500 to operate at Tyrone; Treas., Andrew W. Black, 4229 Fifth Ave., Pittsburg.

DELAWARE CITY, DEL.—A committee has been appointed to confer with W. Taylor Leland, of Philadelphia, in regard to the proposed works, noted in our issue of Oct. 15. Geo. B. Money, Mayor; David Stielman, Cy. Clk.

BALTIMORE, MD.—A special meeting of the water board was called for Oct. 27, at which time work estimated to cost $2,000,000 was expected to be ordered. In 1894 a loan of $2,000,000 was authorized for extending the mains in the suburbs, especially in Hamden, Woodberry, Walbrook and West Arlington, and for making other improvements. S. M. Gray, Engr., Providence, R. I.

RICHMOND, VA.—Chas. E. Bolling, Supt., has submitted a report recommending that a new pump be purchased and steps taken at once to increase the water supply; estimated cost, $200,000.

COLUMBIA, S. C.—The penitentiary authorities are said to be considering plans for an independent water supply.

JACKSONVILLE, FLA.—A new stand-pipe will probably be erected. B. F. Dillon, Chn. Trustees; R. N. Ellis, Engr.

ST. AUGUSTINE, FLA.—Bids are asked until Nov. 17 for the purchase of $85,000 in 5% 30-year bonds, of which $65,000 are for new water-works. A. L. Rogers, Secy.; J. N. Hazlehurst, Engr.

OXFORD, MISS. — Bids are asked for constructing works, including 289 tons 4 and 6-in. cast-iron pipe, 47 hydrants, 65,000-gallon steel tank, etc. W. D. Porter, Secy.

STARKVILLE, MISS.—An election will soon be held to vote on the construction of works, according to reports; supply from artesian wells.

LEAVENWORTH, IND.—It is reported that a private company has been organized to construct works.

TRAVERSE CITY, MICH.—The council is considering a resolution calling for an election Nov. 17 to vote on an issue of $100,000 in bonds for water-works.

ORANGEVILLE, ILL.—Bids were asked until Oct. 27 for sinking a well and for furnishing a pump and gasoline engine, according to reports. S. S. Hutchins, Pres. Trustees.

BODE, IA.—About 1,000 ft. of extensions will be made next year. G. T. Peterson, Mayor.

BALDWIN, WIS.—The contract for a water tank and tower, as noted in Engineering News of Oct. 15, has been awarded to the Challenge Wind Mill & Feed Mill Co., Batavia, Ill., at $1,320. Chas. Settergren, Clk.

VIROQUA, WIS.—Wm. Lake & Son are said to have the contract for a 16 × 110-ft. stand-pipe.

BENSON, MINN.—The council is reported as investigating the question of better water supply.

BRAINERD, MINN.—There is talk of improvements to cost $10,000, including filters, raising boilers, extending intake, etc.

DULUTH, MINN.—The following bids were received Oct. 23 for laying intake pipe for new water-works; all local bidders: Tullock Bros. & McFee, $22,150; A. Fredin, $29,890; E. Engle, $43,250; A. & D. Sang, $56,500. W. B. Patton, Cy. Engr.

ELBA, MINN. — Works will not be constructed until spring. J. R. Steffen, Cy. Recdr.

OWATONNA, MINN.—The contract for a filter gallery has been awarded to P. H. Thornton, St. Paul, at $779.

HASTINGS, NEB.—We are informed that an election will soon be held to vote on an issue of $8,000 in bonds for new engine and new process for raising water. L. A. Kinney, Supt.

HOT SPRINGS, S. DAK.—The pumping capacity of the works is to be increased. Frank Allen, Supt.

KANSAS CITY, MO.—The contract for a 10,000,000-gallon pumping engine, as advertised in Engineering News, has been awarded to the Barr Pumping Engine Co., at $34,800. The bids were published last week (p. 142). R. M. Godfrey, Secy. Bd. Pub. Wks.

ST. LOUIS, MO.—A bill has been introduced in the council authorizing the erection of a plant to filter 100,000,000 gallons of water a day, at a cost of $2,000,000. M. L. Holman, Water Comr.

ARANSAS PASS, TEX.—The Aransas Pass Water Co. was incorporated Oct. 20 with a capital stock of $3,000, to supply water on Mustang, St. Joseph and Harbor islands and the adjoining mainland; incorporators, W. H. Stedman, Geo. W. Stedman and E. Stedman.

TRINIDAD, COLO.—An election will soon be held to vote on the purchase of the works.

SOUTH BEND, WASH.—The United States court of appeals is reported to have declared void the contract between this city and the South Bend Water Co.

TILLAMOOK, ORE.—H. Orchard, of Kalama, Wash., submitted a proposition to this city recently for the construction of gravity works; franchise will probably be granted.

HEALDSBURG, CAL.—It is expected that steps will soon be taken to secure municipal works; present plant is owned by Frank Koenig.

LAKEPORT, CAL.—The trustees have engaged A. L. Adams, of San Francisco, to report upon the different plans for works.

LOS ANGELES, CAL.—The directors of the Lake Vineyard Land & Water Co. are reported to have authorized the construction of additional tunneling.

WINDSOR, ONT.—The work of constructing a filter plant is to be commenced as soon as the citizens have voted to issue the $40,000 in bonds, according to reports.

GATINEAU, QUE.—The Gatineau Point council is reported as arranging for the purchase of steam pumps for fire protection.

IRRIGATION.

OGALALLA, NEB.—Press reports state that W. O. Rogers, of Omaha, Neb., has purchased a large tract of land in the North Platte valley under the Alfalfa ditch. Fifty teams are at work on the ditch and expect to complete the canal by Jan. 1. The Alfalfa ditch managers are considering a proposition to extend the canal seven miles further east along the North Platte valley to a point six miles northeast of Ogalalla, which will put 7,000 acres more under the ditch.

SANTA ANA, CAL.—It is reported that H. F. Gardner, Supt. Santa Ana Valley Ditch Co., submitted to the directors at their annual meeting, Oct. 10, a report of the work during the past year, showing that 101 cement gates had been put in, including 11 in main canal, 22 bridges, 1 on main canal; 7 drops, 2 large arched culverts for conveying storm water from arroyos underneath the canals, 1,398 ft. of cement pipe, 7,727 ft. of cement ditch ranging in size from 2½ to 60 heads. The total length of ditches cemented by the various works is about 2⅓ miles.

SEWERAGE.

NEWPORT, N. H.—It is reported that work will soon be begun on the proposed sewer system for this place. Edward W. Gustine, Constructing Engr., Keene, N. H.

BOSTON, MASS.—The aldermen have passed resolutions appropriating $75,000 for improving two sewage pumping stations, and constructing sewers in four streets. Wm. Jackson, Cy. Engr.

NEWTON, MASS.—The aldermen have been petitioned by the residents of Lower Falls to extend the sewer system to that part of the city. H. D. Woods, Cy. Engr.

BROOKLYN, N. Y.—Bids are asked until Nov. 5 for constructing sewers in four streets. T. B. Willis, Comr.

BUFFALO, N. Y.—Bids are asked until Nov. 5 for constructing a 12-in iron and 15 to 10-in. tile pipe sewers in two streets. R. G. Parsons, Secy. Dept. Pub. Wks.——Joseph Harrer has been awarded the contract for constructing a sewer in Meridan St. and Bailey Ave., at $36,800.

JAMAICA, N. Y.—Dr. P. M. Wood writes us as follows: The state board of health met Oct. 16 in New York city and reported adversely to the plan proposed (filtration bed system in Greater New York) by the sewer commissioners of Jamaica. John J. McLaughlin, Village Engr., has been requested by the commissioners to prepare plans for a chemical system and report at the next regular meeting of the board, Nov. 3. The commission is composed of the following gentlemen: Dr. Philip M. Wood, Chn.; Aaron A. Degraw, John Adikes, Wm. C. Bahr and J. Tyler Watts.

NEW YORK, N. Y.—Bids are asked until Nov. 2 for constructing and extending sewers in six streets. C. H. T. Collis, Comr. Pub. Wks., 150 Nassau St., and until Nov. 5 for constructing a sewer in Marion Ave., from 101st to 200th St., and also a sewer in Fox St. Louis F. Haffen, Comr. St. Improvements, 2622 Third Ave.

NIAGARA FALLS, N. Y.—It is reported that the city engineer has been directed to advertise for bids for constructing a sewer in 11th St. W. W. Read, Cy. Engr.

SYRACUSE, N. Y.—We are informed as follows, regarding the proposed intercepting sewers to empty into Onondaga Creek: The plan is being discussed in the chamber of commerce, but will end in discussion probably. Wm. A. Sweet, Engr., is in favor of deepening the creek and storing it with blocks and in concrete made smooth and argues that an open sewer is the safest, least costly and the best for sanitary reasons. It is thought that there will be no sewer construction very soon. The city is bonded to the limit of its valuation and is not raising any money on its bonds, as it has $225,000 on the market now and no bidders. R. R. Stuart, Cy. Engr.

CAPE MAY, N. J.—The council of this city is reported to have visited Philadelphia last week to inspect the sewer system of that city.

PASSAIC, N. J.—The council is considering ordinances for constructing sewers in two streets. R.B.Tindall,Cy. Clk.

SHERIDAN, PA.—G. L. Peck, Asst. Supt. Pennsylvania Co., Pittsburg, and the council are considering the question of constructing a sewer to connect with the main sewer at Cork Run; estimated cost, $2,800,. half of which the railway company is willing to pay.

ALEXANDRIA, VA.—The question of constructing sewers is again being discussed. The last legislature authorized an issue of $200,000 bonds for improvements, but so far the council has taken no action. E. C. Dunn, Cy.

GLENVILLE, O.—Bids are asked until Oct. 31 for the purchase of $4,700 in 6% sewer bonds. F. W. Morris, Village Clk.

CLEVELAND, O.—The council has passed a resolution authorizing the construction of a sewer in Duane St. Frank A. Emerson, Pres. Council.

AUBURNDALE, O.—The state board of health has approved the plans for the proposed sewer system for this place. Councilman Rakestraw, Chn. Com.; Engr., W. G. Clark, of Toledo, O.

CHICAGO, ILL.—Bids are asked until Nov. 4 for constructing sewers in three streets. Joseph Downey, Comr. Pub. Wks.——A special assessment for $1,200,000 for constructing a sewer system in the southern section of the city has been rendered invalid on a technicality.

DECATUR, ILL.—The council has appointed a committee to employ an engineer to prepare plans and specifications for a sewer in Oakland Ave.

MILWAUKEE, WIS.—John O. Jones, of Racine, Wis., was the lowest bidder Oct. 14 for constructing the first 1,800 ft. of the main tunnel sewer in Cambridge Ave., at $4.22 a foot.

RIPON, WIS.—Press reports state as follows: The city will likely be served with an injunction, prohibiting the use of its sewerage system, unless immediate steps are taken looking toward improvement below the Ceresco dam. For several years past refuse matter has been left along the creek bed, the water supply being insufficient to carry it away. During the past summer it has been especially odorous and disease in families living in the vicinity is attributable to this cause, physicians say. Ceresco citizens have made the complaint and the council will, it is thought, take quick action with regard to the matter.

WAXAHACHIE, TEX.—The city will, within a few days, begin the construction of a sewerage system, by laying about 1¼ miles of 10-in. and 8-in. pipe on the outlet end. Only the court house and jail will be connected at present. On the present work the city furnishes the materials and superintendence, while the county performs all the labor with convicts. Evens & Howard, of St. Louis, were awarded the contract for furnishing the pipe. W. A. Spaulding, C. E., will have charge of the work for the city; James S. Davis, Chn. Sewer Com.

SAN FRANCISCO, CAL.—Plans have been adopted for a sewer system in the district commencing at 23d St., thence along Indiana St. to 19th; 19th St. to Minnesota, Minnesota to 20th, 20th to Michigan, Michigan to 22d, 22d to Georgia, Georgia to 23d, and 23d to Indiana. A resolution of intention has been passed providing that 20th Ave., between California and Lake Sts., be sewered with an 8-in. iron stone pipe sewer. Thos. Ashworth, Supt. Sts.

SANTA MONICA, CAL.—A sewer district is to be formed, and a main trunk sewer constructed.

WINDSOR, ONT.—The following bids were received recently for constructing the central sewer system: Clark & Connolly, Toronto, Ont., $8,713; William Lyons (awarded contract), $7,672; Joseph Ferry, $7,607; Sewell & Smith, $9,138; Chick & Co., $9,161; Cole & Shaw, $7,797. Wm. Newman, Cy. Engr.

GARBAGE DISPOSAL—STREET CLEANING.

SYRACUSE, N. Y.—The joint health board and council committee, appointed to select a site and system for garbage disposal has visited Bridgeport, Conn., Philadelphia and other cities, and is reported as in favor of a garbage reduction plant, estimated to cost $70,000.

HARRISBURG, PA.—Local papers advise the council to investigate the cost of a garbage crematory before adopting plans for garbage disposal.

NEW BRIGHTON, PA.—Councilmen P. D. Hall and L. D. Boggs are members of a committee that has been investigating the garbage disposal plants in other cities. Thos. Dixon, Comr. Pub. Wks.

JACKSONVILLE, FLA.—The next budget of the board of public works is expected to contain an appropriation for a new garbage crematory; estimated cost, $14,000 to $18,000. A. F. Harley, Cy. Engr.

LOUISVILLE, KY.—The question of a garbage crematory or reduction plant is likely to be agitated in the near future. J. H. Pearson, Cy. Engr.

SAN FRANCISCO, CAL.—The organization of the Sanitary Reduction Co. to construct plants to dispose of the garbage of this city was noted in our issue of Oct. 1. Ex-Mayor L. R. Ellert, Pres., is said to be in the east selecting machinery for the plant .

STREETS AND ROADS.

BOSTON, MASS.—The street commissioners of Charlestown are considering the question of improving Beacham St. at a cost of $10,000. Councilman Connorton can be addressed.——The council has approved an order recommended by the finance committee appropriating $536,000 for streets, sewers and park improvements.

CAMBRIDGE, MASS.—The council proposes to appropriate about $20,000 for widening and extending two streets.

WORCESTER, MASS.—The road improvement association of Worcester held a meeting Oct. 17 at which the question of building better roads in that vicinity was considered. Chas. G. Washburn, Lincoln Holland, Albert H. Inman and Elwood Goodell are among those interested.

PASCOAG, R. I.—It is reported that this place has voted to issue $50,000 in bonds for improving and rebuilding about nine miles of roads and also for the purchase of a stone crusher, etc.

WILTON, CONN.—At a town meeting Oct. 5 the town appropriated about $5,000 for road improvements. John Knapp, Supt. of Roads.

BROOKLYN, N. Y.—Bids are asked until Nov. 2 for the construction of a roadway of macadam and brick on the Eastern Parkway extension from Rockaway Ave. to Bushwick Ave., at Vandeveer St. Bids will also be received for the removal of the granite block pavement, which is to remain the property of the department of parks, and the substitution therefor of a brick pavement on concrete foundation, on Bushwick Ave., from Vanderveer St. to Rose Place, the beginning of the brick pavement already laid on Bushwick Ave. Bids must be in two distinct offers. Timothy L. Woodruff, Comr. of Parks, Prospect Park, Brooklyn; J. E. Smith, Secy. ——Local papers state that the shore road commission will soon receive bids for the construction of a portion of the driveway. The commission will have at its disposal $250,000 to begin the work. Olmstead, Olmstead & Elliott, Boston, Mass., are the landscape architects; William Jackson, of Boston, Consult. Engr ; Edwin C. Swezey, 3d Ave. and 39th St., Brooklyn, Engr. in Charge; Pres. E. R. Kennedy.——The road committee of the good roads association, which has its headquarters at 1187 Bedford Ave., is considering the question of constructing a road from Bath Beach to connect with East New York. Frank Share and H. B. Fullerton, of the association, can be addressed.

BUFFALO, N. Y.—Bids are asked until Nov. 5 for asphalt paving in Prospect Ave. from Porter Ave. to Massachusetts St. R. G. Parsons, Secy. Dept. Pub. Wks.

NEW YORK, N. Y.—Bids are asked until Nov. 2 for asphalt block paving in three streets; asphalt paving in five and granite block paving in two other streets. C. H. T. Collis, Comr. Pub. Wks; and until Nov. 5 for grading and paving in five streets. Louis F. Haffen, Comr., 2622 Third Ave.

NORTH HEMPSTEAD, N. Y.—The town board and the commissioners of highways of this place have decided to issue $56,000 in 4% bonds for building macadam roads.

DOVER, N. J.—The board of freeholders has been petitioned to construct macadam road from Mount Arlington Boulevard to Kenvil and one from Succasunna to the county road at Ledgewood. W. E. King, County Engr., Landing, N. J.

JERSEY CITY, N. J.—It is reported that the board of freeholders of Greenville recently voted to appropriate $155,000 for asphalt paving in three streets.

NEWARK, N. J.—The Essex county park commission, 800 Broad St., Newark, has awarded the contract for the landscape alterations to the Branch Brook Park to James Serne, of Newark, at $29,156.

EASTON, PA.—The highway department has decided to macadamize and otherwise improve four streets. H. R. Fehr, Cy. Engr.

PHILADELPHIA, PA.—The highway committee has reported favorably on an ordinance for widening a portion of Letitia St., at a cost of $31,000, which does not include the land damages.

WASHINGTON, D. C.—The residents of Columbia Heights have petitioned the district commissioners to pave and grade a number of streets in that part of the city. N. A. Ballinger, Geo. V. Simons and Charles S. Bundy, of the citizens' association of Columbia Heights, are interested.

BALTIMORE, MD.—Ordinances have been approved to grade, pave and curb 15 blocks in four streets. Janon Fisher, Cy. Comr.

NEWPORT NEWS, VA.—The question of improving certain streets at a cost of about $35,000 is being considered. Geo. Y. Alsop, Cy. Engr.

COVINGTON, KY.—It is reported that at the election on Nov. 3 the proposition to issue $75,000 in bonds for brick pavements will be voted upon.

NASHVILLE, TENN.—Bids are asked until Nov. 10 for furnishing paving brick, as stated in our advertising columns. J. A. Jowett, Cy. Engr.

CLEVELAND, O.—The council has adopted resolutions for brick paving, grading and otherwise improving six streets. Howard H. Burgess, Cy. Clk.

TOLEDO, O.—Bids are asked until Nov. 2 for grading the Wallbridge Ave. approach to the Fasset St. bridge. L. P. Harris, Cy. Clk.

WARREN, O.—The council has plans for macadamizing a number of streets next year. Street Comr. McCracken can be addressed.

SAGINAW, MICH.—We are informed that about 80,000 sq. yds. of paving has been practically decided upon. Additional paving is also proposed, but the material has not yet been decided upon. H. E. Terry, Cy. Engr.

CHICAGO, ILL.—The South Park board is considering an ordinance for constructing a boulevard from Michigan Ave. to the river. James W. Ellsworth, Pres., 1820 Michigan Ave.

KANSAS CITY, MO.—Bids are asked until Nov. 2 for paving with asphalt 19th St., from Main St. to Tracy Ave., and also for improving Lydia St. H. A. Wise, Cy. Engr.

DENVER, COLO.—The board of public works has adopted specifications for grading and curbing portions of about 40 streets; estimated cost $159,702. E. Monash, Pres. Bd. Pub. Wks.

CRIPPLE CREEK, COLO.—The Manitou, Crystal Park & Cripple Creek Carriage & Toll Road Co. has been incorporated with a capital stock of $100,000. It is proposed to construct and operate a carriage, wagon and toll road over a route, which after leaving the town limits of Manitou will follow as near as may be the line of survey heretofore made for the Pike's Peak Ry. Co. in 1883, thence through Crystal Park to Cripple Creek. Walter D. Sarvin, Austin Hutchinson, W. E. Smiley, J. A. Fitting, A. B. Hutchinson and J. W. Kriger are the incorporators.

DOWNIEVILLE, CAL.—At the election Nov. 3 the question of issuing $20,000 in bonds for constructing a wagon road in Sierra county will be voted upon. A. J. Heroux, Clk.

SONORA, CAL.—The board of supervisors has been petitioned to issue $100,000 in bonds for building a road from Sonora to Knight's Ferry. D. M. Ortega, Clk.

MANUFACTURING PLANTS.

WATERBURY, CONN.—A factory occupied by the Waterbury Wrench Co. and William F. Norman & Co., manufacturers of shears, was burned on Oct. 19. The main building was a 2-story wooden structure, 150 × 40 ft., and together with certain water privileges and lands was lately bought for $22,000 by several Waterbury capitalists, organized as the Mattatuck Mfg. Co. The company will probably rebuild on an enlarged scale.

BROOKLYN, N. Y.—It is stated that the Newhall Engineering Co., of Philadelphia, has been engaged by Arbuckle Bros. to prepare the plans and superintend the construction of the sugar refinery which the firm proposes to erect in Brooklyn to refine sugar in connection with its coffee business. The refinery will have a capacity to turn out from 2,000 to 2,500 barrels of sugar per day.

NIAGARA FALLS, N. Y.—Francis Frost & Co., paint manufacturers, of Toronto, Ont., will build a branch factory on Bath Ave., this city. Electric power will be used.

BEAVER FALLS, PA.—Mayer Bros.' pottery was burned on Oct. 21, entailing a loss estimated at $100,000.

ALLEGHENY, PA.—The McKinney Mfg. Co., Market St., is reported to have begun the erection of a large iron building, adjoining its present works.

PHILADELPHIA, PA.—It is stated that plans have been submitted for a 1-story brick addition to the plant of the Glen Willow Ice Mfg. Co., just above Manayunk. It will be 116 × 40 ft. The company will also need two new boilers in its present boiler house.

WAYNESBORO, PA.—The Geiser Mfg. Co. is erecting large pattern works.

CUMBERLAND, MD.—A newspaper report states that the Baltimore & Ohio R. R. Co.'s rolling mill, at Cumberland, which has been idle for some years, will be utilized. The mill will be used as a repair shop in connection with the new machine shops, and will employ 500 men. It is said to be the intention of the company to make all of its own engines.

KEYSER, W. VA.—It is reported that the new Baltimore & Ohio car shops soon to be erected at Keyser will be built entirely of iron, 500 × 85 ft., constituting a wing to the square shops already at that place, and will employ some 200 to 300 hands, most of whom will be skilled mechanics. The town paid the company $10,000 to secure the shops. It looks as if the company has abandoned the shops at Connellsville, Pa.

BIG STONE GAP, VA.—On Oct. 19 the car shed and shops of the Howells Valley Ry. burned, together with an engine and two cars. Loss estimated at $10,000. No insurance.

BRISTOL, VA.—A press report from this place states that J. M. Crowell has closed a deal for paper mill machinery amounting to $30,000, and will organize a stock company for the purpose of manufacturing paper in Bristol.

MANCHESTER, VA.—The Richmond Cotton Mills Co. has been incorporated with a capital stock of $200,000, for the establishment of cotton mills at this place; incorporators: John A. Smith, of Bessemer City, N. C.; Alfred G. Bishop, Jr., of Richmond; Alfred G. Bishop, Sr., of New York, and Henry A. Haines, of Elizabeth, N. J.

CLIFTON, S. C.—The Clifton Cotton Mill Co. will soon begin operating a new plant. The building is 320 × 103 ft., four stories high, with a picker building 100 × 100 ft. The dam and foundation of the building cost $50,000. The power generated by water is 2,000 HP. on two pairs of 42-in. McCormick wheels, built by S. Morgan Smith, York, Pa., supplemented by an 800-HP. steam engine, manufactured by the C. G. Cooper Co., of Ohio. The power is designed for 50,000 spindles, but the present building will only accommodate 35,000, one end being left for an extension for 15,000 more spindles in the future. A weave-room containing 1,100 looms has also been completed in connection with the plant. For the benefit of the operatives, a hotel, store and a number of dwellings have been built. Pres., D. E. Converse, of Spartanburg, S. C.

WALTERBORO, S. C.—The new cotton mill on which work has been in progress for nearly a year will be completed in a few weeks, and it is expected that it will be in full operation before Jan. 1.

CHATTANOOGA, TENN.—It is stated that the plant of the Chattanooga Pulley Co., which was recently destroyed by fire, will probably be rebuilt soon, but the exact date has not yet been determined. The officers of the company contemplate the erection of a 1-story brick building with annexes, to cost about $8,000, while new machinery costing $15,000 or more will be purchased.

AKRON, O.—The stoneware works of Whitmore, Robinson & Co., were destroyed by fire on Oct. 20. Loss, about $200,000; insurance, $100,000. It is stated that the plant will be rebuilt.

INDIANAPOLIS, IND.—The Munger bicycle plant has been sold to Frank Fowler, of Chicago, formerly connected with the Fowler Bicycle Co. He expects to enlarge the plant to about four or five times its present capacity and employ from 250 to 500 people.

BAY CITY, MICH.—The Dry Dock Iron Works was destroyed by fire on Oct. 17. It was insured for $16,000.

DETROIT, MICH.—It is reported that the United Alkali Co., of Great Britain, with a capital stock of $40,000,000, has purchased for $170,000 100 acres of land in the western suburbs of Detroit and will erect a soda ash and salt works to employ 1,000 men. C. A. Rathbone, 604 Union Trust Bldg., negotiated the sale.

BARRON, WIS.—The Barron stave and heading plant burned on Oct. 24. Loss estimated at $10,000; insurance, $4,000.

GREAT FALLS, MONT.—Volk Bros.' brewery burned on Oct. 22. Loss, about $30,000; insurance, $17,500.

PETERBORO, ONT.—The Dixon Co.'s saw mill and lumber yards, Donnell's planing mill and Green's pump factory, were destroyed by fire on Oct. 26. Loss estimated at $40,000; fully insured.

GAS PLANTS

LYNN, MASS.—The Lynn Gas & Electric Co. has contracted with Bartlett, Hayward & Co., of Baltimore, Md., for the erection of a holder of 1,000,000 cu. ft. capacity, to be erected the coming summer.

BROOKLYN, N. Y.—The Coney Island Gas & Fuel Co., which was granted a franchise by the town board of Gravesend nearly three years ago, has commenced laying mains in the principal streets at Sheepshead Bay (now Ward 31). Efforts are being made to have street lamps put in. Jas. A. Eustis, Supt.

NEW YORK, N. Y.—Justice MacLean, in the Supreme Court, Oct. 27, issued an injunction to restrain the board of aldermen from awarding a franchise to the Consumers' Gas, Heat & Power Co. for laying pipes in the streets to supply fuel gas through the city. A franchise has also been asked by the Metropolitan Fuel Gas Co. which offers to furnish fuel gas to the public at 50 cts. per 1,000 cu. ft., and to manufacturers and the city at 25 cts., paying the city 25 cts. per lin. ft. of pipe laid. The company also offers the city $100,000 for the franchise and will put up a bond of $500,000 for the faithful performance of the work. The Metropolitan company's officers are: Pres., H. M. Thompson; Vice-Pres., C. D. Hauke; Secy. and Treas., H. Dailey, Jr.; Consult. Engr., James L. Hastings.

RICHMOND HILL, N. Y.—The Brooklyn & Queens County Gas Co., which recently petitioned for an extension of 60 days' time in which to lay its mains in this place, commenced work last week.

JERSEY CITY, N. J.—Bids are asked until Nov. 2 for street lighting, as noted more fully under Electric Light and Power. Geo. T. Bouton, Clk. Bd.

PHILADELPHIA, PA.—Bids are asked until Nov. 4 for two Brander patent charging machines, with all necessary appurtenances, and also for two turntables and foundations complete, at Point Breeze works; also for repairs to wharves at 25th Ward works. Thos. M. Thompson, Dir. Pub. Wks.——George W. Stewart is erecting a retort house for the bureau of gas at Tioga St. and Delaware Ave. It is to be one story high, 318 ft. square and will cost $16,000.

DELAWARE CITY, DEL.—It is stated that the syndicate that has applied for a water-works franchise has also asked for a franchise for a gas plant. J. Taylor Leland, of Philadelphia, is interested.

WILMINGTON, DEL.—A petition, said to contain 4,000 names, has been presented to the street and sewer department asking that the Oxy-Hydrogen Co., of which J. Edward Addicks is controlling stockholder, be permitted to lay mains and complete its plant.

BROWNSVILLE, TENN.—A franchise has been granted to G. W. Benedict, of Cincinnati, for a water-gas plant, to be erected at once. A. D. Bright, Jr., of Brownsville, is said to be interested.

CANTON, O.—The Stark Oil & Gas Co. was incorporated in West Virginia Oct. 19, with a capital stock of $50,000, commencing with $600, to drill oil and gas wells, etc.; incorporators, M. S. Hasler, Samuel Lowenstein, Jacob L. Simon and others, of Canton.

TOPEKA, KAN.—The Topeka Gas Co. has been petitioned to extend its pipes through Potwin, and, it is said, will probably make the extensions.

MISCELLANEOUS CONTRACTS.

FIRE ENGINE.—Lebanon, Pa.—The Rescue Fire Co. will purchase a new fire engine.

STREET SIGNS.—Indianapolis, Ind.—Bids are asked by the board of public works until Nov. 2 for street signs.

DREDGING.—Wilmington, Del.—Bids are asked until Nov. 5 for dredging in Murderkill River, Del. Maj. W. F. Smith, U. S. A.

BONDS.—Brooklyn, N. Y.—Bids are asked until Nov. 5 for the purchase of $2,111,240 in 3½% gold bonds. Geo. W. Palmer, Comptroller.

MAUSOLEUM.—Newark, N. J.—It is stated that Judge Kreuger has awarded the contract for a family mausoleum to cost $100,000 in Fairmount Cemetery.

EXTENDING WHARF.—Baltimore, Md.—Bids are asked until Oct. 29 for extending the wharf at Quarantine station. N. H. Hutton, Engr., Harbor Board.

WHARF.—Newport, R. I.—Kaull & Anthony have commenced preliminary work for their wharf 130 ft. long and 75 ft. wide, just south of Crowley's shipyard.

STONE, ETC.—Memphis, Tenn.—Bids are asked until Nov. 2 for furnishing brush, poles, rip-rap stone, etc. Capt. G. D. Fitch, U. S. Engr., 99 Madison St, Memphis.

BONDS,—Arverne-by-the-Sea, N. Y.—Bids are asked until Nov. 7 for the purchase of $8,000 in 5% village bonds. John R. Waters, Pres. Bd., 54 Franklin St., New York city.

RACE TRACK.—Fort Erie, Ont.—The Fort Erie Jockey Club will build a race track and various buildings, to cost $200,000. R. A. Waite, of Buffalo, N. Y., prepared the plans.

TELEPHONE SYSTEM.—Wilkes Barre, Pa.—The council has granted the People's Telephone Co. permission to construct and operate lines in this city. T. H. Atherton is interested.

STONE CRUSHER.—Ludington, Mich.—The county commissioners are reported to have decided to buy a stone crusher and to macadamize some of the sandy roads leading to this city.

SPRINKLING CART.—Eureka, Cal.—Supervisor Clark has been authorized to prepare specifications and advertise for bids for the purchase of a sprinkling cart for use on the Arcata Road.

TELEPHONE.—Grafton, N. Dak.—It is reported that the system of the Northwestern Telephone Co. will be extended to this place soon. H. G. Webster, Local Mgr., for Grand Forks, N. Dak.

GUN EMPLACEMENTS.—Savannah, Ga.—Bids are asked until Nov. 16 for building gun emplacements on Tybee Island, Ga., as stated in our advertising columns. Capt. O. M. Carter, U .S. Engrs.

GUN EMPLACEMENTS.—New London, Conn.—Bids are asked until Nov. 28 for building gun emplacements on Great Gull Island, N. Y., as stated in our advertising columns. Capt. Smith S. Leach, U. S. Engrs.

REMOVAL OF PIERS.—New York, N. Y.—Bids are asked until Nov. 2 for the removal of the piers at the foot of Jane and Horatio Sts., North River; 15,561 sq. ft. of area. Geo. S. Terry, Secy., Dept. of Docks.

DREDGING.—New York, N. Y.—Bids are asked until Nov. 10 for 85,000 cu. yds. of mud and sand dredging in Sherman's Creek, Harlem River. Geo. S. Terry, Secy. Dept. of Docks, Pier A, Battery Place, North River.

GUN EMPLACEMENTS.—Wilmington, N. C.—Bids are asked until Nov. 21, for building gun emplacements near mouth of Cape Fear River, N. C., as stated in our advertising columns. Lt. Col. D. P. Heap, U. S. Engrs.

CONCRETE BATTERY.—New York, N. Y.—Bids are asked until Nov. 28 for constructing a concrete battery at Fort Hancock, Sandy Hook, N. J., as stated in our advertising columns. Col. G. L. Gillespie, U. S. Engrs.

WHARF.—St. Louis, Mo.—James Short has been awarded the contract for constructing a wharf at the foot of Krauss St. in Carondelet at $7,297. The work house is to furnish the dike rock, macadam and rip-rap to be used.

DAMS.—San Francisco, Cal.—The state debris commission has authorized the following mines to construct dams: Gold Run mine, Placer county; Cascajo mine, Calaveras county; Larsen mine, El Dorado county; King Sayer mine, Plumas county.

STONE CRUSHERS, ROAD MACHINES, ETC.—Pascoag, R. I.—It is reported that the taxpayers at a meeting on Oct. 19 voted an appropriation for the purchase of a stone crusher, road machine, engine, etc.; $50,000 was appropriated for building roads.

NAVAL SUPPLIES.—Washington, D. C.—Bids are asked until Nov. 4 for supplies for the navy yards at Norfolk, Va., and Brooklyn, N. Y., and until Nov. 17 for supplies for the navy yard at Mare Island, Cal. Edwin Stewart, Paymaster-Gen., U. S. Navy, Washington.

TUNNEL AND MASONRY DRAIN.—New York, N. Y.—Bids are asked until Nov. 4 for excavating a tunnel and constructing a masonry drain at Jerome Park reservoir, near Sedgwick Ave. James C. Duane, Pres.; Edward L. Allen, Secy. Aqueduct Comn., 280 Broadway.

MARINE RAILWAY; ETC.—Bridgeport, Conn.—A. J. Beardsley & Son intend to spend $30,000 enlarging their shipyard; the marine railway will be made 400 ft. long, and will be operated by larger machinery; contract for boilers has been let to the Bridgeport Boiler Works.

DITCH.—Los Angeles, Cal.—The contract for the Rubio Canon ditch which will carry off the storm water from Rubio Canon and protect a territory of 4,200 acres to the northeast, was let Oct. 14 to Jas. H. Dovey, of Pasadena, Cal., at $6,500. The stone ditch will be 6,000 ft. long.

COLD STORAGE.—Brooklyn, N. Y.—The Metropolitan Cold Storage & Heating Co. has applied for a franchise to lay pipes, tubes, etc., for heating and refrigerating purposes. It is proposed to build a plant near Wallabout Market to cost $100,000. J. Herbert Watson is the attorney.

PARK IMPROVEMENTS.—Buffalo, N. Y.—Plans have been approved by the park commissioners for dredging the North Park lake and placing a dam and lock at end of same; also for excavating for small lakes at Humboldt Park. The last named work is provided for by a $10,000 appropriation.

PIER WORK.—Brooklyn, N. Y.—Bids are asked until Nov. 4 for removing old pier and bulkhead and preparing for and building a new wooden pier and approach, with appurtenances, including a sewer box through same, at the foot of Metropolitan Ave.; surety required, $30,000. T. B. Willis, Comr. Cy. Wks.

PIER.—Jersey City, N. J.—The Erie R. R. has filed plans for the rebuilding of Pier No. 5, just north of the station at the foot of Pavonia Ave., which was recently burned. The plans provide for the extension of the dock to the building line. It will be 900 ft. long, 70 ft. wide, and 20 ft. high; estimated cost, $40,000.

DRAINAGE WORK.—New Orleans, La.—The executive committee of the drainage board has decided to propose a plan for the removal of the drainage of the Melpomene Canal to the upper line canal, to cost $15,000. This is the beginning of the construction of an extensive drainage system for the entire city. B. M. Harrod, Ch. Engr.

CONDUITS.—Baltimore, Md.—At the election Nov. 3 the question of funding the floating debt amounting to $1,600,000 and also of issuing $1,000,000 of city bonds with which to construct conduits for electric light and other wires in the streets and alleys will be voted upon. Alcaeus Hooper, Mayor; Wm. F. Stone, Cy. Register.

PIPE LINE.—Trenton, N. J.—Vice-Chancellor Emery rendered a decision Oct. 22 in favor of the United States Pipe Line Co., in the proceedings for an injunction brought by the Delaware, Lackawanna & Western R. R. Co., to restrain the other company from laying its oil pipes under the tracks in Warren county. The Pipe Line Co. will go on now with the construction of its line to the seaboard.

GRADE CROSSING.—Boston, Mass.—A grade crossing commission is considering plans for abolishing the grade crossings of the New York, New Haven & Hartford and the New England railways in Dedham, Hyde Park and West Roxbury. Plans were submitted by Collin M. Ingersoll, Jr., of the New Haven railway. A hearing will be given Nov. 7. S. N. Aldrich, Chn. Com., 20 Beacon St.; E. B. Bishop and Henry C. Southwick, Comrs.

PARK.—Brooklyn, N. Y.—Olmstead, Olmstead & Eliot have completed plans for the new Dyker Beach park, on Gravesend Bay, between Bath Beach and Fort Hamilton, and workmen are now grading a roadway along the banks of the proposed lagoon. J. & F. Kelly have the contract for a 600-ft. wooden bridge across the meadows, to be completed before Jan. 1. The basin is to be dredged and other improvements made as rapidly as possible.

MAIL TUBE.—Brooklyn, N. Y.—At a meeting of the New York & Brooklyn Bridge trustees, Oct. 26, the New York Mail & Newspaper Transportation Co. was granted permission to construct two 8-in. pneumatic tubes on the bridge for conveying mail between the post offices of the two cities; tubes are estimated to cost $140,000; company will receive $14,000 a year from the government and will pay $1,000 a year to the bridge trustees. Maj. P. H. McNulty is interested.

FERRY APPROACH.—Galveston, Tex.—The commissioners' court received plans from the following Oct. 14 for a ferry approach at Bolivar: W. H. Tyndall, 2107 Market St., Galveston; estimated cost, with Heffron's covered piling, $37,500, with creosoted piling, $46,000; T. P. Nichols, estimated cost, with creosoted piling (not less than 20 lbs. per cu. ft.), $55,000; A. J. Johnson, $53,576, creosoted, not less than 20 lbs., etc.; H. T. Wilson, $24,957, with uncreosoted piling, $39,187, with creosoted piling, $31,197, with Poynor, Bryant, Bryant & Co.'s patent covered piling. The foregoing are all based upon a structure 35 ft. wide. H. C. Ripley submitted plans for a structure 20 ft. wide, planked all over so that wagons may pass by turning out on to the railway track.

PARK WORK.—New York, N. Y.—Bids are asked until Nov. 9 for constructing parapet-wall on Riverside Drive, from the existing wall near 86th St., to 88th St.; for grading for widening the roadway of 153d St., between 7th Ave. and Macomb's Dam Road; for an approach to the new Macomb's Dam bridge and setting curb-stones and grading and paving with asphalt the sidewalks surrounding the plot of land north of 153d St., between 7th Ave. and Macomb's Dam Road; and for furnishing and delivering garden-mold, where required on Central and Riverside parks. The engineer's estimates of the work to be done are as follows: 75 cu. yds. of concrete foundation; 112 cu. yds. of rubble masonry; 500 lin. ft. of parapet wall; 500 lin. ft. of granite coping; 1,600 cu. yds. earth and rock excavation; 9,000 sq. ft. of asphalt walk; 6,275 cu. yds. of garden mold, etc. S. V. R. Cruger, Pres. Park Comrs.

FILLING, ETC.—Hartford, Conn.—Estimates are wanted for pumping 1,250,000 cu. yds. of sand from the river and depositing same one-eighth to one-quarter of a mile distant; also information as to cost of plant to accomplish the result at the most economical rate, length of time required and if 425,000 cu. yds. can be pumped at the same ratio. This work is projected in connection with the long-discussed plans for protecting the city from the high waters of the Connecticut River. A committee has been appointed to investigate the matter and at a recent public meeting several plans were proposed. Estimates made in 1866 placed the cost of dykes at $300,000, or of raising the more important of the flooded area (45 acres) to a level 1 ft. above the 1854 flood line, requiring 425,000 cu. yds. of filling, at $170,000. The committee considering the different plans includes D. G. Stoughton and Niles B. Preston, Mayor.

TUNNEL.—Brooklyn, N. Y.—Local papers state that plans have been completed by the New York & Brooklyn R. R. Co. for a traffic tunnel under the East River, between Brooklyn and New York, which it is claimed can be completed within a year. The start is to be made as soon as the necessary franchises are secured in Brooklyn. The consent of New York has already been obtained. The Brooklyn terminal station will be located near Willoughby and Adams Sts. The route will be in nearly a straight line from the Brooklyn terminal to the New York terminal at Park Row and Ann St. The tunnel will be wide enough for four tracks. It is estimated that a speed of 25 miles an hour can be maintained, thus rendering it possible to make the trip from terminal to terminal in less than two minutes. The entire distance will be less than 8,100 ft.; estimated cost, $6,000,000. Pres., B. S. Hennessy; Secy. and Treas., Otto Andrea; Silas B. Dutcher, Pres. Hamilton Trust Co., Brooklyn; J. N. Partridge, Pres. Brooklyn City & Newtown Ry., and Emerson McMillan, who superintended the construction of the East River gas tunnel, are interested.

CONTRACT PRICES.

PIPE SEWER.—Brooklyn, N. Y.—The following bids were received by T. B. Willis, Comr. Cy. Wks., Oct. 23, for a pipe sewer in Moffatt St., between Hamburg Ave. and Knickerbocker Ave., and in Hamburg Ave., between Cooper St. and Moffatt St.:

Items.	P. Farrell, $1,907.	J. Jennings, $1,622.	A. J. Puff, $1,587.	J. J. Maloney, $1,396.	John Bray, $1,329.	R. O'Grady, $1,400.	J. J. Creem, $1,278.
Pipe:							
18-in. cement..	$1.95	$1.59	$1.55	$1.35	$1.30	$1.50	$1.18
15-in. " ..	1.65	1.19	1.35	1.25	1.10	1.50	1.05
12-in. " ..	1.25	1.09	1.05	.90	.80	.80	.79
18-in. vitrified.	2.00	1.69	2.40	...	1.40	...	...
15-in. "	1.80	1.29	2.25	...	1.20	...	...
12-in. "	1.35	1.19	2.00	...	.90	...	...
Manholes	35.00	29.00	27.00	25.00	25.00	26.00	25.00
Basins	100.00	89.00	97.00	85.00	90.00	90.00	85.00
F'd'n plank ...	18.00	18.00	18.00	18.00	18.00	18.00	18.00
Concrete	1.00	3.50	1.00	1.00	4.00	.01	.01

STONE PAVING.—Camden, N. J.—L. E. Farnham, Cy. Engr., opened bids Oct. 23 for paving several streets, contracts being awarded as follows; all local bidders: Thos. A. Nelson, paving Fern St., 7th to 8th St., with granite blocks, $1.18 a sq. yd.; repaving, 12 cts.; removing old material, 8 cts. a sq. yd.; new flagstone, 27 cts. a lin. ft.; new curbstone, 30 cts. a lin. ft.; new gutter-stone, 16 cts. a lin. ft.; resetting gutter-stone, 2 cts. a lin. ft.; resetting curbstone, 3 cts. a lin. ft.; Wm. H. Sherman, rubble paving in Liberty St., 3d to 4th St., 63 cts., 8 cts., 5 cts., 23 cts., 30 cts., 75 cts., 1 ct. and 4 cts. respectively, for same items as in preceding contract; Wm. H. Sherman also received contract for rubble paving in St. John St., Royden St. to Line St., for which the bids were as follows:

Items.	B. F. Sweeten & Son.	Thos. A. Wilson.	Wm. H. Sherman.	F. A. Ward, agent.
Paving, sq. yd.	$0.65	$0.63	$0.64	$0.67
Repaving, sq. yd.	.09	.12	.08	.09
Removing old material, sq. yd..	.05	.08	.05	.09
New flagstone, lin. ft.	.26	.27	.23	.25
New curbstone, lin. ft.	.30	.30	.30	.27
New gutter-stone, lin. ft.	.16	.15	.15	.16
Reset gutter-stone, lin. ft.	.01	.02	.01	.02
Reset curbstone, lin. ft.	.04	.03	.04	.03

DREDGING.—Baltimore, Md.—Col. Peter C. Hains received the following bids Oct. 26 for dredging 5,000,000 cu. yds. in ship channel leading to harbor at Baltimore:

	Per cu. yd.	Total.
Morris & Cumings Dredging Co......	$.089	$445,000
American Dredging Co.	0884	442,000
Baltimore Dredging Co.	0875	437,500
Elijah Brainard.	10	500,000
Virginia Dredging Co.	0799	399,500

WATER MAIN.—East Cleveland, O.—The contract for laying a water main in Euclid Ave. has been awarded to Brennan & Decelle, at 31 cts. a ft. for 10-in. and 29 cts. for 8-in. pipe; contract for pipe awarded to the Lake Shore Foundry, at $19.45 a ton, delivered on street.

RIVER BANK PROTECTION.—Evansville, Ind.—The water-works trustees have voted to award the contract for river bank protection, as advertised in Engineering News, to Eichel, Arnold & Co., bids being received Oct. 15 as follows; L. Weinheimer, Clk.:

Bids Received at Evansville, Ind., Oct. 15, for River Bank Protection.

Quantities.		T. A. Kearns, Chicago.	Charles E. Shover, Indianapolis.	Bedford, Weikel & Nugent, Evansville.	Eichel Arnold & Co., Evansville.	Michael Weber & Co., Evansville.	Richardson & Young, Chicago.
Piling	31,700 lin. ft.	$0.25	$0.21½	$0.19¾	$0.19½	$0.32	$0.22
White oak wales	15,850 ft.	.02½	.026	.023	.02¼	.03	.023
Iron bolts and washers	12,500 lbs.	.03	.03½	.02¾	.03	.04	.03
Riprap filing	1,300 cu. yds.	1.26	1.25	1.76¼	1.20	1.20	1.20
Slope paving	3,000 " "	2.40	2.05	4.75	2.85	2.70	3.70
Total		$17,534	$15,446	$23,510	$17,023	$20,779	$20,374

LEVEE WORK.—Greenville, Miss.—A press report states that the board of Mississippi levee commissioners met in special session Oct. 15 and let contracts for levy work aggregating about 500,000 cu. yds., as follows: Greenville levee, section 1, to Johnson & Shippey, for 9.49 cts. a cu. yd.; Greenville levee, section 2, to Tim Sullivan, for 10.4 cts. a cu. yd.; Greenville levee, section 3, to Johnson & Shippey, for 10.88 cts.; Greenville enlargement, to C. A. Winter, for 23⅞ cts.; Ingomar levee, to Kennedy & Tracey, for 8.5 cts.; Seldens to Heaths, to A. & J. Wynne, for 10.5 cts.; Hall's landing levee, to John G. Sessions, for 10.99 cts.; Arcadia, to A. J. Roach, for 11.9 cts.

DRAINAGE DITCHES.—St. Paul, Minn.—The state drainage commission has awarded the contract for the extension of the Spring Creek ditch in Norman county: 16,000 cu. yds., to John Foley, at 9 cts. a cu. yd., to be completed in 30 days; contract for the extension of the Mustinka ditch in Grant county, 20,000 cu. yds., was awarded to W. E. Blaistead, at 8 cts. a cu. yd., to be completed in 30 days. O. H. Hoffman, Engr. Comn., was directed to examine all completed ditches and make necessary repairs.

CAST-IRON PIPE.—Holyoke, Mass.—The water commissioners received bids Oct. 19 for an additional 1,800 tons of 20-in. water pipe, and awarded the contract to the National Pipe & Foundry Works, at $20.35 a gross ton for pipe and 1.9 cts. a lb. for special castings. The bids received Sept 25 for 2,500 tons of 20-in. pipe, as advertised in Engineering News, were published in our issue of Oct. 1.

TELFORD ROAD.—Camden, N. J.—The following bids were received Oct. 13 by the town of Stockton, Camden county, for building a telford road on Cooper St., from Federal St. to Delaware River:

Items.	B. F. Sweeten & Son.	Shanley Bros.	[1]F. A. Ward, agent.
10-in. Telford, sq. yd	$0.67	$0.71	$0.72
Granite blocks, sq. yd	1,20	1.24	1.28
Covered gutter, lin. ft.	2.20	2.24	1.89
Extra earth excavation, cu. yd	0.15	0.15	0.18

[1] Awarded contract; injunction has been asked for by citizens.

RIP-RAP EMBANKMENTS.—Duluth, Minn.—The following bids were opened by Maj. Clinton B. Sears Oct. 20 for rip-rap embankment at Agate Bay, Minn., as advertised in Engineering News:

Bidder.	Embankment, 410 ft., per. ft.
Wm. H. Randall, West Duluth, Minn.	$91.34
Jacob H. Carlson, Duluth, Minn.	71.15
Samuel Menieee, Duluth, Minn.	84.20
Tulloch Bros. & Magee, Duluth, Minn.	85.90
A. & D. Sang, Duluth, Minn.	89.25
Jacob Zimmerman, Duluth, Minn.	75.48
Geo. R. King and Hugh Steele, Duluth, Minn.	71.90
Cooper & Doubleday, St. Paul, Minn.	157.98
Elisha G. Gay, Oneida, N. Y.	205.00
Wm. McCurdy, Houghton, Mich., and Alex. McCurdy, Duluth, Minn.	81.00
Powell & Mitchell, Marquette, Mich.	76.48
Porter Bros., Duluth, Minn. (accepted)	63.17
Walter H. Singer. Duluth, Minn.	85.00

Improvement of Erie Canal, Middle Division—Contract No. 1.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from the east line of Oneida county to a point 100 feet below the lower hollow quoin of Lock No. 46.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $6,800; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of coneract, $47,600; the amount of bond for the faithful performance of contract, on execution of contract, $68,000. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope. "Proposal for the improvement of the Erie canal, from the east line of Oneida county to a point 100 feet below the lower hollow quoin of Lock No. 46." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Erie Canal, Middle Division—Contract No. 2.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from a point 100 feet below the hollow quoin of Lock No. 49 to a point 100 feet below the lower hollow quoin of Lock No. 50.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $9,250; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $64,750; the amount of bond for the faithful performance of contract, on execution of contract, $92,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, from a point 100 feet below the lower hollow quoin of Lock No. 49 to a point 100 feet below the lower hollow quoin of Lock No. 50." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Erie Canal, Middle Division—Contract No. 3.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from a point 100 feet west of the upper hollow quoin of Lock No. 50 to 100 feet west of the center of Camillus Road Bridge.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $6,350; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $44,450; the amount of bond for the faithful performance of contract, on execution of contract, $63,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, from a point 100 feet west of the upper hollow quoin of Lock No. 50 to 100 feet west of the center of Camillus Road Bridge." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE.
43-3t Superintendent of Public Works.

Improvement of Erie Canal, Middle Division—Contract No. 4.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y. October 22d, 1896.

Pursuant to chapter 79, laws of 1895 and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from 100 feet west of the center of Camillus Road "113" to 100 feet west of the center of Peru Road Bridge.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $6,950; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $48,650; the amount of bond for the faithful performance of contract, on execution of contract, $69,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, from 100 feet west of the center of Camillus Road "113" to 100 feet west of the center of Peru Road Bridge." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE.
43-3t Superintendent of Public Works.

DRAINAGE CHANNEL.—Peoria, Ill.—The following bids were received Oct. 20 for the improvement of the old Farm Creek channel, as advertised in Engineering News; 10,000 ft. long, 50 ft. wide on bottom, 4 to 7 ft. deep; excavated material to be put in levees 150 ft. apart and 12½ ft. above grade of channel; Jacob A. Harman, Engr., Peoria:

Bidder.	Excavation, 100,000 cu. yds.	Clearing Timber, 35 acres.	% discount for cash.	Total.
Grant Smith & Co., Mendota, Wis.	$0.31	$20.00	10	$31,700
Crescent Stone Co., Peoria, Ill...	.1548	39.00	15	16,485
" " " Peoria, Ill...	.1397	34.50	4	15.177
McArthur Bros. Co., Chicago, Ill..	.14	40.00	15	15,400
*A. V. Wills & Sons, Pittsfield, Ill.	.09	10.00	2	9,350

*Accepted.

DREDGING.—Newport, R. I.—Maj. D. W. Lockwood received the following bids Oct. 21 for dredging 35,000 cu. yds. in Newport Harbor, as advertised in Engineering News:

	Per cu. yd.
Hartford Dredging Co., Hartford, Conn. (accepted)	$0.37
R. G. Packard, New York	.57½
Columbia Dredging Co., Fall River, Mass.	.53½

ASPHALT PAVING.—Kansas City, Mo.—Four contracts for asphalt paving were awarded Oct. 14, three to the Barber Asphalt Paving Co., at $2.12, $2.15 and $2.30 a sq. yd, and one to the Gilson company, at $2 a sq. yd. for bituminous asphalt, according to a local paper.

LEVEE WORK.—New Orleans, La.—The state board of engineers has awarded the contract for 50,000 cu. yds. of enlargement work in Plaquemines parish and the Lake Borgne levee district to V. Adema, at 10 cts. a cu. yd.

LIGONIER BLOCK PAVING.—Allegheny, Pa.—A contract for paving Overlook St. has been awarded to A. V. Purnell, at 30 cts. a cu. yd., for 1,500 cu. yds. excavation, 55 cts. a sq. yd. for 830 sq. yds. brick sidewalks, $1.68 a sq. yd. for 1,450 sq. yds. Ligonier block paving, 50 cts. a lin. ft. for 1,000 lin. ft. curbing, 70 cts. a lin. for 300 lin. ft. granite crossings.

PIPE SEWERS.—Lincoln, Ill.—T. S. Davey, Cy. Engr., writes us that the contract for constructing the Brainard Branch sewers has been awarded to Aur & Co., and that for the South Kickapoo St. sewer to David Mitchell, the bids being as follows:

Bids Received at Lincoln, Ill., Oc

Bidder.	24-in. pipe, 2,532 f
J. P. Shannahan, Chicago, Ill	$1.25
James H. Roach, Chicago, Ill	1.24
Aur & Company, Lincoln, Ill	.93
E. P. Hodgkins, Chicago, Ill	1.10
F. S. Selley, Lincoln, Il	.95
H. D. Hallett, Aurora, Ill	1.05
Wm. Davidson, Mattoon, Ill.	1.03
A. Mayfield, Lincoln, Ill	1.00
David Mitchell, Lincoln, Ill	....

CAST-IRON PIPE.—Brooklyn, N. Y.—The following bids were received by Theo. B. Willis, Comr. Cy. Wks., Oct. 23, for furnishing 48-in. cast-iron pipe for main relief sewer along Clinton Ave. bulkhead wall: McNeal Pipe & Foundry Co., $20.95 per 2,240 lbs. for 48-in. pipe, and $2.25 per 100 lbs. for special casting; Warren Foundry & Machine Co., $19.90 and $2.20.

[illegible] $2.55 for cut nails.

SCRAP.—Car wheels, $10.50 to $11.50; wrought turnings, $8.50 to $9; cast borings, $7.25 to $7.75, all delivered at purchasers' works; hammered car axles, $16 to $17, delivered at New York; wrought pipe and tube, $7.50 to $8,

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Improvement of Erie Canal, Midle Division—Contract No. 5.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superinendent of Public Works, Albany, N. Y., ctober 22d, 1896.

Pursuant to chapter 79, laws of 1895, nd chapter 794, laws of 1896, sealed proosals will be received by the Superintendnt of Public Works, at his office in Alany, N. Y.. until Tuesday, November 10th, 896, at 12 o'clock noon of that day, for he improvement of the Erie canal from 100 eet west of the center of Peru Road Bridge o 100 feet west of the lower hollow quoin of ock No. 51.

Plans, specifications, notices and form f contract may be seen from the date of ublication of this notice to the date fixed or the receipt of proposals, at the office f the Superintendent of Public Works in lbany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the ffice of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass he tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $7,050; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $49,350; the amount of bond for the faithful performance of contract, on execution of contract, $70,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposals for the improvement of the Erie canal, from 100 feet west of the center of Peru Road Bridge to 100 feet west of the lower hollow quoin of Lock No. 51." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Oswego Canal—Contract No. 6.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for building a stone apron to a portion of Phoenix dam and work connected therewith on the Oswego canal.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $650; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $4,500; the amount of bond for the faithful performance of contract, on execution of contract, $6,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for building a stone apron to a portion of Phoenix dam, and work connected therewith on the Oswego canal." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Oswego Canal—Contract No. 7.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for raising Braddock's dam on the Oswego canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall b agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $550; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $3,850; the amount of bond for the faithful performance of contract, on execution of contract, $5,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for raising Braddock's dam on the Oswego canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Oswego Canal—Contract No. 8.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for raising Minnetto dam on the Oswego canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $685; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $4,795; the amount of bond for the faithful performance of contract, on execution of contract, $6,850. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for raising Minnetto dam on the Oswego canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

price bid, $4,900. The plant is for the village of , N. Y.

TAYLOR & SON, 98 and 100 Indiana St., Chi- have recently filled an order for a sprocket chain, links made of 1½-in. iron, for operating canal lock nery at Lockport, N. Y.

TON F. WILLIAMS & CO., of St. Louis, are busy ntracts for their combined crusher and breaker, and naking shipments of their clutch pulleys and brick inery to all parts of the country.

E McLAGON MACHINE CO., New Haven, Conn., has a contract with the Charter Oak Brick Co., of Hart- for a complete new set of apparatus for manufactur- rick. The machinery will increase the capacity of harter Oak Co. to 50,000 brick per day.

E SAGINAW CLAY CO., Saginaw, Mich., has just a contract, it is said, to furnish the city of Battle 1,000,000 brick for paving purposes. The plant of ompany has been idle for some time, but it is now operated full time and with a full force of hands.

EARLE C. BACON, Havemeyer Bldg., New York Engr. of the Farrel Foundry & Machine Co., has received a large order for rock crushing machinery. order is from a mining company and is for 15 of the st crushers made. The capacity of the plant is 4,- tons daily.

E HARRISBURG FOUNDRY & MACHINE WORKS, isburg, Pa., has a contract to build two engines for lectric plant under construction at Rio de Janeiro, l. The company is building a similar engine for a at Chattanooga, Tenn., and is installing the engine e Goodrich House in Cleveland, O.

E EDGAR THOMSON STEEL WORKS, Pittsburg, has resumed work in all departments, after a two s' shut-down. The present order is from the Jap- e Government, and calls for 10,000 tons of steel rails. Carnegie Co.'s big works at Duquesne and Home- , are also again in full operation.

MR. R. D. KINNEY, 918 Filbert St., Philadelphia, Pa., has opened an office for the sale of the products of the R. S. Newbold & Son Co., of Norristown, Pa., among which is the Kinney internal-fired water tube boiler. One of these boilers is now being built for Mr. Drexel, as an addition to his "Public Ledger" newspaper plant.

MR. CHAS. A. TURNER, Pittsburg, Pa., manufacturer of the Dolomite sectional steam pipe covering, it is stated, has lately finished insulating the steam plants of J. Painter & Sons, Zugg & Co., Crescent Steel Co., Republic Iron Works, American Iron & Steel Works, Carbon Steel Co., Wm. Clark Sons & Co., Pittsburg Reduction Co., and Edith Furnace Co.

THE NATIONAL CHUTE & ENGINEERING CO., of Philadelphia, Pa., has moved its office to Room 714, Gerard Bldg. The company furnishes plans, specifications, estimates, etc., for the complete construction and equipping of gravity-steeplechases, chutes, toboggans, swaneries, etc., and makes a specialty of designing and equipping amusement resorts in their entirety.

THE LEECHBURG FOUNDRY & MACHINE CO., of Pittsburg, Pa., is said to have received an order from the United States Iron & Tin Plate Mfg. Co., Demmler, Pa., for a 14 × 16-in. heavy vertical engine. It has lately shipped a 22-in. cold rolling mill to the La Belle Steel Co., of Wheeling, W. Va., and a Mesta patent pickling machine to the Irondale Steel & Iron Co., Middletown, O.

THE YOUNGSTOWN BRIDGE CO., Youngstown, O., is furnishing the iron work for a new building for the Lloyd-Booth Co., Youngstown, O., 60 × 140 ft., with lean to 30 ft. wide. The building is of brick and iron. The building will be equipped with a Shaw electric traveling crane furnished by the Industrial Works, Bay City, Mich., and a Bement, Miles & Co. planer capable of planing 10 ft. wide and 30 ft. long. There will also be a Pond lathe with 54-in. swing, 30 ft. long.

COOGAN & KALVELAGE, Milwaukee, Wis., have purchased the plant of the National Blower Co., at 17th St. and St. Paul Ave., and will operate under the firm name

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Improvement of Oswego Canal—Contract No. 9.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for raising High Dam on the Oswego canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $900; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $6,300; the amount of bond for the faithful performance of contract, on execution of contract, $9,000. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for raising High Dam on the Oswego canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Oswego Canal—Contract No. 10.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for raising Oswego dam on the Oswego canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $2,165; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $15,155; the amount of bond for the faithful performance of contract, on execution of contract, $21,650. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for raising Oswego dam on the Oswego canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Oswego Canal—Contract No. 11

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for improving Lake Ontario level of the Oswego canal.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $1,650; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $11,550; the amount of bond for the faithful performance of contract, on execution of contract, $16,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for improving Lake Ontario level of the Oswego canal." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Erie Canal, Middl Division—Contract No. 12.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for improving Lock No. 46, Erie canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $825; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $5,775; the amount of bond for the faithful performance of contract, on execution of contract, $8,250. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for improving Lock No. 46, Erie canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

of National Blower Works. They are prepared to manufacture steam hot blast apparatus for heating, ventilating and drying purposes. They furnish dry kiln work, planing mill exhausters, ventilating wheels, engines, etc. A finely illustrated catalogue has just been issued, which shows a variety of blowers and exhausters, suitable for all kinds of work in this line.

MR. H. SHEELER, 83 Washington St., Chicago., has the contract for moving a church for Athens College, Athens, O.; for a heavy job of shoring on the Union Station at Columbus, O., and has recently completed the raising of a large factory at Marietta, O. Mr. C. H. Rector, manager for Mr. Sheeler, advises us that he has several contracts on hand in Chicago, among them the overhauling and moving of all the buildings at Fisher's Garden; the raising of the J. W. Butler Co.'s paper house; a contract with the South Side St. Ry. Co., and several other contracts.

THE BERLIN IRON BRIDGE CO., East Berlin, Conn., will erect for the Union Traction Co., of Rutherford, N. J., a new power house and car barn. The buildings will be of brick, with steel frame-work, and the plant when completed will be up to date in all respects. The car barn is 97 × 100 ft., adjoining which will be the offices, storerooms and repair shop. The engine-room is 50 × 65 ft., and the boiler-room 40 × 65 ft. The roofs are supported on steel trusses, and the covering is to be corrugated iron throughout. The roof of the engine-house is lined with the Berlin Co.'s patent anti-condensation fireproof roof lining, which gives protection against fire and condensation.

MR. WILLIS SHAW, No. 506 New York Life Bldg., Chicago, reports having recently shipped a car load of hoisting engines to Watkins & Hardaway, at Anderson, S. C., and a pumping and hoisting plant to the Egypt Gold Mining Co., and G. W. Hess, of McDuffie county, Ga., Mr. W. E. Howley, of Pittsburg, who was recently awarded the boulevard contract there, has just contracted with Mr. Shaw for a narrow gage locomotive and a number of hoisting engines; and Mr. Jos. J. Duffy, of Chicago, is being supplied with an air compressing plant, boilers, rock drills, etc., for the construction of the new water tunnel. Other sales reported are: Hoisting outfits to the Ontario Gold Mines Co., of Seine River, Canada; Willard & Cornwell, at Louisville, Ky.; Benezette Williams, at Joliet, Ill.; Russell & Ravell, Terre Haute, Ind.; and the Southern California Mountain Water Co., at San Diego.

THE ARMINGTON & SIMS ENGINE CO., Providence, R. I., is reported as working on the following orders: Two engines, 8 × 9 ins., 30 HP. each, for an isolated lighting plant in Reading, Pa.; one engine, 15 × 12 ins., 100 HP., for the new municipal lighting plant of Quakertown, Pa.; one engine, 27 × 18 ins., 400 HP., for the Nanticoke (Pa.) Electric Light Co.; one engine, 13 × 12 ins., 100 HP., for the Stearns-Roger Mfg. Co., Denver, Colo.; one engine, cross compound, 16½ and 23 × 15 ins., 250 HP., for the Baltimore & Ohio tunnel plant, fifth order; one engine, third order ,18½ × 18 ins., 200 HP., for Wilkesbarre (Pa.) Electric Light Co.; one engine, tandem compound, third order, 13 and 20½ × 15 ins., 200 HP., for Bridgeport (Conn.) Electric Light Co.; one engine, cross compound, 18 and 32 × 18 ins., 600 HP., fifth order, for Hyde Park (Mass.) Electric Light Co.; one engine, cross compound, fourth order, 18 and 32 × 18 ins., 600 HP., London (Ont.) St. Ry. Co. Since June 4 engines were shipped as follows: One engine, 75 HP., to Pennsylvania R. R., Hoboken, N. J.; two engines, 50 HP. each, for a new opera house in a city of Brazil; one engine, 35 HP., James F. Moore & Co., Boston; two engines, 45 HP., to E. P. Hampson & Co., 36 Cortlandt St., New York; three engines, 160 HP., four of 100 HP. each, for the Havemeyer Building, New York; one engine, 100 HP., for Frederick Hollender & Co., New York; three engines, 150 HP. each, State Mutual Life Assurance Co., Worcester; two engines, 200 HP. each, to Hollingsworth & Whitney Co., Paper Mill, Waterville, Me.; one cross compound engine, 250 HP., to Middletown (N. Y.) Electric Light Co.; one engine, 200 HP., to Hyde Park (Mass.) Electric Light Co.; one engine, 100 HP., and one engine, 150 HP., to Peace Dale (R. I.) Mfg. Co.; one engine, 60 HP., to Rowland Hazard, Esq., Mine LaMotte, Mo.

NEW COMPANIES.—The Nassau Construction Co., Newark, N. J.; to carry on a general contracting business; $10,000; commencing with $5,000; J. H. Carson, Perry Tiffany, Danl H. Shea, all of New York city.

Cobleskill Telephone Co., Cobleskill, N. Y.; $6,000; D. C. Dow, M. Harder, L. A. Hodge and others, of Cobleskill.

V. C. & C. V. King Co., New York city; to manufacture calcine plaster and cement; $50,000; C. Volney King, Vincent C. King, Jr., and Edwin H. Price, of New York city.

Fresno Planing Mill & Furniture Factory, Fresno, Cal.; to do general planing and mill business; $10,000; W. H. Hollenbeck, J. F. Hall, F. K. Prescott.

United States Malleable Iron & Steel Co., Chicago; to mine iron, minerals, etc.; $100,000; Henry H. Blake, Frank J. Kilcrane and Manuel Friendlander.

Stubbs Steel Co., Camden, N. J.; to manufacture iron and steel;; $25,000, commencing with $10,000; Wm. H. Stubbs, Isaac J. H. Stubbs, Philadelphia, Pa.; Robt. Simona, West Chester, Pa.

Monarch Iron Co., Duluth, Minn.; $200,000; S. W. Eckman, Arthur Howell and T. W. Wahl, all of Duluth.

American Tunnel Co., Charleston, W. Va.; to deal in mining property and to construct tunnels; $2,500,000, commencing with $50; A. E.Humphreys, Jno. B. White, Geo. S. Chilton.

Mariposa Quartz Mill Co., New York city; to deal in mining machinery; $1,000,000, commencing with $50; Henry A. Kirkham, Walter Cooper, Francis J. Kirkham, all of Brooklyn, N. Y.

Crescent Elevator Co., Minneapolis, Minn.; $100,000, commencing with $1,000; Chas. M. Harrington, Fred C. Van Dusen, Wilbur J. Hartzell, all of Minneapolis, Minn.

Mixer Ice Machine Co., Paterson, N. J.; $300,000, commencing with $100,000; William M. Mixer and Wallace A. Downey, of New York; Warren B. Hutchinson, of Passaic City, N. J.

Improvement of Erie Canal, Middle Division—Contract No. 13.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for improving Lock No. 49, Erie canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $800; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $5,600; the amount of bond for the faithful performance of contract, on execution of contract, $8,000. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for improving Lock No. 49, Erie canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Erie Canal, Middle Division—Contract No. 14.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for improving Lock No. 50, Erie canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $825; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $5,775; the amount of bond for the faithful performance of contract, on execution of contract, $8,250. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for improving Lock No. 50, Erie canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE.
43-3t Superintendent of Public Works.

Improvement of Oswego Canal—Contract No. 15.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for rebuilding and lengthening Lock No. 18, Oswego canal, at Oswego, and for other work incident thereto.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $3,300; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $23,100; the amount of bond for the faithful performance of contract, on execution of contract, $33,000. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for rebuilding and lengthening Lock No. 18, Oswego canal at Oswego, and for other work incident thereto." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE.
43-3t Superintendent of Public Works.

Improvement of Erie Canal, Eastern Division—Contract No. 1.

NEW YORK STATE CANALS — NOTICE to Contractors — Office of the Superintendent of Public Works, Albany, N. Y., October 17th, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Monday, November 2d, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from Lock No. 18 to Lock No. 19.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works, as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works, for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $10,000; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $70,000; the amount of bond for the faithful performance of contract, on execution of contract, $100,000. All proposals for the above work must be addressed to the Superintendent of Public Works, at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, from Lock No. 18 to Lock No. 19." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE, /
43-2t Superintendent of Public Works.

Montgomery Construction Co., Baltimore, Md., to improve land and construct streets and railways; $100,000; George E. Teeple, Austin McLanahan, Charles H. Byrne, Henry W. Williams.

Sydnor Pump & Well Co., Richmond, Va.; to manufacture and sell all kinds of water-pumping appliances; $15,000; Thomas Jeffress, J. Clements Shafer, Thomas G. Sydnor.

Amazonas Co., Newark, N. J.; to build and operate railways in Venezuela; $1,000,000, commencing with $225,000; Jacob V. Olcott, R. Morgan Olcott, J. Machado Pinto, all of New York city.

Sumner Iron Works, Everett, Wash.; $90,000; T. B. Sumner, F. W. Sumner.

Electric Light, Power & Conduit Co., St. Louis, Mo.; $50,000; Samuel M. Dodd, James Campbell, James W. Bell.

United Milling Co., Syracuse, N. Y.; to deal in mining machinery and properties; $50,000; Lewis F. Smith, C. T. Blanchard and F. O. Fulmer, of Syracuse.

Murray Land & Improvement Co., Brooklyn, N. Y.; to deal in real estate and erect buildings; $25,000; Charles D. King, Wilkins E. Putnam, W. J. Northridge, Mary E Murray.

Fort Pitt Stone & Brick Co., of Carnegie, Pa.; $50,000, commencing with $5,000; William H. Roberts, Robert J. Hardy, George T. Kirkbride.

Ohio Producing Co., Wheeling, W. Va.; to engage in producing and distributing oil; $250,000, commencing with $25,000; E. Opperman, D. L. Sherbondy, H. F. Lyman, Cleveland, O.

New York Wire Nail Co., New York city; $250,000, commencing with $100; H. G. Hochstadter, Geo. O. Macnabb, Jno. T. Easton, all of New York city.

Clinton Mills Power Co., Clinton Mills, N. Y.; $10,000; George Brooks, George M. Jervis and E. V. Adams, of Cooperstown.

Carbondale Mills Elevator Co., Carbondale, Ill.; $5,000; O. A. Harker, F. A. Prickett, J. M. Dillinger.

Evens & Howard Fire Brick Co., St. Louis, Mo.; $500,000; John Shaffer, J. T. Howard, Ellis L. Evans, Benjamin W. Clark.

Williams Oil & Gas Co., Wheeling, W. Va.; to produce oil and gas; $25,000, commencing with $40; Jno. E. Clator, W. H. Hormish and H. L. McKnown.

Brooklyn Ice Skating Co., Brooklyn, N. Y.; $100,000; J. De Courcy Ireland, A. F. Ireland, Edward T. Paul and Woolsey Carnalt, of New York, and Walter S. Brewster, of Brooklyn.

Smith-Vassar Telephone & Telegraph Co., Boston, Mass.; $1,100,000, commencing with $1,000; John W. Chandler, Brooklyn, Mass.; Wm. G. Burnham, Boston, Mass.; Geo. Kempton, Sharon, Mass.

Spokane Sandstone Co., Spokane, Wash.; $250,000; J. F. Price, J. W. Douglas, George Thrader.

Last Chance Mining & Milling Co., Spokane, Wash.; $500,000; E. H. Tomlinson, W. J. C. Wakefield, Spokane; W. A. Hendryx, Los Angeles, Cal.

Dominion Paving and Contracting Co., Toronto, Ont.; $25,000; D. Van Vlack, C. A. Masten and J. Kilgour.

American Carbide Co., New York city; to manufacture calcium carbide; $1,500,000, commencing with $100; Chas. C. Adams, Arthur W. Tobey, Benj. H. Moore, Philadeuphia, Pa.

Octagon Oil & Gas Co., Sistersville, W. Va.; $250,000, commencing with $8,000; J. A. Kennedy, James Kennedy and Frank Lawrence.

United States Air Brake Co., Philadelphia, Pa.; to manufacture air brakes and railway appliances; $5,000,000, commencing with $500; Geo. N. Torrence, Jas. H. Wilson and A. J. Wisner.

Cycle Components Co., New York city; to manufacture bicycles and bicycle appliances; $25,000, commencing with $100; Alvin L. Strasburger, Wm. H. Cashen and Robert Perkins, Rockaway, N. J.

Beckford Water Heating Co., Pittsburg, Pa.; to manufacture iron and steel; $1,000; treas., James Duncan, Jr., Pittsburg.

Gas Generator Co., Chicago, Ill.; to deal in patents; $25,000; Charles S. Burton, E. T. Wray and L. W. Johnstone.

Tatro Mfg. Co., Beaver Falls, Pa.; to manufacture iron and steel, $30,000; commencing with $3,000; Geo. Davidson, New Brighton, Pa.

Corsicana Shippers' Compress Co., Corsicana, Tex.; $30,000; Claude W. Jester, W. A. Polk and Geo. T. Jester.

Minneapolis Wire & Iron Works, Minneapolis, Minn.; $25,000, commencing with $5,000; F. A. Clarke, F. E. Tucker, J. D. Coskey.

Joint Railway & Steamer Transfer Co., New York city; $25,000; Caleb Haley, Fred S. Roselle, George T. Moon.

Nova Scotia Construction Co., New Brunswick, N. J.; to construct railways, wharves, etc.; $50,000, commencing with $5,000; Charles R. Strong, Robt. B. Strong, and James D. Murray.

West Coast Construction Co., Jersey City, N. J.; to construct railways and public works; $10,000, commencing with $1,000; Chas. H. Seaman, Trenton, N. J.; Alex. Bogey, Brooklyn, N. Y.; Homer K. Peck, Tenafly, N. J.

Improvement of Erie Canal, Eastern Division—Contract No. 2.

NEW YORK STATE CANALS — NOTICE to Contractors — Office of the Superintendent of Public Works, Albany, N. Y., October 17th, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Monday, November 2d, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from Lock No. 20 to Lock No. 21.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works, as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works, for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $2.900; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $20,300; the amount of bond for the faithful performance of contract, on execution of contract, $29,000. All proposals for the above work must be addressed to the Superintendent of Public Works, at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, from Lock No. 20 to Lock No. 21." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Erie Canal, Eastern Division—Contract No. 3.

NEW YORK STATE CANALS — NOTICE to Contractors — Office of the Superintendent of Public Works, Albany, N. Y., October 17th, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Monday, November 2d, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from Lock No. 27 to Lock No. 28.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works, as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works, for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $3,750; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $26,250; the amount of bond for the faithful performance of contract, on execution of contract, $37,500. All proposals for the above work must be addressed to the Superintendent of Public Works, at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, from Lock No. 27 to Lock No. 28." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-2t Superintendent of Public Works.

Improvement of Erie Canal, Eastern Division—Contract No. 4.

NEW YORK STATE CANALS — NOTICE to Contractors — Office of the Superintendent of Public Works, Albany, N. Y., October 17th, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Monday, November 2d, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from Lock No. 28 to Lock No. 29.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works, as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works, for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $1,650; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $11,550; the amount of bond for the faithful performance of contract, on execution of contract, $16,500. All proposals for the above work must be addressed to the Superintendent of Public Works, at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal from Lock No. 28 to Lock No. 29." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-2t Superintendent of Public Works.

Improvement of Erie Canal, Eastern Division—Contract No. 5.

NEW YORK STATE CANALS — NOTICE to Contractors — Office of the Superintendent of Public Works, Albany, N. Y., October 17th, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Monday, November 2d, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from Lock No. 32 to Lock No. 33.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works, as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works, for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $4,500; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $31,500; the amount of bond for the faithful performance of contract, on execution of contract, $45,000. All proposals for the above work must be addressed to the Superintendent of Public Works, at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, from Lock No. 32 to Lock No. 33." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-2t Superintendent of Public Works.

Contract Work Should Always be Advertised in a Paper Read by Contractors.

Nearly Every Prominent Contractor and Manufacturer of Contractors' Supplies in North America Reads Engineering News

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PERSONALS.

Mr. Lemuel Rich, contractor of North Adams, Mass., died Oct. 24.

Mr. Jas. C. Danforth, contractor, of Bay City, Mich., died Oct. 31.

Mr. John F. Roller, at one time Deputy Commissioner of Public Works, of Syracuse, N. Y., died Oct. 22.

Mr. Oscar Arcand, civil engineer, of New York city, was married Oct. 28, to Miss Ella Cooke, of Montreal, Que.

Mr. M. H. Dooley has been appointed Superintendent of the Northeastern R. R., of Georgia, with office at Athens, Ga.

Mr. S. T. Smith has been elected President of the Florence & Cripple Creek R. R., with headquarters at Denver, Colo.

Mr. C. H. Patterson has been appointed Superintendent of the city power dam, water and electric light plant of Austin, Tex.

Lieut. P. J. Werlich, U. S. Navy, has been ordered on steel inspection duty at the works of the Bethlehem Iron Co., South Bethlehem, Pa.

Mr. E. A. Richards has been appointed General Manager of the North Eastern R. R., of Georgia, with headquarters at Athens, Ga.

Mr. H. F. Dowst has been appointed Superintendent of the Eastern Division of the Maine Central R. R., with headquarters at Bangor, Me.

Mr. A. M. Stark has been appointed Superintendent of the Pecos River R. R., with office at Pecos, Tex., to succeed Mr. C. E. Pollock, resigned.

Mr. H. T. Woods, Secretary of the Tabor & Northern Ry., has been elected General Manager and Master Mechanic, with headquarters at Tabor, Ia.

Mr. Matthew Roderick, civil engineer, of Seattle, Wash., was killed in a duel with a foreman of the Cariboo Mining Co., near Camp McIlney, B. C., Oct. 28.

Mr. Frank B. Durfey, contractor, of Norwich, Conn., died Oct. 25, aged 47. He was Superintendent of the Norwich Water Power Co. for several years.

Mr. James K. Lyons, Assoc. M. Am. Soc. C. E., of Pittsburg, Pa., has been appointed Chief Draftsman of the Bridge Department of the Carnegie Steel Co.

Lieut. Robt. E. Peary, Civil Engineer, U. S. N., whose leave of absence for arctic exploration has expired, has been ordered to duty at the New York Navy Yard.

Mr. Wm. H. McDoel, Vice-President and General Manager of the Louisville, New Albany & Chicago Ry., has been appointed Receiver, with office at Chicago, Ill.

Mr. David H. Darling, formerly connected with the New York Belting & Packing Co., of New York city, is now a Manager of the Mercer Rubber Co., of the same city.

Mr. William Patton Powell, civil engineer, of the City of Mexico, was married Oct. 22 to Miss Ethel Louise Alford, daughter of the Hon. Lore Alford, of Waterloo, Ia.

Mr. Oliver C. Smith, civil engineer, with O'Keefe & Orbison, paper-mill architects and builders, of Appleton, Wis., was married Oct. 21 to Miss Louise Reilly, of that city.

Mr. Henry Kistner has been appointed General Foreman of Motive Power and Car Departments of the Monterey Mexican Gulf R. R., with headquarters at Monterey, Mexico.

Mr. William A. Heindle, civil engineer and Superintendent of the Metropolitan Ry. Co., of Washington, D. C., was married Oct. 28, to Miss Mary Elizabeth Powell, of Baltimore, Md.

Mr. Stephen S. Gregory, Fellow in Civil Engineering, of Cornell University, Ithaca, N. Y., committed suicide Oct. 29. He was 21 years of age and was a graduate of the University of Texas.

Mr. Phineas W. Sprague, of Boston, Mass., has been appointed by the U. S. Circuit Court of that state as Temporary Receiver of the Blackstone Valley Street Ry. Co., of Blackstone, Mass.

Mr. W. W. Atterbury, Master Mechanic of the shops of the Pennsylvania Lines West of Pittsburg, at Fort Wayne, Ind., has been appointed Superintendent of Motive Power of the Pennsylvania R. R., at Altoona, Pa., to succeed Mr. J. M. Wallis, whose promotion to the office of General Superintendent was announced in our last issue.

Mr. E. R. Bossange, architect, of New York city, has been awarded the annual prize of the exhibition of the Society of Beaux Arts, held at the rooms of the Architectural League in that city.

Mr. Monroe Greenwood, President of the California Electrical Works, and Vice-President of the Sunset Telephone & Telegraph Co., of San Francisco, Cal., died at San Mateo, Cal., Oct. 11, aged 68.

Mr. M. E. Bates, of Chicago, Ill., for many years with the Edison Manufacturing Co. in the capacity of an electrical engineer, has accepted a position in charge of the electric lighting plant at Verde, Ariz.

Mr. R. G. Matthews, formerly General Superintendent of the Buffalo, Rochester & Pittsburg Ry., has accepted a position with the American Signal Co., of Baltimore, Md., with headquarters in Columbus, O.

Mr. Thomas J. Fay, formerly New York representative and General Manager of the C. & C. Electric Co., of New York city, has resigned and will open an office shortly as a consulting electrical engineer.

Mr. P. Ryan has been appointed Superintendent of the Montana Division of the Great Northern Ry. Line, with headquarters at Kalispell, Mont., to succeed Mr. W. Hale, whose resignation was noted last week.

Mr. L. J. W. Jones, Chief Chemist of the Omaha & Grant Smelting Co., of Omaha and Denver, Neb., has been appointed Professor of Analytical Chemistry at the Colorado State School of Mines, Golden, Colo.

Mr. Geo. H. Barrus, M. Am. Soc. M. E., has formed a partnership with Mr. W. S. Monroe, under the firm name of Barrus & Monroe, as mechanical and electrical engineers, with an office in The Rookery, Chicago.

Mr. W. W. Tomlinson has been appointed Chief Engineer of the New Orleans & Western R. R., with headquarters at New Orleans, La., to succeed Mr. C. B. Beasom, whose resignation was announced last week.

Mr. W. F. Durfee, M. Am. Soc. M. E., of New York city, will deliver a lecture Nov. 17 at the Colt Memorial Building, New Haven, Conn., on the subject: "Hero of Alexandria and the Arts and Mechanism of His Time."

Prof. Geo. C. Tilden, for many years Professor of Analytical Chemistry at the Colorado State School of Mines, Golden, Colo., has resigned to take charge of an important mining commission. He is at present in Aukland, New Zealand.

Mr. Samuel Campbell, civil engineer, of England, died Oct. 27, at Fair Haven Heights, Conn. He finished a professional engagement of eight months in the South, several weeks ago, and was visiting relatives preparatory to returning to England.

Mr. Henry K. McHarg, President of the Texas Central R. R., has been elected President of the Marietta & North Georgia Ry. This road has been purchased by a new company and will hereafter be known as the Atlanta, Knoxville & Northern Ry., and Mr. Eugene C. Spalding, Receiver of the old road, has been elected Vice-President.

Lieut. Col. Henry C. Stanley, M. Inst. C. E., Chief Engineer of Railways for Queensland, Australia, is in this country on a tour of inspection of American railway methods of construction and operation, and also methods of storing and shipping dressed meats in the interests of the Colonial Government. He will visit most of the large Western railways.

Mr. George H. Thomson, M. Am. Soc. C. E., and Mr. Virgil S. Bogue, M. Am. Soc. C. E., have been appointed respectively by Mayor Wurster, of Brooklyn, and Mayor Strong, of New York, as members of the board of experts which will report on the question of running the surface railway cars or elevated railway cars over the New York and Brooklyn Bridge. We noted the appointment of Mr. L. L. Buck, M. Am. Soc. C. E., as the other member of this board last week.

Gen. Joseph T. Torrence, at one time in the iron and steel business in Chicago, Ill., and a well-known figure in Chicago financial and railway circles, died Nov. 1, aged 53. He was born in Mercer county, Pa., and began active life as a blacksmith in a blast furnace at Sharpsburg, Pa. He became foreman of the shop at the age of 17 and at the outbreak of the war enlisted in an Ohio regiment. He accumulated a great fortune in business in Chicago, and during the latter years of his life devoted his energies to a comprehensive scheme for the economical handling of freight by the railways entering Chicago.

Mr. William A. Harris, manufacturer of the Harris-Corliss engine, of Providence, R. I., died Oct. 29, of cancer of the stomach. He was born in Woodstock, Conn., March 2, 1835, and went to Providence in 1838. From 1840 to 1846 he lived in North Adams, Mass. In 1855 he entered the employ of the Providence Forge & Nut Co., now known as the Rhode Island Tool Co., as a draftsman. In 1856 he entered the service of the Corliss Steam Engine Co., in the same capacity, and remained until Aug., 1864, when he began business on his own account. In 1883 he was a member of the Common Council and also a member of the lower house of the General Assembly.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Nov. 6. Secy., O. Von Geldern, 819 Market St., San Francisco, Cal.
CHICAGO ELECTRICAL ASSOCIATION.
Nov. 6. "The Metric System in Electrical Industries," by F. S. Hickok. Secy., J. R. Cravath, 810 Old Colony Bldg.
ENGINEERS' CLUB OF PHILADELPHIA.
Nov. 7. "The Queen Lane Division of the Philadelphia Water Supply System," by Allen J. Fuller. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERS' CLUB OF KANSAS CITY.
Nov. 9. Secy., F. W. Tuttle, Baird Bldg.
DENVER SOCIETY OF CIVIL ENGINEERS.
Nov. 10. Secy., Walter Pearl, 36 Jacobson Bldg.
NORTHWEST RAILWAY CLUB.
Nov. 10. Secy., T. A. Foque, Soo Line, Minneapolis.
NORTHWESTERN SOCIETY OF ENGINEERS.
Nov. 10. Secy., D. W. McMorris, 635 Burke Block, Seattle, Wash.
RAILWAY SIGNALLING CLUB.
Nov. 10. Secy., Geo. M. Basford, The Rookery Bldg., Chicago.
ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
Nov. 10. Secy., Daniel Carhart, 410 Penn Ave., Pittsburg.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Nov. 10. "Structural Steel for Ships," by J. R. Oldham. Secy., F. A. Colburn, Case Library Bldg.
WISCONSIN POLYTECHNIC SOCIETY.
Nov. 10. Secy., W. K. Means, Loan and Trust Bldg., Milwaukee, Wis.
NEW ENGLAND RAILROAD CLUB.
Nov. 11. Secy., Edw. L. Jones, P. O. box 1158, Boston.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Nov. 12. Secy., James K. Zollinger, Norton Bldg., Louisville, Ky.
ENGINEERING ASSOCIATION OF THE SOUTH.
Nov. 12. Secy., L. P. Brown, Nashville, Tenn.
SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
Nov. 12, 13 and 14.—The fourth general meeting to be held at No. 12 W. 31st St., New York city.
CENTRAL RAILWAY CLUB.
Nov. 13. Secy., H. D. Vought, Buffalo "Courier," Buffalo, N. Y.
MONTANA SOCIETY OF ENGINEERS.
Nov. 14. Secy., Forrest J. Smith, Denver Block, Helena.
INDIANAPOLIS ENGINEERING CLUB.
Nov. 14. Secy., C. C. Brown, Indianapolis, Ind.
ENGINEERS' CLUB OF MINNEAPOLIS.
Nov. 16. Secy., Elbert Nexsen, 1620 S. E. 4th St., Minneapolis, Minn.
WESTERN RAILWAY CLUB.
Nov. 17. Secy., W. D. Crossman, The Rookery, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
Nov. 17. Secy., F. W. Hart, 15th and H Sts., N. W., Washington, D. C.
ENGINEERS' AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Nov. 18. Secy., F. Van Vleck, Los Angeles.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Nov. 18. Secy., J. A. Pilcher, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Nov. 18. Secy., S. E. Tinkham, City Hall.
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Nov. 18. Secy., R. W. Pope, 26 Cortlandt St., New York city.
WESTERN FOUNDRYMEN'S ASSOCIATION.
Nov. 18. Secy., A. Sorge, Marquette Bldg., Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
Nov. 18. "Steel Frame Construction of High Buildings," by Julius Baier. Secy., Wm. J. Bryan, Turner Bldg.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Nov. 18. Secy., C. W. Hunt, 127 E. 23d St., New York.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 19. Kimball House, Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
ENGINEERS' CLUB OF CINCINNATI.
Nov. 19. Secy., J. F. Wilson, P. O. box 333.
NEW YORK RAILROAD CLUB.
Nov. 19. "Compressed Air Motors in Railway Service." Secy., W. W. Wheatly, 168 Montague St., Brooklyn, N. Y.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Nov. 19. Secy., C. H. McLeod, Montreal, Can.
TACOMA SOCIETY OF CIVIL ENGINEERS AND ARCHITECTS.
Nov. 20. Secy., 201 Washington Bldg., Tacoma, Wash.
ENGINEERS' CLUB OF COLUMBUS.
Nov. 21. Secy., M. S. Hopkins, 14½ N. High St., Columbus O.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 1, 2, 3, 4. Meeting to be held at the Society House, New York city. Secy., F. R. Hutton, 12 W. 31st St., New York city.
WESTERN SOCIETY OF ENGINEERS.
Dec. 2. Secy., N. L. Litton, Monadnock Block, Chicago.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Dec. 7. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF WESTERN NEW YORK.
Dec. 7. Secy., Carleton Greene, Library Bldg., Buffalo.
NORTHWESTERN TRACK AND BRIDGE ASSOC.
Dec. 11. Secy., D. W. Meeker, St. Paul, Minn.
AMERICAN SOCIETY OF IRRIGATION ENGINEERS.
Dec. 11 and 12. Annual meeting to be held in Denver, Colo. Secy., John S. Titcomb, Room 36, Jacobson Bldg., Denver, Colo.
NATIONAL IRRIGATION CONGRESS.
Dec. 15, 16 and 17. Annual meeting to be held in Phoenix, Ariz. Secy., C. M. Heintz, Los Angeles, Cal.

WESTERN SOCIETY OF ENGINEERS.—On Oct. 16 and 17 a large number of the members visited the Bedford Stone Quarries in Indiana, the Louisville (Ky.) Cement Works and Louisville Water-Works.

DETROIT ENGINEERING SOCIETY.—At the meeting of Oct. 16, A. George Mattson, of the Detroit Drydock Co., read a paper on the progress in building marine engines on the Great Lakes. The question of economy in the consumption of fuel with decrease in speed and power was debated.

AMERICAN GAS LIGHT ASSOCIATION.—At the annual convention, which met in St. Louis, Oct. 27, 28 and 29, the following papers were presented: "A Discussion of the Methods Employed in Introducing Gas Stores," by Chas. H. Nettleton; "Some Experiments in Interior Illumination," C. H. Page, Jr.; "Inclined Retorts Up To Date," Frederick Egner; "A Modern Retort House," W. A. Miller; "The Separation of Water Gas Tar," A. S. Miller.

THE CIVIL ENGINEERS' CLUB OF CLEVELAND.—A meeting was held Tuesday evening, Oct. 27. Mr. Cecil L. Saunders read a paper on "Gas Producers and the Mechanical Handling of Fuel." The subject was presented under the following heads: A discussion of the various types, the necessity for attention to detail of construction, the relation of character of coal to type to be used, a possible field for future economy, coal handling from hoppers and unloading coal by mechanical devices. Messrs. E. A. Sperry, A. Mordecai, J. W. Seaver, C. M. Barber and John McGeorge engaged in the discussion.

F. A. Coburn, Secy.

WESTERN FOUNDRYMEN'S ASSOCIATION.—The regular monthly meeting of the Western Foundrymen's Association was held at the Great Northern Hotel, Oct. 21, 1896. The meeting was called to order by Wm. Ferguson, Vice-President. Applications for membership by the Ingersoll-Sergeant Drill Co. of New York for active, and Henry W. Carter, of Chicago, for associate membership, were acted upon and the applicants were duly elected. The Secretary then read the report of the committee on apprenticeship. After the reading of the report it was decided to postpone the formal discussion until a later meeting. The Secretary was instructed to write several interested people requesting them to present written discussions of this report. The meeting then adjourned.

FRANKLIN INSTITUTE.—At the meeting on Wednesday evening, Oct. 21, Mr. Walter Atlee read a paper on "The Improvement of the Channel of the Delaware River," which embraced an historical summary of what had been accomplished, a detailed statement of the plans at present being carried out by the government engineers, and the ultimate purpose of the channel improvement work. The speaker illustrated his paper with the aid of a large chart giving a section of the river bottom in mid-channel, from Philadelphia to deep water in the Bay, upon which was drawn, for comparison, the 26-ft. line at mean low water, the depth to be obtained by the present and prospective plans of the government engineers.

Among those taking part in the discussion were Messrs. Chas. H. Cramp, L. Y. Schermerhorn, L. M. Haupt and John C. Trautwine.

ENGINEERS' CLUB OF ST. LOUIS.—At the regular meeting of Oct. 21, Mr. Wm. H. Bryan, M. Am. Soc. C. E., read a paper on "Boiler Efficiency, Capacity and Smokelessness with Low Grade Fuel." The discussion among the mechanical engineers of this country regarding the best method of expressing the economic performance of boilers was explained, and the revision of the generally accepted code for making boiler trials shown to be necessary. The author advocated the statement of boiler efficiency in the percentage realized of the calorific value of the fuel, taking care that the coal used be carefully sampled, and its calorific power determined by the most accurate means possible. He presented a table giving the results of a large number of trials made to determine the efficiency and smokelessness of various types of boilers, with and without improved settings. The paper was accompanied also by a table of fuel analyses and calorific determinations covering all the common Southern Illinois coals. William H. Bryan, Secy.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—At the meeting held on Sept. 20, Mr. Gustave Kaufman read a paper on "Hydraulic Power Transmission." After a brief history of the art of distributing hydraulic power from central stations to many consumers in cities in England, a short description of the plant of the London Hydraulic Power Co. was given. Formulas were presented to show the method of calculating the amount of power in any given quantity of high pressure water. The purpose of the paper was to show the application of a hydraulic system to the uses of Pittsburg, claiming that with this system a relief from the smoke nuisance could be obtained. A description of a plant suitable for the present requirements of Pittsburg was given in detail. The pressure at which the water was to be distributed was assumed at 750 lbs. per sq. in. The plant would deliver about 400 HP. continuously. Distributing mains each 6 ins. diameter were assumed, and a distributing system embracing the entire business part of the city. The estimated cost of the pumping station was $100,000; distributing system, $102,600; engineering and contingencies, $27,400; total, $230,000. The annual cost of operating, including interest on cost of plant, was estimated at $42,000.

The machinery to which the hydraulic power could be successfully applied was stated to be, hydraulic elevators, cranes, hydraulic intensifiers, fire hydrants and hydraulic engines. The principal use is for running hydraulic elevators. It was shown that an average of 51 HP. is furnished by the city of Pittsburg for 102 direct pressure elevators and that it would be cheaper for consumers to use high pressure water at the rates charged by the London Hydraulic Power Co., than to continue the present system. The advantages of the Greathead injector fire hydrants for the purpose of increasing the fire protection and doing away with the objection, on this score, to the modern sky-scrapers was dwelt upon. Estimates of the revenue from these sources show that the establishment of a hydraulic plant in Pittsburg could be made to be very lucrative. Individual steam plants in the various buildings could be dispensed with and in that way reduce the amount of smoke now polluting the atmosphere of Pittsburg. The speaker claimed that engineers specifically employed for the purpose, could readily clear Pittsburg of its smoke without hardship to anyone and that all that is required is for the authorities to pass and enforce rigid laws, making it necessary for manufacturers and business men to employ engineers and direct them to get rid of the smoke. Danl. Carhart, Secy.

NEW PUBLICATIONS.

LITERARY MAGAZINES.—The October English reviews give evidence that some echoes of our exciting Presidential campaign reached across the water. The "Nineteenth Century" has a paper by Mr. Geo. F. Parker, U. S. Consul at Birmingham, on "The Cry for Fraudulent Money in America;" Mr. F. H. Hardy, in the "Fortnightly," writes on "The Battle of the Ballots in America;" and in the "Contemporary" is a paper on "The Old Silver Dollar." Each of these papers discusses to some extent the antecedent causes which have brought about the rise of the silver party and the writer in the "Fortnightly" ventures a prediction whose accuracy or the reverse can probably be verified when this issue reaches our readers. We therefore quote it as follows:

1. The vote cast will exceed by at least 1,000,000 the vote cast in 1892.
2. Mr. Bryan's total vote in the Electorial College will be nearer 100 than 200. McKinley's vote nearer 300 than 250.
3. McKinley's popular vote will show a plurality exceeding 1,250,000 votes.
4. The combined popular vote for the Republican and the National Democratic tickets will be equal to 75% of the total votes cast.

In "The Contemporary" we find also a paper on the results of the inquiry of the recent Royal commission which investigated the subject of vaccination and the English compulsory laws respecting it. The writer reveals himself, however, as a strong partisan of the anti-vaccination side. The editorial on "Money and Investments" discusses financial affairs in the London money market in a most entertaining way. An article in the "Nineteenth Century" is of curious interest as revealing how far London is behind American cities in its hospital ambulance service. The horse-drawn ambulance, so familiar to American city dwellers, and the system by which it is so quickly summoned to succor the injured in an accident or one taken suddenly ill in the street or office, appears to be quite unknown in London.

In "Scribner's" for November we find an entertaining account of an exploration of the Yukon River, from source to mouth, by Mr. Frederick Funston, who made the journey on behalf of the U. S. Agricultural Department. "McClure's" has a paper by Cy. Warman describing in a very picturesque way the competitive trial of the Leslie and the Jull rotary snowplows which was made on the Alpine tunnel branch of the Union Pacific R. R. several years ago.

In "The Century" we find a valuable description of the city government of Birmingham, England, with the title "An Object Lesson in Municipal Government." It will be remembered that Mr. Joseph Chamberlain first won fame by his work when Mayor of this city in carrying out its great public works. In the "North American Review" we notice a paper on "High Buildings," from the pen of Mr. A. L. A. Himmelwright, C. E., who contends that the modern "sky-scraper," properly built, is safe against storm or fire, and that the defects of light and ventilation complained of, are not due alone to the height of buildings, since the older buildings of four or five stories are far inferior as respects light and ventilation to the newer and much higher structures. He opposes the plan of limiting the height of buildings by the width of the street on which they front, and suggests instead that the laws should limit the area of any lot which may be covered with buildings and should also prohibit the building on the entire frontage of a lot, a suggestion which is worth some consideration. In the same magazine is a paper by Col. Geo. E. Waring on "Government by Party," which though not on a topic commonly noted here, deserves mention here by reason of the personality of its author, who presents some facts which at least give food for thought.

The "Review of Reviews" is notable this month for its impartial discussion of the issues of the political campaign that has just closed. Many a thoughtful man in the midst of the heated discussions of the past few months must have wondered how the impartial historian of the future will write down the story of the political issues of 1896. We especially commend this number to those who may desire, now that the hot debate is over and the result is known, to make a calm and dispassionate study of the events and issues of the most notable Presidential election since the Civil War.

UNITED STATES GEOLOGICAL SURVEY.—Bulletin 131. Report of Progress of the Division of Hydrography for the Calendar Years 1893 and 1894. By F. H. Newell. 8vo.; paper; pp. 126. Pub. Doc.

This bulletin is mostly taken up with brief descriptions of stream gaging stations in the west and the results obtained during the years 1893 and 1894.

CALIFORNIA GAME.—Southern Pacific Co.; Passenger Department, San Francisco and New York city. Paper; 5⅛ × 6¾ ins.; pp. 64; illustrated.

This is a handy book of information as to the birds, beasts and fish to be found along different parts of the Southern Pacific Ry., and is distributed free to all who are interested in the matter. It is fully illustrated by excellent half-tone views of the game and of scenery along the line.

OHIO STATE BOARD OF HEALTH.—Report for 1895. C. O. Probst, M. D., Secretary, Columbus, O. 8vo.; cloth; pp., 410; illustrations. Adress the secretary.

The principal interest of this volume to engineers lies in a number of reports on proposed or actual sewerage and water supply systems by members of the board and others. All such improvements must now be submitted to the board for approval. The present report indicates that this is being done with great advantage to the local communities concerned.

LAKE ERIE AS A WATER SUPPLY FOR THE TOWNS ON ITS BORDERS.—By Geo. W. Rafter, M. Am. Soc. C. E., Rochester, N. Y. Reprinted from the Buffalo Medical Journal for August, 1896. 8vo.; paper; pp. 20. Address the author.

This is a very interesting discussion of the purity of water drawn from Lake Erie. It ends with the conclusion that such water should be purified by slow sand filtration. The water supplies of Liverpool and Zurich are described briefly as examples of the European practice of filtering surface water supplies, the quality of which would hardly be questioned here. Results of studies of the water supplies of Buffalo, N. Y., and Lorain, O., are then presented, and finally the conclusion stated above is given.

T-SQUARE CLUB OF PHILADELPHIA.—Report for 1895-6, with Excerpts from the Minutes of the Meetings Since the Club's Formation, President's Address and an Official Record of the Club. President, Albert Kelsey; Secretary, Adin B. Lacey, 77 Brown Bros. Building, 5 × 11 ins.; paper; pp. 32; illustrated.

This club seems to be carrying on a most excellent work in the way of competitive exhibitions of designs, lectures for members, co-operation with other art and allied organizations, and in general an attempt to give architecture its proper place before the public, especially as regards municipal buildings and public art. The activities of the club are indicated by the report under review. We would suggest that the addresses, as well as the names of the members of the club might well be given in the report.

THE MONEY QUESTION.—A Handbook for the Times, by Henry V. Poor, Author of "Money and Its Laws," "Resumption and the Silver Question," "Twenty-two Years of Protection," etc. New York: H. V. & H. W. Poor. Paper; 8vo.; pp. 103.

The author of this pamphlet is well known as the founder and publisher of "Poor's Manual of Railroads," and as a writer of ability and force on financial questions. The present pamphlet is taken from a larger work on "The Monetary History of the United States," which Mr. Poor has in preparation. The discussion is for the most part eminently sound, although in some respects the writer assumes as proved some things on which financial and economic writers are by no means agreed. Greater pains with the literary style and with the arrangement might have made the discussion easier to follow; but the book is one which deserves study by the unprejudiced student of the currency question.

COMMERCIAL RELATIONS OF THE UNITED STATES, 1894 AND 1895. 2 vols. Vol. I., Review, Africa, America, Asia, Australasia. Vol. II., Europe, Polynesia. Cloth; 8vo.; pp. 700, 646. Issued by the Department of State, Washington, D. C., 1896.

The general review of the foreign commerce of the United States, in Vol. I., is the first that has been published since 1881. In view of the many inquiries received by the Department of State for information as to trade conditions in foreign countries and the evident attempts of our manufacturers to increase the sale of their goods abroad, it was felt by the Department that a summary of the world's commerce, compiled from the most reliable sources, should be undertaken as specially valuable at this time in conjunction with the detailed reports from our consular representatives published in the monthly Consular Reports. The volumes will be useful to manufacturers and others interested in procuring statistical and other information in regard to foreign trade.

PROCEEDINGS OF THE ASSOCIATION OF ONTARIO LAND SURVEYORS.—Annual meeting held at Toronto, Feb. 25-27, 1896. A. J. Van Nostrand, Secretary-Treasurer, Toronto, Canada. 8vo; 237 pp.

In addition to committee reports and official transactions this publication contains the following papers and discussions upon them: "The Use of Concrete in Bridge Foundations," G. de Gurse; "Notes on Portland Cement Concrete," M. G. Butter; "Maintenance of a Separate System of Sewers," T. Harry Jones; "The Field of American Engineering," A. Ross Davis; "Notes on Some New Jersey Roads," T. B. Speight; "Road Metal," H. J. Bowman; "The Ditches and Water-courses Act, 1894," B. J. Saunders; "Ontario Boundaries," A. Niven; "Sectional Surveys," P. S. Gibson; "Crown Surveys," James Dickson; "Natural Boundaries," A. P. Walker; "A Road or Not a Road," M. Gaviller; "Through the Barren Lands," J. W. Tyrrell; "Field Testing of Minerals," W. H. Merritt. An appendix contains head notes of reported land cases, by H. L. Esten. With this volume is an exceedingly interesting map of the "Northern Polar Regions with Reference to Eastern Canada," prepared by Willis Chipman and L. B. Stewart to accompany a paper on the "Eightieth Meridian," published in the Proceedings of the Association for 1895.

FIFTEENTH ANNUAL REPORT OF THE UNITED STATES GEOLOGICAL SURVEY, 1893-94. By J. W. Powell, Director. Government Printing Office, Washington, D. C. 1895. Large 8vo.; pp. 755; 48 plates.

The first 250 pages of this volume are devoted to formal reports of the progress of work of the survey. The greater part of the work has been topographical. An outline map of the United States is given showing the areas that have been surveyed and mapped up to and including the fiscal year 1894. The remainder of the volume contains technical papers as follows: "Preliminary Report of the Geology of the Common Roads of the United States," by N. S. Shaler. "The Potomac Formation," by Lester Frank Ward. "Sketch of the Geology of the San Francisco Peninsula," by Andrew C. Lawson. "Preliminary Report on the Marquette Iron-Bearing District of Michigan," by Charles Richard Van Hise and William Shirley Bailey, with a "Chapter on the Republic Trough," by Henry Lloyd Smith. "The Origin and Relations of Central Maryland Granites," by Charles Rollin Keyes. "General Relations of the Granitic Rocks in the Middle Atlantic Piedmont Plateau," by George Huntington Williams. The volume is handsomely printed and many of the colored plates are excellent specimens of the engraver's art.

SIXTEENTH ANNUAL REPORT OF THE UNITED STATES GEOLOGICAL SURVEY, 1894-95. Charles D. Walcott, Director. In Four Parts. Part II, Papers of an Economic Character; 8vo.; pp. 598. Part III, Mineral Resources of the United States, 1894, Metallic Products; 8vo.; pp. 646. Part IV., Mineral Resources, 1894, Non-Metallic Products; 8vo.; pp. 735.

The "papers of an economic character" in Part II are: "Geology and Mining Industries of the Cripple Creek District, Colorado," by Whitman Cross and R. H. F. Penrose, Jr. "Geological Reconnaissance Across Idaho," by George H. Eldridge." "Economic Geology of the Mercur Mining District, Utah," by J. Edward Spurr. "The Public Lands and their Water Supply," by Frederick H. Newell. "Water Resources of a Portion of the Great Plains," by Robert Hay. Parts III and IV are the regular annual reports on Mineral Resources, edited by Dr. David T. Day, Chief of the Division of Mineral Resources, which were heretofore published by the Division itself, but are now, according to an act of Congress in 1895, published as parts of the report of the Geological Survey. The change in the method of publication has made the volumes much handsomer in appearance than they used to be, but we think that the extra thickness of paper and great width of margins are not only a waste of money, but make the volumes objectionable to many readers by causing them to occupy too much space in a library.

CUMULATIVE INDEX TO A SELECTED LIST OF PERIODICALS.—Published Monthly by the Public Library, Cleveland, O. $5 per annum.

The Cleveland Public Library has undertaken a novel work, the preparation and publication of a monthly index to current periodical literature, each number of which contains all the references of the number preceding, so that the subscriber has in each number a complete index to the current periodical literature which has been published since the beginning of the year. The periodicals indexed are the monthly literary magazines, the reviews, English and American, and such popular weeklies as "Harper's," "The Outlook," "The Nation," and others. The list of engineering journals includes only "Cassier's," "The Engineering Magazine," and the antediluvian "Scientific American Supplement," if that can be called an engineering journal.

The indexing appears to be carefully and faithfully done and the cross-references are numerous; but it appears to us a mistake to include all the short stories, poems, etc., in such an index. The readers of these do not take the trouble to consult indexes to find what they want. It is the articles of permanent value which deserve indexing, and if the Cleveland Library would confine its index to these and revise somewhat its list of periodicals, it would probably have better chances of success in its enterprise.

MITTHEILUNGEN AUS DEN KOENIGLICHEN TECHNISCHEN VERSUCHSANSTALTEN ZU BERLIN. (Notes from the technical testing stations at Berlin.) Vierzehnter Jahrgang: 1896. Volume I. and II.; pp. 132. Illustrations in text; 6 folding plates; 8vo.; paper. Berlin, 1896. Julius Springer.

Of these two pamphlets Vol. I. contains: "Results of Tests on Exploded Cylinders for Carrying Compressed Gas," "The Preparation of Paper for Microscopical Purposes," "Blotting Papers," "The Testing of Building Bricks," "Tests of Paper in France," and "Japanese Paper." Vol. II. contains: "Effect Upon the Microscopic Texture of Soft Steel Rails of Rolling at Different Temperatures," "Comparative Tests of German Building Sands," "Changes of Conditions Governing the Congealing of Mineral Oils," "Copying Paper, Strength of Paper; Paper Standard."

The extensive series of tests of iron tanks for the storage of hydrogen gas was undertaken at the instance of the German aeronautical department at Berlin, as a number of tanks in use by that department exploded and no cause could be found. The tests of building bricks comprised tests as to their hardness, specific weight, density, absorption of water, freezing and heat tests, their crushing strength, power of adhesion, tensile, bending and wearing qualities.

MITTHEILUNGEN AUS DEM OFFIZIELLEN BERICHT der im Franzoesischen Ministerium der Oeffentlichen Arbeiten gebildeten Commission des Methodes d'Essai des Materiaux de Construction. Band I, Allgemeine Grundlagen. Translated by P. Zizmann. Pp. 48; paper; 8vo. Berlin, 1896. Julius Springer.

This is a supplement to the publication just noted, presenting, in concise form, the definitions, units and standards which govern all tests of metals and materials of construction, conducted by the French Ministry of Public Works.

MASTER CAR BUILDERS' ASSOCIATION.—Secretary John W. Cloud, 974 Rookery Building, Chicago, Ill.

Lithograph copies of the drawings of Standards (Sheets 1 to 12, inclusive) and Recommended Practice (Sheets A to E, inclusive), illustrated on a reduced scale by 17 sheets in the "Report of Proceedings" for 1896, may be had on a similar number of sheets 30 × 38 ins. Blue prints can be taken from these sheets. The sheets will be sold at 25 cts. each, plus postage when sent by mail. If needed for blue printing, they should be shipped by express, and orders should specify by what express company they should be shipped. Blue print copies, 30 × 38 ins., of the drawings of Recommended Practice (Plates C, D, E, F and G in back of Proceedings for 1896), regarding axle and journal box and contained parts for cars of 80,000 lbs. capacity, may also be had. These blue prints will be sold at cost, which is now estimated at about 30 cts. each. Pamphlets containing the text of the Standards and Recommended Practice, as printed in the Proceedings of 1896, will be furnished at 25 cts. each. The lithographs, blue prints and pamphlets are now ready for delivery.

MASSACHUSETTS STATE BOARD OF HEALTH: Report for 1894.—S. W. Abbott, M. D., Secretary, Boston, Mass. 8vo.; cloth; pp. 892; many tables. Address the Secretary.

The most valuable matter in this volume is a historical and critical review of the work relating to sewage purification accomplished at the Lawrence Experiment Station in the seven years ending with 1894. The deductions drawn from this long series of careful experiments are of great value, both for the information given and because in many instances they will render it unnecessary to look through the earlier reports. Next in importance is the section on water purification, as studied at the same station. Both these sections were written by Mr. Geo. W. Fuller, who was at the time in charge of the station. As a supplement to the above, the report contains a paper by Mr. H. W. Clark, Chemist of the Station, on the "Physical and Chemical Properties of Sands, with Special Reference to the Filtration of Water."

Interesting papers are contributed on "The Composition of the Deep Wells in Boston and Vicinity," and "The Bacterial Contents of Certain Ground Waters, Including Deep Wells," by Dr. Thos. M. Drown and Prof. Wm. T. Sedgwick, respectively. The latter paper shows, contrary to views often expressed by other writers, that deep-seated waters often contain a notable number of bacteria. The investigations recounted, however, show nothing to shake the confidence with which well-protected ground waters are regarded as sources of public water supplies.

The papers and discussions named are accompanied with numerous tables of analyses. Many other such tables are given in the sections of the report relating to the examinations of sources of public water supply and the pollution of rivers.

A number of pages are occupied with advice to cities and towns regarding new water and sewerage systems and extensions to old works.

The volume is up to the standard set by previous yearly issues as an aid to the student of those branches of sanitation to which reference has been made.

It is only fair to the board and the public to state that the volume being noticed has been published for nearly a year and that doubtless the results obtained in sewage and water purification during 1895 will soon be available, greatly to the advantage of all interested in these vital questions.

THE JOURNAL OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION.—Published monthly by the Association at 95 Griswold St., Detroit, Mich., John A. Penton, Secy. Vol. I., No. 1; July, 1896. Pamph.; 6 × 9 ins.; pp. 172. $5 per annum; 50 cts. each.

At a convention of foundrymen of the United States, held in Philadelphia, May 12, 13, and 14, 1896, attended by over 300 representatives of the foundry business, a national association was formed, whose objects, according to the constitution then adopted, are the advancement of the interests of foundry operators, to collect for the use of the Association all proper information connected with the foundry business, to interchange experience and encourage uniform customs and actions among foundrymen." One of the duties of the secretary is the publication of a monthly Journal, the first number of which is before us. It contains the proceedings of the convention, the constitution and list of members of the Association, and the following technical papers read at the convention: "Foundry Cranes, with the Different Methods of Driving Them," by A. E. Outerbridge, Jr.; "The Air Compressor for Use in the Foundry," by C. W. Shields; "The Chemistry of Iron, with Determinations and Their Value," by Charles James; "How to Turn Out Good Molders," by D. J. Matlack; "Utility and Advancement of Green, Dry and Loam Sand Molding," by Thos. D. West; "Physical Tests and Chemistry of Cast-Iron," by W. J. Keep; "Molding Machines and Their Applications," by Harris Tabor; "Cupolas and Cupola Practice Up to Date," by Dr. Edward Kirk; "The Sand Blast in the Foundry," by E. C. Brooksbank.

This number of the Journal also contains a paper by Mr. Thos. D. West, on "Power of Blast Penetration and Improvements in Center Blast," read at the monthly meeting of the Western Foundrymen's Association on June 17, and a paper by Mr. W. T. Rainey on "The Manufacture of Coke and Its Selection for the Foundry," read at the monthly meeting of the Philadelphia Foundrymen's Association on June 3. A feature of the Journal is a Review of the Foundry Literature for the Month, which it is intended to publish in each number. It will contain a brief review or mention of the original articles appearing in the columns of the engineering journals of the country having reference to the foundry business.

The Journal is well printed, but it is defective in containing neither a table of contents nor an index. We would also suggest that it might be improved by printing on the top of each right hand page the title of the paper or subject discussed on that page, instead of repeating on every page the name of the Journal.

TRADE PUBLICATIONS

STEAM VALVES, SAFETY VALVES, ETC.—Alex. Turnbull & Co., Bishopbriggs, Glasgow, Scotland.

A set of loose circulars illustrating the different forms of valve made by the firm, including "dead-weight" safety valves, which are commonly in use in Great Britain, but are unknown in this country, and accompanied by a handsomely printed pamphlet of 26 pages with half-tone illustrations, giving an interesting history of "The Iron and Steel and Allied Trades of Scotland," together with a description of the works owned by the firm and of its various products.

SLIDE-VALVE ENGINES AND STEAM BOILERS.—Houston, Stanwood & Gamble, Cincinnati, O. Pamph.; 8 × 10¾ ins.; pp. 32.

This catalogue illustrates a series of plain slide-valve engines with throttling governors, and with cylinders, single, double or cross-compound. The building of slide-valve throttling engines in these days may seem a retrogression to an ancient type, but the builders give some good reasons why, especially in the case of compound non-condensing engines, this type is preferable to the high speed automatic engine.

CHEMICAL AND PHYSICAL APPARATUS.—Henry Heil Chemical Co., St. Louis, Mo. Cloth; 7 × 10 ins.; pp. 447; illustrated.

This is one of the most complete and best arranged catalogues of chemists' and chemical laboratory supplies, chemicals and physical apparatus which has come to cur notice for some time. Although containing a vast variety of apparatus it is so arranged by reference numbers and an index that any item, however small, can be readily found, and generally each apparatus is explained by illustration as well as descriptive text. A valuable feature of the catalogue is a number of lists or outfits of apparatus designed for assayers, iron and steel analysis, agricultural experiment station work, colleges and schools, botanists, biologists, etc. Especial attention is also called by the catalogue to the facilities of the firm for manufacturing special apparatus according to drawings and specifications. The index covers 32 closely-printed pages.

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CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work. Place.	See Eng. News.
Nov. 5.	Water meters, Philadelphia, Pa.	Oct. 29
Nov. 5.	Dredging, Wilmington, Del.	Oct. 29
Nov. 5.	City building work, New York, N. Y.	Oct. 29
Nov. 5.	Steel bridge, Woonsocket, R. I. Advertised, Engineering News, Oct. 29.	Oct. 29
Nov. 5.	Sewers, Brooklyn, N. Y.	Oct. 29
Nov. 5.	Bonds, Brooklyn, N. Y.	Oct. 29
Nov. 5.	Pipe sewers, Buffalo, N. Y.	Oct. 29
Nov. 5.	Sewers, New York, N. Y.	Oct. 29
Nov. 5.	Asphalt paving, Buffalo, N. Y.	Oct. 29
Nov. 5.	Paving, etc., New York, N. Y.	Oct. 29
Nov. 5.	Reformatory building work, Mansfield, O.	Oct. 22
Nov. 5.	Steel bridge, Providence, R. I. Advertised, Eng. News, Oct. 22 and 29.	Oct. 22
Nov. 5.	Post office building, New London, Conn. Advertised, Eng. News, Oct. 15 and 22.	Oct. 15
Nov. 5.	Lighthouse, Boston Harbor, Mass.	Oct. 8
Nov. 5.	Street railway franchise, Santa Rosa, Cal.	Oct. 8
Nov. 5.	Hotel, theatre, etc., Washington, D. C.	Oct. 1
Nov. 6.	Water bonds ($300,000), Cleveland, O.	Oct. 15
Nov. 6.	Plumbing, walls, etc., Providence, R. I.	Oct. 29
Nov. 6.	Bridge planking, Cleveland, O.	Oct. 29
Nov. 6.	Electric lighting, Big Rapids, Mich.	Oct. 29
Nov. 6.	Ditch, etc., Fairhaven, Wash.	Nov. 5
Nov. 6.	Sewer, Ukiah, Cal.	Nov. 5
Nov. 6.	School building, etc., St. Louis, Mo.	Nov. 5
Nov. 7.	Lighting, Pittsburg, Pa.	Nov. 5
Nov. 7.	Electric light plant, East Palestine, O.	Nov. 5
Nov. 7.	Gasoline light'g (1,400 lamps), Providence.	Nov. 5
Nov. 7.	Water mains (4 streets), Chicago	Nov. 5
Nov. 7.	Bridge, St. Joseph, Mo.	Nov. 5
Nov. 7.	Bonds ($8,000), Arverne-by-the-Sea, N. Y.	Oct. 29
Nov. 9.	Hospital building, etc., Fort Leavenworth. Advertised, Eng. News, Oct. 15 to 29.	Oct. 15
Nov. 9.	Lighthouse tower, New Bedford, Mass.	Oct. 8
Nov. 9.	Electric plant for post office, New York.	Oct. 22
Nov. 9.	Bonds ($16,045,951), New York, N. Y.	Oct. 22
Nov. 9.	Reservoir at Morris Plains, N. J.	Oct. 29
Nov. 9.	County jail, Hanford, Cal.	Oct. 29
Nov. 9.	Park work, New York, N. Y.	Oct. 29
Nov. 9.	Brick school building, Pittsburg, Tex.	Nov. 5
Nov. 9.	Cast-iron sewer pipe, Baltimore, Md.	Nov. 5
Nov. 9.	Macadam paving, Boston, Mass.	Nov. 5
Nov. 9.	Trestle approach, Bay City, Mich.	Nov. 5
Nov. 9.	Levee work, Port Allen, La.	Nov. 5
Nov. 9.	Grading, sidewalks, etc., Syracuse, N. Y.	Nov. 5
Nov. 9.	Pipe sewers, Syracuse, N. Y.	Nov. 5
Nov. 9.	Foot bridge, Syracuse, N. Y.	Nov. 5
Nov. 9.	Armory building, Ogdensburg, Pa.	Nov. 5
Nov. 10.	Improving jail, Hamilton, O.	Nov. 5
Nov. 10.	Repairing bridge, Philadelphia, Pa.	Nov. 5
Nov. 10.	Heating and ventilating, Pittsburg, Pa.	Nov. 5
Nov. 10.	Electric light bonds, Cameron, Mo.	Nov. 5
Nov. 10.	Naval supplies, Washington, D. C.	Nov. 5
Nov. 10.	Brick paving, Cincinnati, O.	Nov. 5
Nov. 10.	Water conduits, Niagara Falls, N. Y.	Nov. 5
Nov. 10.	Dredging (85,000 cu. yds.), New York, N. Y.	Oct. 29
Nov. 10.	Paving brick, Nashville, Tenn. Advertised, Engineering News, Oct. 29.	Oct. 29
Nov. 10.	Bridge, Modesto, Cal.	Oct. 29
Nov. 10.	River and harbor bonds, Cleveland, O.	Oct. 22
Nov. 10.	Water-works, Milford, Ill. Advertised, Eng. News, Oct. 22 to Nov. 5.	Oct. 22
Nov. 10.	Residence, Stockton, Cal.	Oct. 22
Nov. 10.	Tunnels, etc., for power, Los Angeles, Cal.	Oct. 22
Nov. 10.	Canal improvements,, Albany, N. Y. Advertised, Eng. News, Oct. 22 to Nov. 5.	Oct. 22
Nov. 10.	Dams, etc., Rock Island, Ill. Advertised, Eng. News, Oct. 15 to Nov. 5.	Oct. 15
Nov. 10.	Dredging machinery, Portland, Ore. Advertised, Eng. News, Oct. 15 to Nov. 5.	Oct. 15
Nov. 11.	Hydraulic dredges (2), St. Louis, Mo. Advertised, Eng. News, Oct. 15 to Nov. 5.	Oct. 15
Nov. 11.	Hospital building, Hoboken, N. J.	Oct. 22
Nov. 11.	Iron bridge, Knoxville, Ia.	Oct. 29
Nov. 11.	Steam supply pipes, Kings Park, N. Y. Advertised, Engineering News, Nov. 5.	Nov. 5
Nov. 11.	Plumbing, etc., Kings Park, N. Y. Advertised, Engineering News, Nov. 5.	Nov. 5
Nov. 11.	Heating and ventilating, Kings Park, N. Y. Advertised, Engineering News, Nov. 5.	Nov. 5
Nov. 12.	Brick paving, Cincinnati, O.	Nov. 5
Nov. 12.	Levee work, New Orleans, La.	Nov. 5
Nov. 12.	Belgian block paving, Brooklyn, N. Y.	Nov. 5
Nov. 12.	Crib bulkhead, Brooklyn, N. Y.	Nov. 5
Nov. 12.	Administration building, Springfield, O.	Oct. 15
Nov. 12.	Electric lighting, Geneva, N. Y.	Nov. 5
Nov. 13.	School buildings (2), Boston, Mass.	Nov. 5

Nov. 13.	Repair shops, city of Chicago	Nov. 5
Nov. 13.	Steam heating, Richmond, Ky. Advertised, Eng. News, Oct. 22 and 29.	Oct. 22
Nov. 13.	Sewer bonds ($35,000), Cleveland, O.	Oct. 22
Nov. 13.	Cast-iron sewer, Madison, Wis. Advertised, Engineering News, Nov. 5.	Nov. 5
Nov. 13.	Levee work, New Orleans, La.	Nov. 5
Nov. 14.	Shore protection on Raritan Bay, N. J. Advertised, Engineering News, Nov. 5.	Nov. 5
Nov. 14.	Gun forgings, Washington, D. C.	Nov. 5
Nov. 14.	Office building (four stories), Joliet, Ill.	Oct. 22
Nov. 14.	Macadam roads, Somerville, N. J.	Oct. 22
Nov. 14.	Pumping engines (6), Chicago, Ill. Advertised, Eng. News, Sept. 24 to Oct. 22.	Sept. 24
Nov. 14.	Grain elevators, etc. (2), Galveston, Tex.	Sept. 24
Nov. 14.	Sewage pumping mach'y, Mexico, Mex.	Aug. 27
Nov. 14.	Electric wiring, etc., Troy, N. Y.	Nov. 5
Nov. 14.	Electric light plant, Negaunee, Mich.	Nov. 5
Nov. 16.	Iron and steel bridge, Albany, Ga.	Nov. 5
Nov. 16.	Lead (75 tons), Holyoke, Mass. Advertised, Eng. News, Nov. 5 and 12.	Nov. 5
Nov. 16.	Sewers, Washington, D. C. Advertised, Eng. News, Nov. 5 and 12.	Nov. 5
Nov. 16.	Removing wreck, Norfolk, Va. Advertised, Eng. News, Oct. 22 and Nov. 5.	Oct. 22
Nov. 16.	Light station, Portland, Ore.	Oct. 29
Nov. 16.	Dam and spillway, Ogden, Utah. Advertised, Eng. News, Oct. 29 to Nov. 12.	Oct. 29
Nov. 16.	Gun emplacements, Tybee Island, Ga. Advertised, Eng. News, Oct. 29 to Nov. 12.	Oct. 29
Nov. 16.	Pipe (26,000 tons), Baltimore Advertised, Eng. News, Nov. 5 and 12.	Nov. 5
Nov. 16.	Ditch work, Rose, Minn.	Nov. 5
Nov. 16.	Water bonds ($22,000), Coraopolis, Pa.	Nov. 5
Nov. 16.	Water-works, Eatonton, Ga. Advertised, Eng. News, Nov. 5 and 12.	Nov. 5
Nov. 17.	Heating and ventilating, Newburg, N. Y.	Oct. 29
Nov. 17.	Light station, Cleveland, O.	Oct. 29
Nov. 17.	Naval supplies, Mare Island, Cal.	Oct. 29
Nov. 17.	Water bonds, St. Augustine, Fla.	Oct. 29
Nov. 17.	Valves, etc. (66-in.), Brooklyn, N. Y.	Oct. 22
Nov. 18.	U. S. building work, St. Paul, Minn. Advertised, Eng. News, Oct. 22 and 29.	Oct. 22
Nov. 18.	Hospital building, Cherokee, Ia.	Oct. 8
Nov. 18.	School building bonds, Toledo, O.	Oct. 29
Nov. 18.	Brick sewers (7,943 ft.), Middletown, O.	Nov. 5
Nov. 18.	Pipe sewers (2,651 ft.), Middletown, O.	Nov. 5
Nov. 19.	Water-works, St. Augustine, Fla. Advertised, Eng. News, Oct. 22 to Nov. 12.	Oct. 22
Nov. 20.	Bridge bonds ($20,000), Cleveland, O.	Oct. 29
Nov. 20.	Postoffice building, Saginaw, Mich.	Nov. 5
Nov. 20.	Sewers, Salt Lake City, Utah	Nov. 5
Nov. 20.	Electric light plant, Lakewood, O.	Nov. 5
Nov. 20.	Fire apparatus, Hazleton, Pa.	Nov. 5
Nov. 21.	Gun emplacements, Wilmington, N. C. Advertised, Eng. News, Oct. 29 to Nov. 19.	Oct. 29
Nov. 23.	Gun emplacements and wharf in Va. Advertised, Eng. News, Oct. 22 to Nov. 12.	Oct. 22
Nov. 23.	Fog signal boilers, San Francisco,	Nov. 5
Nov. 23.	Gas franchise, Sacramento, Cal.	Nov. 5
Nov. 24.	Batteries at Key West, Fla. Advertised, Eng. News, Nov. 5 to 19.	Nov. 5
Nov. 24.	Naval supplies, Washington, D. C.	Nov. 5
Nov. 24.	Battery on Dutch Island, R. I. Advertised, Eng. News, Nov. 5 to 19.	Nov. 5
Nov. 24.	Brick paving (2 streets), Cincinnati, O.	Nov. 5
Nov. 24.	County jail and residence, Atlanta, Ga.	Oct. 1
Nov. 25.	Electric or gas lighting, Lancaster, Pa.	Oct. 22
Nov. 25.	Macadamizing (2 miles), Brooklyn, N. Y. Advertised, Eng. News, Nov. 5 to 19.	Nov. 5
Nov. 27.	Pier extensions, Milwaukee, Wis. Advertised, Eng. News, Nov. 5 to 19.	Nov. 5
Nov. 27.	Battery at Hawkins' Point, Md.	Nov. 5
Nov. 28.	Concrete battery, Sandy Hook, N. J. Advertised, Eng. News, Oct. 29 to Nov. 19.	Oct. 29
Nov. 28.	Gun emplacements, New London, Conn. Advertised, Eng. News, Oct. 29 to Nov. 19.	Oct. 29
Nov. 30.	Breakwater extension, Buffalo, N. Y. Advertised, Eng. News, Oct. 15 to Nov. 5.	Oct. 15
Nov. 30.	Buildings (32), Fort Hancock, N. J. Advertised, Eng. News, Nov. 5 to 26.	Nov. 5
Nov. 30.	Battery at Sullivan Island, S. C. Advertised, Eng. News, Nov. 5 to 26.	Nov. 5
Nov. 30.	Artesian well on Sullivan Island, S. C. Advertised, Eng. News, Nov. 5 to 26.	Nov. 5
Dec. 1.	Franchise, gas and el. lights, Benicia, Cal.	Oct. 22
Dec. 1.	U. S. building work, St. Paul, Minn. Advertised, Eng. News, Nov. 5 and 12.	Nov. 5
Dec. 2.	Dredging, Wilmongton, Del.	Nov. 5
Dec. 9.	Hospital building, Los Angeles, Cal.	Oct. 15
Dec. 10.	Hospital building, San Andreas, Cal.	Nov. 5
Dec. 10.	Stone breakwater in Delaware Bay, Del. Advertised, Eng. News, Nov. 5 to Dec. 3.	Nov. 5
Dec. 30.	Steel rails (150,000 tons), Sydney, N.S.W. Advtsd, Eng. News, Sept. 3, Oct. 1, Nov. 5.	Aug. 6
Jan. 8.	Wooden bridge (220 ft.), Tillamook, Ore.	Oct. 8

RAILWAYS.

East of Chicago.

LAKE SUPERIOR & ISHPEMING.—The Marquette (Mich.) "Journal" says that this company is removing a number of dwellings, preparatory to an extension of its tracks. About four miles of track are to be put in. It is expected to have all work completed by the opening of navigation next spring. Work may begin inside of two weeks. Gen. Mgr., John M. Egan.

MIDLAND.—The Windsor, N. S., "Journal," says that the prospects for the construction of this railway are brighter than they have been for a long time, and it is possible that active work may begin next spring. A meeting in the interests of this railway was recently held at Halifax. There were present Messrs. Strong and Reid, of Montreal, and S. H. Holmes, of Halifax, of the Midland Ry. Co., Hon. H. M. Goudge, Dr. Allan Haley, and Arthur Drysdale. The meeting was held for the purpose of making arrangements with the local government for building a line from Truro to Windsor.

NORTHERN NEW YORK.—A press rumor says that it is proposed to extend the Northern New York R. R., from its southern terminus at Tupper Lake, 20 miles south to Long Lake, N. Y. The work on the extension will begin, it is hoped, before January. A connection will ultimately be made from Long Lake with the D. & H. at North Creek, Saratoga county. These extensions will open up all the lower part of the Adirondack Mountains.

PEMIGEWASSET VALLEY.—It is stated that Charles H. Burns, of Bridgeport, Conn.; Hall & Grey and F. S. Whitehouse, of Lincoln, N. H., have begun work on a railway through this valley, in New Hampshire, north from North Woodstock, on the Boston & Maine. The road is to be used at first to transport lumber and freight.

PITTSBURG & BROWNSVILLE.—This company noted in our issue of last week proposes to build a line fifteen miles long. Pres., Geo. S. Davidson, Pittsburg, Pa.; Directors: Wm. K. Wilkins, Joseph F. Kuntz, Allegheny, Pa.; L. G. Hohl, Chas. W. Davidson, Pittsburg, Pa.; Florian G. Ross, Dunkirk; James R. Elliott, Braddock, Pa.

QUEEN ANNE'S.—An arrangement is said to have been effected with the Pennsylvania R. R. in regard to the proposed crossing of the latter at Greenwood and Ellendale, Del. The Queen Anne's Co. will now build the remaining 25 miles of the railway to Lewis, Del. The contract will soon be awarded, and it is expected to have the whole line from Queenstown to Lewis ready for operation by April, 1897. Pres., W. H. Bosley, Baltimore, Md.

WHITE RIVER JUNCTION & ELY.—A press dispatch from Montpelier, Vt., states that Dr. W. Seward Webb is said to be one of the financial backers of a new railway line in the eastern part of the state, for which a charter will be asked of the Legislature now in session. The proposed line is from White River Junction, by way of the Pompanoosuc River Valley to Ely, and from there to Barre, by way of Chelsea. Along the line of the proposed railway are extensive and valuable copper mines, as well as extensive marble and granite quarries. These are now badly cramped for want of transportation facilities, and will be greatly enhanced in value by the completion of the road. The length of the proposed line of railway will be about 50 miles, and it will connect with the Boston & Maine and Central Vermont systems.

WILKES BARRE & NORTHERN.—A. H. Holbrook, Wilkes Barre, Pa., writes us that the projected length is 12 miles, touching Luzerne, Dallas and Harvey's Lake. The road is now completed from Luzerne to Dallas, six miles, and will be in operation by Dec. 1. The remainder of the road is now under construction. Pres., John B. Reynolds, Wilkes Barre, Pa.; Ch. Engr., Thos. Wright, Luzerne, Pa.

Southern.

ATLANTA & ALABAMA.—A. R. Littlejohn, New Orleans, La., is quoted as saying that this railway, noted in our issue of Oct. 8, as the Atlanta & Selma, is projected from Atlanta, Ga., via Selma, Ala., to New Orleans. R. M. Mitchell, of Atlanta, is president and general manager, and Eb. T. Williams, attorney. The line runs centrally between the Georgia Pacific and the Atlanta & West Point and Western of Alabama railways as far as Selma, and thence in a direct line to New Orleans. Its cost is estimated at $20,000 per mile. The territory through which it passes has valuable timber lands, many valuable water powers and minerals, and is practically undeveloped. Between all points east of Atlanta and west of New Orleans a distance of 169 miles will be saved.

CARRABELLE & APALACHICOLA.—It is stated that work was to have begun on this railway Oct. 22. It is projected between Apalachicola and Carrabelle, Fla.

CHATTANOOGA SOUTHERN.—It is reported that the Chattanooga Southern may be extended from Gadsden, Ala., its present terminus, to Birmingham, a distance of about 55 miles. Gen. Mgr., M. F. Bonzano, Chattanooga, Tenn.

GREENWOOD, ANDERSON & WESTERN.—W. B. Strang, Jr., & Co., of New York, who have the contract for building a 15-mile extension from Seivern to Batesburg, S. C., have petitioned for the appointment of a receiver. They claim that they have not been paid for the work done and ask that the lease of the Carolina Midland to the Greenwood, Anderson & Western be included as part of the property of the latter line. The Greenwood, Anderson & Western has leased the Carolina Midland, extending from Allendale to Seivern, S. C., 55 miles, and proposes to build from Seivern via Greenwood to Greenville, S. C., 115 miles. Twelve miles of this extension have been graded and six miles of track laid.

JACKSONVILLE, TAMPA & KEY WEST.—Judge James W. Locke, in the United States Court, has ordered a postponement of the sale of this railway until the first Monday in March, 1897. The sale was to have taken place Nov. 2, but the complainant, the Pennsylvania Co., for insurance on lines and granting annuities, petitioned for the change on account of the disordered condition of the money market.

PARIS MOUNTAIN & GREENVILLE.—The Paris Mountain Land Co., of Greenville, S. C., has asked for a charter. The company is to be capitalized at $10,000, and besides dealing in real estate, proposes to build a railway from Greenville to Paris Mountain. This may be either a steam or electric road. The incorporators are W. J. Thackston, H. C. Markley, O. B. Cagle, W. T. Thackston, J. F. Richardson, A. G. Furman, A. G. Gower, H. J. Haynesworth, Frank Hammond, of Greenville; S. M. Grist, Yorkville, and S. F. Trolobridge, of Piedmont.

NORFOLK & WESTERN.—This company is said to be considering the extension of its line to Huntington, from Kenova, W. Va., by building a branch three miles long. Gen. Mgr., J. H. Sands, Roanoke, Va.

ROANOKE & SOUTHERN.—This line is leased by the Norfolk & Western, extends from Winston, N. C., to Roanoke, Va., 102 miles, and will be sold under foreclosure Nov. 24. The upset price is to be $500,000, and it is probable that the Norfolk & Western will acquire the road.

SEABOARD AIR LINE.—This company has decided to extend its line from Cheraw to Columbia, S. C., via Kirshaw and Camden. Work is expected to begin soon.

SOUTH GEORGIA.—Chas. B. Dunn, Ch. Engr., Morven, Ga., writes us that rails are laid to Morven and prospects are favorable for completing the line at an early date. The line as finished, noted in our issue of Oct. 22, is six miles long. The projection is 22 miles long. Pres., J. W. Oglesby, Hartpine, Ga.

TENNESSEE, GEORGIA & ATLANTIC.—The Augusta, Ga., "Chronicle," says that some contracts for building this railway, noted in our issue of Oct. 22, have been let and that preliminary arrangements are being rapidly made.

VIRGINIAS.—A press dispatch from Huntington, W. Va., dated Oct. 30, says that Gen. Wm. G. Dacey, 1 Broadway, New York city, who is president of the Virginias Ry. Co., and for a year past has contemplated the construction of a road from Huntington, up Guyan River and on through the Virginias, where it will connect with a line leading to the seacoast, states that if McKinley is elected he will put 1,000 men at work on this new line of road inside of 60 days.

Northwest.

DES MOINES & KANSAS CITY.—A press dispatch says that the Des Moines & Kansas City will, on Nov. 1, have its narrow gage line completed to standard between Des Moines and Van Wert, Ia., a distance of 75 miles.

MARSHFIELD & SOUTHEASTERN.—It is reported that the Marshfield & Southeastern R. R. will be extended from Marshfield, Wis., to Princeton, a distance of 90 miles, early next spring. The completion will, by connecting ing with the Chicago & Nortwestern at Princeton, Wis., make the shortest line from Marshfield to Milwaukee. It is also stated that extensive machine shops are to be built and maintained at Marshfield, and that the town will probably be made a division point. Gen. Mgr., Chas. H. Grundy, Marshfield, Wis.

TRACK ELEVATION AT CHICAGO.—Alderman O'Neill, chairman of the special track-elevation committee, has secured the passage of two ordinances, which will tend to push to completion track elevation at the stock yards. The first order directs the mayor and commissioner of public works to require the Metropolitan and Lake St. Elevated railway companies to elevate the plane of their tracks at Rockwell St. to such a height as shall be necessary to enable the surface roads in Rockwell St. to elevate their tracks in accordance with the ordinance passed June 11, 1896. The second order instructs the mayor and the commissioner of public works to require the Lake Shore & Michigan Southern and the Chicago, Rock Island & Pacific railway companies to elevate their tracks between 37th and 47th Sts., in accordance with the ordinance passed July 9.

WISCONSIN CENTRAL.—A press dispatch from Neenah, Wis., says that this company will soon construct a solid roadbed at Neenah in place of nearly 1,500 ft. of trestle work. An average depth of 11 ft. of filling will be required to bring the roadbed up to the present elevated track and it is estimated that the improvement will require nearly 2,000 carloads of gravel.

Southwest.

ATCHISON, TOPEKA & SANTA FE.—This company is considering the building of an extension from Perry, Okla., to Stillwater, a distance of 25 miles. Work will probably be commenced next spring.

GULF, COLORADO & SANTA FE.—It is stated that the business men of Richmond, Tex., are raising a bonus to extend this railway into Richmond. A spur about two miles in length will be needed.

GULF & BRAZOS VALLEY.—A dispatch from Mineral Wells, Tex., quotes Pres. W. A. Squires as saying that all arrangements for the construction of this road from a connection with the Texas & Pacific Ry. to the Jack county line on the north, a distance of 25 miles, have been completed, and that work on the line has commenced. When the road reaches the Jack county line money will be obtained on its bonds, and after paying all liabilities there will be a surplus of fully $100,000 to be used in construction north to Henrietta and south to Velasco. Additional money will be received out of the company's bonds as sections of ten miles are completed. Connection will be made at Henrietta with the St. Louis, Oklahoma & Texas Air Line Ry., which is building to that point from Sapulpa, in the Indian Territory, the southwestern terminus of the St. Louis & San Francisco Ry. With this connection this road would be the short line to St. Louis for a populous and productive portion of Texas.

KANSAS CITY, PITTSBURG & GULF.—Robert Gillham, Ch. Engr., is quoted as saying that tracklaying is progressing at the rate of nearly one mile per day. Between Beaumont, Tex., and the Sabine River, the line is graded. This section is 30 miles in length. Track will be laid from the Sabine River to Lake Charles Junction, a distance of 20 miles, by Nov. 15. Between Horatio and Mena, Ark., a distance of 60 miles, 25 miles are graded, and tracklaying will begin in December.

LAREDO.—The business men of Laredo, Tex., are considering the building of a railway from Laredo to the Minerva Coal Mines. C. Millard is surveying the route. T. T. Brewster is interested.

NEW ORLEANS & SOUTHERN.—This railway which has been operated by the New Orleans & Western, has been sold, it is stated, to Patrick Campbell who is said to represent London capitalists. The purchase price was $51,500. The road is 66 miles long, standard gage, has six locomotives and 68 cars. Receiver, G. S. Taylor, New Orleans, La.

TEXAS & PACIFIC.—A report from New Orleans, La., says that this company has asked permission to build several terminal tracks and a viaduct inside the city limits. Gen. Mgr. L. S. Thorne, Dallas, Tex.

Rocky Mountain and Pacific.

ALAMEDA & SAN JOAQUIN.—Application has been made for a franchise to construct a railway from a point commencing at or near the coal mines of the San Francisco & San Joaquin Coal Co., in Alameda county, to a point near the city of Stockton, Cal.; notice is given that bids will be received by the council for said franchise until Nov. 9. J. M. McCall, Cy. Clk.

CHAMELA, GUADALAJARA & SAN LUIS POTOSI.—Arrangements are said to have been completed for the construction of the first section of this railway in Mexico. The plans from Guadalajara to Chamela, the Pacific coast terminus, a distance of about 250 miles, have been approved by the Mexican authorities. The plans from Guadalajara to San Luis Potosi, about 187 miles, are now being made, under the direction of Engineer Corona, of Guadalajara. It is expected to begin active work in December at Guadalajara on the Mexican Central.

RIO GRANDE WESTERN.—E. J. Yard, Ch. Engr., Salt Lake City, Utah, writes us that the statement under the head of this railway in our issue of Oct. 22, concerning the extension now building, is in error. The extension was given as 36 miles from Richfield to Belmont. It should have read 36 miles from Salina to Belknap, via Richfield and Elsinore.

STREET AND ELECTRIC RAILWAYS.

LEWISTON, ME.—The extension of the Lewiston & Auburn Electric R. R. to Minot and Mechanic Falls, and eventually to connect with the Norway & South Paris Electric Ry., is being considered.

MANCHESTER, N. H.—The Manchester St. Ry. Co. has begun work upon the extensions noted in our issue of last week.

BRIDGEWATER, MASS.—Meetings of citizens have recently been held to promote the building of an electric railway from Brocton to Bridgewater, noted in our issue of Oct. 22. It is proposed to capitalize the company to be formed at $10,000 per mile. I. N. Nutter, J. H. Strong, R. W. Nutter and J. S. Allen are interested.

GARDNER, MASS.—The "News" states that two companies are trying to secure a franchise to build an electric railway from Gardner to Fitchburg. F. S. Coolidge, E. F. Blodgett, D. C. Miles, and J. A. Stiles are interested.

SPRINGFIELD, MASS.—The selectmen of West Springfield have granted a franchise to the Springfield, Agawam & Suffield Electric Co.; the company is to pay $125,000 to assist in building a bridge between Springfield and West Springfield.

WALPOLE, MASS.—The franchise granted by the selectmen about a year ago to the Norfolk Central St. Ry. Co., has lapsed because of the failure of the company to get its road into operation before Oct. 1, as per agreement, and there is some question whether it will be regranted.

WICKFORD, MASS.—It is stated that the route for the new Seaview Ry. is being cleared and that grading is to begin at once. It is now stated that the proposed new road will start from the Wickford depot, on the Newport & Wickford Ry., thence run south to the village of Hamilton, and then practically follow the shore line to Narragansett Pier. The new road will open up a territory along the shore which is adapted to the building of summer residences.

ROCKVILLE, CONN.—The town council has reported favorably upon the application of the Rockville & Ellington St. Ry. Co. to lay tracks. The railway company is to pay to the city $1,000 a year and cars must be running by June, 1897.

WILLIMANTIC, CONN.—Persons representing a syndicate of capitalists are said to have been negotiating for the franchise of the Willimantic St. Ry. Co. The charter covers the principal highways and streets extending from the northerly end of the village of South Coventry through and about this city, Windham Center, South Windham and Franklin to Baltic. It is understood that negotiations are completed.

ONEONTA, N. Y.—The Oneonta St. R. R. Co., it is reported, will build a power-house and station on Mechanic St., at the foot of Chestnut St.

PATCHOGUE, N. Y.—The board of trustees will take action Nov. 11 upon the application of the Patchogue & Port Jefferson Traction Co. to build and operate a trolley road in Patchogue.

QUEENS, N. Y.—There is a probability that the Long Island Electric R. R. Co. will early in January have cars running from Queens to Brooklyn. The grading of the road is completed almost to Queens, and the rails have been laid as far as Hollis. The work of laying the tracks, keeps in advance of the macadamizing. The stone has been laid as far as the village line of Jamaica. The tracks, so far as laid, are complete, with the exception of pavement that will be laid between the rails. The work is progressing favorably.

CAMDEN, N. J.—A large force of men is reported to be at work along the River road in Stockton extending the line of the Camden & Suburban Ry. Co., from State St. to Cooper Ave.

ASHLAND, PA.—It is reported that an electric railway may be built to connect Centralia and Ashland.

BRADFORD, PA.—A trolley line is to be built from this place to Lewis Run in the near future.

BRISTOL, PA.—The Doylestown, Pa., "Intelligencer" says that the extension of the Newtown & Bristol Electric Ry. up the Newportville road to Fallsington and Morrisville will doubtless be under construction next spring. Joseph L. Lovett and M. V. Lynn, of Emilie, have secured right of way from property owners on the route almost without exception to Morrisville borough line.

DOYLESTOWN, PA.—The East Penn. Traction Co. proposes to build an electric railway to connect Doylestown, Centreville, Newtown, New Hope, Morrisville, and Bristol. The capital stock of the company is $350,000. A large number of names is published, of subscribers to the stock, among which are: Chas. F. Burger, Brooklyn, N. Y., Prest.; Robt. E. Pleive, Geo. H. Kelwig, New York city; Walter Brown, Samuel S. Harper, Jas. M. Rooney, Philadelphia; Malcomb A. Buckman, Newtown; James T. Fish, Fallsington.

PITTSBURG, PA.—Work on the Brownsville extension of the Pittsburg & Birmingham traction line is being pushed forward rapidly. Pres. Harry Moore is quoted as saying that a new route will circle the hill top, as now, taking in the principal points of Beltzhoover, Knoxville and Allentown, and when business justifies it, the company proposes to extend the line into Baldwin township. ——The Consolidated Traction Co. was to have begun on Oct. 26 to tear up its tracks on Penn Ave., from 34th to East Liberty St. It is expected that the work will take six weeks.

PITTSBURG, PA.—The Millvale & Etna St. Ry. Co. has been granted permission by the Millvale authorities to double track its line through that borough and for an extension to Bauerstown.

STEELTON, PA.—Consent has been given to the Citizen's Passenger Ry. Co. to make several extensions and rebuild portions of the road.

WILLOW GROVE, PA.—A trolley line will, it is said, be put in operation from Willow Grove, Pa., to Trenton, N. J. The company will be known as the East Penn Traction Co. A. D. Cadwallader, of Yardley, Pa., is president, and David Hanley Stone, of this city, secretary. Surveys have been made, and if possible the company will endeavor to have cars running before Jan. 1, 1897.

WILKESBARRE, PA.—Surveys are stated to have been made for a new trolley road from this city to Hazleton and the scheme of building the road and connecting the various electric systems from Carbondale to Hazleton promises to be realized. The new line will be about 24 miles between this city and Hazleton, and as the distance by steam roads is 49 miles, the trolley can readily compete with the existing roads for time, and at a much lower price. The Wyoming Valley and the Lehigh Traction companies are said to be interested.

WASHINGTON, D. C.—L. H. Hyer, Ch. Engr., 1216 F St., N. W., writes us that the projected length of the Washington, Annapolis & Chesapeake Electric R. R. is 27 miles, from Washington via Columbia Park, Mitchellville, Davidsonville, Hills Point, Bay Ridge, to Annapolis. Most of the right of way is secured; the survey is finished and estimates will soon be furnished to the directors.

CHARLESTON, S. C.—Chas. H. Deane and others, noted last week, propose to build at once an electric railway system in this city. The name of the company is the Charleston Electric Ry. Co. Capital stock not less than $300,000, nor more than $1,000,000. Application has been made to the city council for a franchise. The length will be 20 to 25 miles, and with equipment will cost more than $200,000, it is estimated. The company gives bonds to begin the work of construction within ten days after permit is granted. Address P. H. Gadsen.

GREENVILLE, S. C.—The secretary of state has issued a commission to the Paris Mountain Land Co. It proposes to build a railway through Greenville to Paris Mountain, to be operated by steam, horse or electric power. The capital stock is $10,000. The incorporators are S. F. Trowbridge, of Piedmont; Sam M. Grist, of Yorkville; W. J. and W. F. Thackston, H. C. Markley, O. B. Cagle, J. F. Richardson, A. G. Furman, A. G. Gower, H. J. Haynsworth and Frank Hammond, all of Greenville.

AUGUSTA, GA.—It is reported that a company is considering the building of an electric line from Augusta to Aiken, S. C., to pass through Langley, Graniteville and Bath. The road will be about 18 miles long.

NEW ORLEANS, LA.—The New Orleans & Western Co., it is stated, has determined to use trolley motors, in addition to the compressed air, for hauling freight cars in its yards at Port Chalmette. Six motors will be placed in service. Ch. Engr., W. W. Tomlinson.

COLUMBUS, O.—In addition to the $20,000 of the receiver's certificates recently authorized for running expenses, Receiver George H. Worthington has applied to the Court for permission to issue $200,000 in certificates to pay for building extensions of the Columbus Central St. Ry.

CLEVELAND, O.—The Cleveland & Southern Electric Ry. Co. has been incorporated by H. C. Mason, F. L. Taft, Alfred P. Biddle, A. M. Austin and C. H. Olds. The road will be for passenger, freight and mail service, and the route is designed for an entirely new field, passing through Cuyahoga, Medina, Summit and Stark counties. The termini will be Cleveland and Massilon.

DAYTON, O.—The Dayton & Miamisburg Traction Co. is said to be considering some extensions, one of which is to Hamilton.

HAMILTON, O.—The Cincinnati & Miami Valley Traction Co. has been incorporated with headquarters at Hamilton, to build and operate an electric railway from the southern border of Butler county, through Hamilton, Middletown, Trenton, Franklin, on across Butler county, the Edge of Warren and to the northern edge of Montgomery county. The capital stock is $100,000 divided into 1,000 shares of $100 each. The incorporators are Dennis Dwyer, William E. Mays, Albert Emanuel, John I. Tracy and Albert J. Dwyer.

IRONTON, O.—Henry Cook, contractor, is pushing the work of installing a new electric railway.

LIMA, O.—Receiver J. N. Hutchison has sold the Lima St. Ry. plant and franchise to E. W. Moore, of Cleveland, for $50,250. It is understood that the purchaser, E. W. Moore, represents the bondholders. The company intends to begin work of repairing and rebuilding the line at once. In addition, several miles of new track will be constructed, connecting different points, but just what additions will be made has not been fully determined.

AURORA, ILL.—The new electric car line between Aurora and Batavia, has been completed. The road is eight miles in length, substantially built throughout.

JOLIET, ILL.—The street railway company is said to be considering an extension from Lockport to Lemont.

MILWAUKEE, WIS.—Excavations for the Milwaukee & Waukesha Electric Ry. were begun Oct 22 at 1st and Lincoln Aves. While the operations are now on a small scale, it is said a large force is soon to be put to work.

ST. PAUL, MINN.—Local papers state that citizens are considering the building of a belt line street railway. Among those interested are: M. D. Munn, R. A. Kirk and J. W. Bishop.

BURLINGTON, IA.—Articles of incorporation of the Burlington Ry. & Light Co. have been filed by J. J. Ranson, G. H. Higbee, E. C. Walsh, A. E. Walsh and C. H. Walsh. The capital stock is $1,250,000. The object of the incorporation is the ownership and operation of steam and street railways, gas and electric light plants, power and steam heating plants, etc.

MASON CITY, IA.—A press report states that the contract for grading for the Mason City Electric Ry. line has been let to Cullin & Co., of Cedar Rapids; 8¼ miles are to be put in and the line is to be completed in 60 days.

SIOUX CITY, IA.—A. F. Call, Vice-Pres. Sioux City Traction Co., is quoted as saying that it had been decided to make an important extension of the company's West 7th St. line. The extension will be built from the end of the line for four blocks up Ross St.

ST. LOUIS, MO.—The St. Louis, Fenton & Southwestern Ry. Co., which has been granted a franchise to build an electric railway through St. Louis county, over a private right of way, from Carondelet to Big River, in Jefferson county, has petitioned the county for the privilege of changing its route and laying T-rails on road crossings. It also asks to be allowed to use electric automatic signal bells at all crossings. John Scullin is asked to extend his street railway 1½ miles, by citizens.

FAYETTEVILLE, ARK.—Local newspapers state that the first step towards preparing for the construction of the street railway has been taken and the work will be continued until fully accomplished.

LOS ANGELES, CAL.—The Mateo St. & Santa Fe Ave. St. Ry. Co. is asking that a franchise be advertised for sale for the construction and operation of a street car line.

SANTA MONICA, CAL.—The "Outlook," states that all deeds have been signed for right of way for the road to Calabasas district. Supervisor Hay says the cost of constructing the road will be in the neighborhood of $2,500.

SAN DIEGO, CAL.—The San Diego Electric Ry. Co. has been granted additional franchises for the extension of its road, and before the winter season is over several more miles of trackage will be added to this system.

VENTURA, CAL.—Application has been made to the board of supervisors asking that a franchise be granted to E. S. Thatcher, trustee, to construct and operate a steam or electric railroad in Ventura county, from San Buenaventura to the foot of the grade of the Upper Ojai Valley. The board will receive bids for said franchise until Nov. 23. A. S. Kenagy, Cy. Clk.

GUADALAJARA, MEX.—The street car company will shortly change the traction of its lines to either electricity or compressed air. Mr. Blake, the engineer, is engaged in investigating the subject and upon rendering his report work will be commenced.

MONTREAL, QUE.—The "Gazette" says that the Montreal St. Ry. Co. is pushing the construction of its Guy St. and Cote des Neiges line. The laying of the rails has commenced on the Point St. Charles end of the route, one track having already been built on Shearer, between Centre and William Sts.

DANVILLE, QUE.—It is stated that the Asbestos & Danville Ry. Co. will apply to the legislature for power to build and run an electric railway from Danville to Asbestos, Richmond county.

ELECTRIC LIGHT AND POWER.

PITTSFIELD, MASS.—The Pittsfield Electric Light Co., it is reported, will probably soon add new machinery to its plant, to cost about $5,000, as it is proposed to supply Dalton, Mass., with light. The company is considering the plan of utilizing water power.

WAKEFIELD, N. Y.—It is reported that the Eastchester Electric Light Co. has been refused permission to supply this place with light.

BROOKLYN, N. Y.—E. O. Matthews, chief of bureau of yards and docks, Washington, D. C., in his report, recently submitted, recommends an additional dynamo and engine for the light plant at the Brooklyn navy yard, at a cost of about $12,000.

BUFFALO, N. Y.—The council has voted to ask for bids for lighting the city with either gas or electricity. Councilmen Ash, Adam, Jipp or Klink can be addressed.

COXSACKIE, N. Y.—It is reported that a company is being organized to build an electric light plant in this town.

CORNING, N. Y.—The Corning Heat, Light & Power Co. has petitioned the council for a franchise for an electric light plant. A. D. Welsh, Engr., and Hosea A. Clark, Corning, are interested.

GENEVA, N. Y.—Bids are asked until Nov. 12 for electric lighting for five years, beginning May 7, 1897. About 100 arc lights will at least be wanted. S. D. Willard, Chn. Com.

HAMBURG, N. Y.—It is reported that the contract with the Hamburg Electric Light Co. expired Oct. 1, and the village board has completed arrangements by which the company is to furnish 2,000 c. p. lights for five years at $62.50 a lamp a year. This is somewhat lower than the former price.

MORRISVILLE, N. Y.—Press reports state that the Morrisville Electric Light Co.'s plant at Eagleville was destroyed by fire Oct. 26, causing a reported loss of about $4,000.

RICHMOND (S. I.), N. Y.—The Richmond County Electric Co., Pres., Erastus Wiman, and the Midland Electric Light, Heat & Power Co., in which Albert Reynaud is interested, have applied for franchises.

RICHMOND HILL (L. I.), N. Y.—At the meeting of the trustess Oct. 26, a proposition for lighting the village was received from the Jamaica Electric Light Co. The offer is to furnish arc lights of 1200 c. p. at $100 a light a year. The company will be ready to turn on the lights by Dec. 1. Incandescent lights will also be furnished to private houses. The company has just renewed its contract with Jamaica and is building a large plant between Richmond Hill and Jamaica, as noted in our issue of last week.

TROY, N. Y.—Bids are asked until Nov. 14 for electric light wiring, tubing, etc., for the new county court-house. Archs., M. F. Cummings & Son, 10 Times Bldg., Troy; F. P. Harder, Secy., Court House Comrs.; J. H. Peck, Chn.

RIDGEWOOD, N. J.—The Ridgewood Electric Light Co. has again been awarded the contract for lighting the village streets, its bid being the same as last year, $70 per arc light. Next year more lamps will be needed. The capacity of the present plant is 35 arc lights, and the contract calls for 40.

RIVERTON, N. J.—It is stated that after endeavoring for several years to gain admission into the borough of Riverton, the Beverly Electric Light Co., of Beverly, N.J., has succeeded in obtaining the sanction of council to run poles and wires through the town. The extension of the system from Beverly will require an enlargement of the plant to three times its present capacity, and probably its removal to Riverside.

PITTSBURG, PA.—Bids are asked until Nov. 7 for lighting the South Side Market House. E. M. Bigelow, Dir. Pub. Wks.

ROCHESTER, PA.—It is reported that the Rochester Electric Light Co. is about to double the capacity of its plant, by erecting an addition and putting in a new 150-HP. engine and two new boilers.

WELDON. N. C.—The Roanoke Navigation & Water Power Co. is reported to have been granted a franchise for an electric light plant in this place.

COLUMBIA, S. C.—An electric light plant, it is stated, will be added to the equipment of the new Granby Cotton Mfg. Co.'s mill at this place, which will begin operations Nov. 15. Other new mills noted under Manufacturing Plants will include electric plants in their equipment.

CUTHBERT, GA.—We are informed that the General Electric Co., 44 Broad St., New York, has been awarded the contract for a complete electric light plant, as advertised in Engineering News, at $6,192. Robt. L. Moye, Mayor.

COAL CREEK, TENN.—R. M. Edward & Co. are reported as contemplating the erection of a 15-arc and 200-incandescent light plant.

ATTICA, O.—It is stated that the question of constructing an electric light plant is being considered by the citizens.

BLANCHESTER, O.—The council on Oct. 20 awarded to the Fort Wayne Electrical Corporation, Fort Wayne. Ind., the contract for the machinery for the proposed plant at $6,300; the contract for the power house was awarded to Brooks Bros., of Jackson, Mich., at $3,100, and the contract for the engine was awarded to I. & E. Greenwald, Cincinnati, O., at $2,600; Engr., G. L. McKibben, Van Wert, O.; Owen Brown, Village Clk.

BLUFFTON, O.—The construction of an electric light plant is reported as being considered.

BRYAN, O.—Frank B. Rae, Elec. Engr., 910 Fort Dearborn Bldg., Chicago, writes us that the following bids were received for an electric light plant, delivered and erected:

One 125-HP. and one 60-HP. direct-connected engine; one 200-HP. heater; two separators; erection and pipe work:

McIntosh & Seymore, Auburn, N. Y. engines only	$2,450
Fischer Foundry & Machine Co., Pittsburg "	2,562
Ball Engine Co., Erie, Pa., complete	3,661
Russell & Co.,[1] 4-valve Russell engine	[2]3.272
Other items	[2]745
McEwen Eng. Co.,[3] complete	2,885

Two 60-light arc dynamos; 100 arc lamps; one 75 K-W. alternating dynamo and switchboard; 31 transformers, capacity 1,000 lights; meters for 1,000 lights; switchboard, etc.:

Fort Wayne Electric Corporation, Fort Wayne, Ind.	[2]$8,165
Western Electric Co., Chicago	8,218
General Electric Co., Cincinnati office	8,518

Pole line construction, circuits for 63 street and 40 commercial arc lights; primary circuits for 1,000 incandescent lights; erection of converters; arc lamp suspension, etc.:

Craighead Engineering Co., Cincinnati, O	$6,450
Chase Construction Co., Detroit, Mich	4,960
Bissell, Dodge & Erner Co., Toledo	[2]4,929
Adams, Green & Co., Morrison, Ill	5,985
Fort Wayne Electric Cor., Fort Wayne, Ind	6,153

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[1] By Arbuckle-Ryan Co., Toledo; [2] awarded contracts; [3] by Bissell, Dodge & Erner Co., Toledo.

EAST PALESTINE, O.—Bids are asked until Nov. 7 for furnishing and constructing a complete electric light plant. J. H. Logan, Mayor; John Archibald, Clk.

LAKEWOOD, O.—Bids are asked until Nov. 20 for constructing an electric light plant at this place, according to reports. Wm. F. Closse, Clk.

LONDON, O.—It is stated that this place has sold $2,000 of 6% electric light bonds.

FENNVILLE, MICH.—Ira Hutchins has been granted a 15-year franchise for an electric light plant in this place, according to reports.

MARQUETTE, MICH.—The electric light and power commission has recommended to the council the construction of a new dam at the upper falls, steel or iron head gates, the purchase of transformers, etc., for an electric water-power plant estimated to cost about $52,950. J. R. Van Evera, Alfred Kidder and Sampson Bier compose the commission.

NEGAUNEE, MICH.—Bids are asked until Nov. 14 for constructing an electric light plant. F. B. Rae, Engr., 134 Monroe St., Chicago, Ill.; Mapor Kirkwood can be addressed.

CHICAGO, ILL.—It is reported that the Hyde Park Electric Light & Power Co. will meet Nov. 22 to authorize the issue of $200,000 in 6% bonds, half of which will be used for extending the plant and the remainder for a new mortgage.

LODI, WIS.—Thos. Hackel is reported to have been granted a ten-year franchise for an electric light plant in this city.

SOUTH MILWAUKEE, WIS.—Bids were asked until Nov. 4 for constructing an electric light plant, according to reports. T. McGovroy, Village Clk.

FALLS CITY, NEB.—It is reported that at an election held Oct. 6 it was voted to issue bonds for extending the electric light plant.

GUTHRIE, OKLA.—The council is stated as considering the question of constructing an electric light plant and water-works.

CAMERON, MO.—Bids are asked until Nov. 10 for the purchase of $12,000 of electric light bonds. Bids for the construction of the plant will be asked for soon after the bonds have been sold. Consult. Engr., A. L. McRae, 306 Oriel Bldg., St. Louis. Mo.

FORT WORTH, TEX.—Press reports state that M. R. Rosson proposes to purchase the electric light and power plants in this city for a syndicate of capitalists of Glasgow, Scotland. It is proposed to enlarge them and make a number of improvements.

AZUSA, CAL.—Bids are asked until Nov. 10 for constructing the power works on the San Gabriel River, as noted in our issue of Oct. 22. The specifications call for bids on 13 sections of work, seven are tunnels and the others wooden pipe, steel siphons, cement work, gate house and tunnel linings. There will be 28 tunnels, aggregating 17,100 ft. in length and of diameter sufficient to carry the entire summer flow of the river, about 5,000 ins.; 8,600 ft. of wooden pipe. The water wheels and dynamos will be located near the H. C. Robert's homestead or at the mouth of the canyon. The entire length of tunnels and ditches where wooden pipe is not used will be lined on the bottom and sides with concrete cement. There is an option in the bidding of 10,900 ft. of conduit in case no wooden pipe is used. Engr., E. C. Balch, 28 Baker Block, Los Angeles, Cal.

MODESTO, CAL.—The committee has submitted a report on the proposed electric light plant to cost about $16,000. It is probable that nothing will be done for the present. The plant proposed will have 30 arc and 750 incandescent lights. Messrs. Hewel, Harter and Hatton compose the committee.

NOGALES, ARIZ.—It is reported that Howell Hinds and associates have recently been granted concessions for lighting Hermosillo and Guaymas by electricity, and that within the next year extensive plants will be erected in both cities.

NEW COMPANIES.—Burlington Ry. & Light Co., Burlington, Ia.; $1,250,000; J. J. Ransom, G. H. Higby, E. C. Walsh, A. E. Alsh, C. H. Walsh. The object of the incorporation is the ownership and operation of steam and street railways, gas and electric light plants, power and steam heating plants, etc. The incorporation is to run 20 years.

Greater New York Electric Light & Power Co., New York, N. Y.; $50,000; Jacob Fleischhauer, Allan Lexow, Chas. K. Lexow.

Laguna Water & Power Co., San Diego, Cal.; $3,000,000, with $400,000 paid in; J. W. Thompson, Edwin Parker, Chas. D. Long, E. E. Shaffer and H. C. Gordon, all of San Diego.

Orient Electrical Co., Youngstown, O.; $25,000; Lucius E. Cochran, Geo. M. McKelvey, Wick C. Cans, Mason Evans, A. B. Mannix.

Brinkley Electric Light & Power Co., Brinkley, Ark.; $15,000; J. J. Ferrell, M. A. Ferrell, F. E. Sapp.

Aberdeen Gas & Electric Light Co., Aberdeen, S. Dak.; $75,000; Fred A. Bartholemew, John S. Bartholemew, Geo. B. Clifford, William Summers, Geo. W. Jenkins.

BRIDGES

HARTFORD, CONN.—The council has authorized the mayor to call a meeting of citizens to consider the question of appropriating money for building a 70-ft. masonry bridge over the Park River at a cost of $25,000, as petitioned for by the Pope Mfg. Co.

SYRACUSE, N. Y.—Bids are asked until Nov. 9 for constructing a foot bridge over the Erie Canal at West Genesee St. M. Z. Haven, Cy. Clk.

ARLINGTON, N. J.—The Erie R. R. Co. has awarded the contract for a new double-track steel girder bridge over the Passaic River between West Arlington and North Newark to the New Jersey Steel & Iron Co., of Trenton, N. J. The structure will have a 147 ft. draw and four spans of 95¾ ft. each in length.

BRADDOCK, PA.—Press reports state that the plans of the new bridge, which it is proposed to erect across the Monongahela River at Braddock, were received at the office of the United States engineer in Pittsburg Oct. 20. Secretary of War Lamont has approved of the alterations made in the plans, and the company is now at liberty to begin the work. The bridge is to be erected by the Union R. R. Co. at the foot of 13th st., Braddock, and will be a double structure. The driveway will be above the railway tracks, and the whole bridge is to be built of steel trusswork. The channel spans are 361 ft. long, and the bridge will be 56.66 ft. above low water mark.

PHILADELPHIA, PA.—Bids are asked until Nov. 10 for repairing bridges, etc. T. M. Thompson, Dir. Pub. Wks.

PITTSBURG, PA.—It is stated that Charles Jutte, Pittsburg, has sold the bridge charter over which the Braddock & Homestead Ry. will pass. The steel bridge will be built in West Braddock, and will cross the river at that point.

PITTSBURG, PA.—A resolution has been introduced into councils authorizing the department of public works to have plans prepared for re-building the bridges carrying Penn, Shady and Highland Aves., over the Pennsylvania R. R., at an estimated cost of $35,000. The Consolidated Traction Co. will use the bridges and proposes to pay two-thirds the expense.

WASHINGTON, D. C.—The district commissioners and the board of trade have decided in favor of a single viaduct at Kendall Green for the Baltimore & Ohio R. R. Co.

ALBANY, GA.—Bids are asked until Nov. 16 for constructing a double-track iron and steel bridge over Flint River, according to reports. The structure will have two spans of 140 ft. each. W. O. Watson, Comr. Bd. Roads.

BAY CITY, MICH.—Bids are asked until Nov. 9 for constructing a trestle approach to the 23d St. bridge. J. H. Bloomshield, Clk. Bridge Comrs.

KANSAS CITY, MO.—It is stated that the officials of the Missouri, Kansas & Texas system have decided to remove the wooden bridges along the road and place Howe truss steel bridges in their stead. The number of bridges between Texas Junction and Franklin Junction is 37. J. W. Petheram, Ch. Engr., Dallas, Tex.——The park board has decided to construct a stone and steel bridge over Anderson Ave., at Independence Boulevard. Engr., Robt. Gillham.

ST. LOUIS, MO.—The members of the North St. Louis Improvement Association have appointed Wm. Burden, J. K. Cummings and A. H. St. Clair a committee to solicit subscriptions for the formation of a new company to construct a third bridge over the Mississippi River at this city. Congressman Chas. F. Joy, of St. Louis, is reported as to support the matter in Congress.

ST. JOSEPH, MO.—Bids are asked until Nov. 7 for constructing a bridge in Bloomington township, according to reports. W. B. Hazen, County Surv., St. Joseph.

HOUSTON, TEX.—The city engineer has been authorized to prepare plans for a bridge over White Oak near Beauchamp Springs, to cost $6,384.

LOS ANGELES, CAL.—Bids are asked until Nov. 5 for constructing a 4-span pile bridge over the San Gabriel River on the Whittier Road. Address the county clerk. It is reported that the Southern California Ry. Co. is preparing to build a steel girder truss bridge across the Los Angeles River on the line to San Diego. This bridge will have two spans of 149 ft. each, and the grade line will be higher than the present trestle used at that point. A similar bridge is to be built at Rivera. That structure will have two spans of 100 ft. each. Gen. Mgr. K. H. Wade, Los Angeles; Ch. Engr., F. T. Perris, San Bernardino, Cal. The council received bids as follows for constructing a bridge over the Los Angeles River on the Los Felis Road. Ledbetter & Mercereau 130-ft. span and 160 ft. of pile trestle, $7,383; D. P. N. Little, $3,347 to $4,433; Gillard & Smith, $6,500, and Sawyer & Arthur, $4,225 to $5,337.

MADDINGTON FALLS, QUE.—The Dominion Bridge Co., Ltd., of Montreal, has been awarded the contract for building a new steel bridge at this place for the Drummond County Ry. Co. at a cost of about $26,000. Gen. Mgr. W. Mitchell, Drummondville, Que.

VANCOUVER, B. C.—It is reported that the council has voted to direct the engineer to prepare plans for a new bridge at Point Ellice. The structure will have three 217-ft. spans, and is estimated to cost about $150,000. T. H. Tracy, Cy. Engr.

CHARLOTTETOWN, P. E. I.—L. L. Beer, James Paton, H. C. McDonald, T. A. McLean and L. E. Prowse have been appointed a committee to consider the question of erecting an iron bridge over the Hillsboro River.

BUILDINGS

BOSTON, MASS.—Bids are asked until Nov. 13 for constructing two brick school buildings; bonds of $30,000 and $20,000 are required. Archs., T. M. Clark, 22 Congress St., and James Mulcahy, 43 Milk St., Boston; Edward H. Dunn, Chn. Com.

BROOKLYN, N. Y.—The Masons of this city are considering the question of constructing a Masonic hospital. A meeting was held last week at Aurora Grata Cathedral, Bedford Ave. and Madison St., to consider the subject.——V. G. Hall & Co. have sold for Mrs. Eugene Schieffelin, of New York, 10 lots on Second St., on which it is proposed to erect 5-story flats.——The joint committee on schoolhouses and sites of localities of the board of education at its last meeting decided to recommend the erection of several new schoolhouses. A meeting will be held Nov. 6 to consider the question.

BUFFALO, N. Y.—Wm. D. Koelsch will build a 3-story brick flat building to cost $20,000, on Chenango St. Archs., Eckel & Ackerman, 46 Niagara St.——Robert A. Wallace has prepared plans for a brick and stone residence for J. A. Munson to cost $10,000.——Ex-Mayor Philip Becker will build an iron frame, brick and terra cotta office building, at 470 Main St., to cost $60,000.——J. F. Burke and E. C. Coatsworth will build a 4-story brick flat building on Franklin St., to cost $20,000.

KINGS PARK, N. Y.—Bids are asked until Nov. 11 for constructing new steam supply pipes at the Long Island State Hospital, Kings Park, and for the plumbing, heating and ventilating of two buildings at the hospital, as stated in our advertising columns. I. G. Perry, State Arch., Albany; Dr. W. E. Sylvester, Gen. Supt.; J. G. Deubert, Pres. Bd. Mgrs., Arbuckle Bldg., Brooklyn.

NEW YORK, N. Y.—The board of education has appointed a committee to condemn property in different sections of the city for the erection of four school buildings. Commissioners Hubble, Montant and Taft compose the committee. Geo. S. Greene, Jr., Ch. Engr., Dept. of Docks, and Edward H. Kendall, Consult. Engr., have submitted plans to the board for a roof garden over the dock at the foot of East Third St.——Plans have been filed by Phillip Braender, 263 West 118th St., for 5-story brick flats on 118th St. to cost $80,000.——The lowest bid received Oct. 29 for the stone and brick work, roof cover, interior finish, etc., of the Appraisers' warehouse, in New York was that of D. H. Hayes, of Chicago, at $322,500.——The Central National Bank has awarded the contract to Blake & Williams, 362 West Broadway, for the heating apparatus for its new building, and to the Brooklyn Electrical Equipment Co., 164 Montague St., Brooklyn, for the electric work.

NEW YORK, N. Y.—Plans have been filed by Wm. W. Astor, 21 W. 26th St., for a 12-story office building at Broadway and Exchange Place; by the New York Life Insurance Co., 346 Broadway, for a 12-story building at 30 and 32 Elm St.; and by John R. Todd for a 6-story brick apartment house at Manhattan Ave. and 113th St., to cost $300,000.

NIAGARA FALLS, N. Y.—A schoolhouse will be built in each of the first and third wards. Plans are now being prepared and bids will be asked.

OGDENSBURG, N. Y.—Bids are asked until Nov. 9 for the erection of the 40th company armory building. I. G. Perry, State Arch., Albany and Binghamton, N. Y.; Edwin A. McAlpin, Adj.-Gen., Albany.

ATLANTIC CITY, N. J.—The contract for the new house for the Neptune Hose Co. has been awarded to E. S. Lee. The plans were made by Seymour Davis and provide for a 4-story structure of brick and iron, 47x80 ft., to cost about $25,000.

FORT HANCOCK, N. J.—Bids are asked until Nov. 30 for erecting 32 buildings at Fort Hancock, and for plumbing and heating the same, as stated in our advertising columns. Capt. C. A. Devo, Army Bldg.

ALLEGHENY, PA.—Galen C. Hartman, of Pittsburg, has offered to subscribe $1,000 to a fund of $1,000,000 for enlarging the Western University of Pennsylvania. W. J. Holland, Chancellor, Allegheny.

ALLEGHENY, PA.—F. C. Sauer, Hamilton Bldg., Pittsburg, is preparing designs for a stone and brick church, Fulton and Locust Sts., to cost about $40,000.

CARLISLE, PA.—It is reported that the Beetem Lumber & Mfg. Co., Carlisle, will erect a 2-story brick building 50x100 ft., to be used for its business.

LEBANON, PA.—This city will erect a large brick annex to the high school building. It is reported that desks, etc., are wanted.

LEBANON, PA.—John B. Miles, C. E., Philadelphia, has prepared plans for a new iron roundhouse for the Cornwall & Lebanon R. R. Co. R. T. Spotten, Master Mechanic, Lebanon.

PHILADELPHIA, PA.—The corner stone of the new building at Juniper and Walnut Sts. for the Presbyterian board of publication was laid Oct. 24. The structure will be 11 stories high and is estimated to cost $516,000. Arch., J. M. Huston, 604 Providence Bldg.; Pres., Robt. N. Willson; Vice-Pres., Rev. Wm. B. Greene, Jr.

PITTSBURG, PA.—Bids are asked until Nov. 10 for a hot blast and steam heating and ventilating apparatus for the 23rd ward school building. Arch., Edward Stotz, 349 Fifth Ave.; Dr. W. D. O'Brien, Chn.

PITTSBURG, PA.—McKee & Waughter, 108 Fourth Ave., have completed plans for dwellings for Mrs. Tesh, North Highland Ave., and Mr. Roebart, Evaline St.——Plans for the Pittsburg & Lake Erie R. R. depot have been finished and work will begin early next spring.

SCOTLAND, PA.—The Scotland Industrial School will erect a large brick addition to its building.

WASHINGTON, D. C.—The district commissioners have completed their estimates for the coming year and will ask Congress to appropriate $8,473,797 for district work. Of this amount it is proposed to use $100,000 to begin the construction of a municipal building, about $550,000 for additional school buildings and extensions, and about $80,000 for a hospital, fire enngine house, etc.——The following bids were received by the supervising architect Oct. 28 for the interior finish of the basement, first story, etc., of the post office building in this city:

		Time.
Joseph J. Churchyard, Buffalo, N. Y.	$197,778	8 mos.
Otto Duker & Co., Baltimore, Md.	274,900	......
Henry Shenk, Erie, Pa.	198,730	......
E. F. Gobel, Chicago, Ill.	181,167	8 mos.
Arthur Johnson & Bro., St. Louis	255,900	8 mos.
L. L. Leach & Son, Chicago, Ill.	183,883	8 mos.
Henry Smith & Son, Baltimore, Md.	196,700	8 mos.
John Pierce, New York	198,716	8 mos.
W. E. Spicer & Co., Washington	217,300	8 mos.
Daniel J. McCarthy, Washington	251,655	8 mos.
Richardson & Burgess, Washington	266,554	12 mos.
D. S. Hess & Co., New York	241,900	8 mos.

NEW BERNE, N. C.—The following bids were received by W. M. Aiken, Supervising Arch., Washington, Oct. 23, for the heating apparatus for the post office building:

		Time.
Joseph Jenkins, 8th and Orange Sts., Wilmington, Del.	$4,798	65 das.
Chafer & Becker, Cleveland, O.	3,797	60 das.
Hunnicutt & Bellingrath Co., Atlanta, Ga.	4,355	60 das.
S. I. Pope Co., Chicago	3,879	70 das.
E. H. Wehle, Louisville, Ky.	4,220	80 das.
Blake & Williams. New York	4,061	90 das.
E. Rutzler, New York	3,906	60 das.

JENNINGS, LA.—It is stated that the congregation of the Methodist Episcopal Church wishes plans for a college building to cost about $35,000. Rev. Chas. K. Woodson can be addressed.

NEW ORLEANS, LA.—It is reported that the Great Southern Telephone & Telegraph Co. is about to erect an office building and improve its plant at a cost of about $500,000.

MEMPHIS, TENN.—R. J. Allen, 1017 Chestnut St., Philadelphia, Pa., has prepared plans for a casino, 200 × 65 ft., for this city; estimated cost, $150,000.

HAMILTON, O.—Bids are asked until Nov. 10 for remodeling the county jail and adding 24 new cells, at a cost of $15,000. F. X. Duerr, County Audr.

WARREN, O.—It is stated that money has been subscribed to complete the Ohio Masonic home, at a cost of $170,000. Address J. M. Stull, Warren.

YOUNGSTOWN, O.—The Pittsburg & Lake Erie R. R. Co. is reported to have completed plans for a new station for this city.

IRON MOUNTAIN, MICH.—The round house of the Quanesec Logging R. R. Co., five miles from this city, was destroyed by fire Oct. 28, causing a reported loss of $15,000.

SAGINAW, MICH.—Bids are asked until Nov. 20 for erecting a post-office building in this city. W. M. Aiken, Supervising Arch., Washington.

CHICAGO, ILL.—It is stated that Jennie & Mundie, Home Insurance Building, are the architects for a $1,000,000 addition to the Fair Building at Adams St. and Maple Place.

ST. PAUL, MINN.—Bids are asked until Dec. 1 for the floor arches, etc., for the U. S. public building in this city, as stated in our advertising columns. Address Wm. M. Aiken, Supervising Arch., Washington, D. C.

TOWER, MINN.—Plans are to be prepared for a new Indian school at Sucker Point, to cost about $40,000.

FORT RILEY, KAN.—The following bids were received by Capt. Geo. Ruhlen, Assistant Q. M., U. S. A., for erecting buildings, etc.: (1) being for barracks, (2) officers quarters, (3) stable:

	(1)	(2)	(3)
V. A. Kelly, Leavenworth, Kan.	$20,480	$18,172	$4,975
Moses P. Keefe, Omaha, Neb.	20,700	21,400	7,375
M. S. Wright, Leavenworth, Kan.	20,953	23,184	7,875
Ulrich & Hulse, Manhattan, Kan.	22,380	23,446	8,435
Murdoch-Campbell Co., Chicago	22,864	25,728	9,220
Holmgreen & Oberg, Junction City, Kan.	26,420	21,396	8,345
W. G. Fuller, Leavenworth, Kan.	24,029	23,714	9,855
Henry J. Schell, Chicago	21,800	27,900	9,250
Fellows & Vansant, Topeka, Kan.	25,100	23,700	9,830
Ziegler & Dalton, Junction City.	23,849	26,507	9,981
Keesee, Mills & Clark, Topeka, Kan.	21,828	22,518	8,200

KANSAS CITY, MO.—The construction of a public building and auditorium in this city at a cost of about $300,000, is reported as under discussion. R. D. Kathrens is said to be interested.

ST. LOUIS, MO.—The matter of a union station in North St. Louis was discussed Oct. 21 by the North St. Louis Improvement Association, and the suggestion made that one be built at Main and North Market for the accommodation of the Burlington, the Missouri, Kansas & Texas, the Wabash and the Merchants' Bridge Terminal railways. G. H. Ten Broeck, C. H. Hannebrink and J. K. Cummings were appointed to confer with the interested roads as to making stops at the North Market St. crossing.

ST. LOUIS, MO.—Bids are asked until Nov. 6 for remodeling the Simmons school building and for furnishing a heating apparatus in two school buildings, etc. John Kissner, Chn. Com.

PITTSBURG, TEX.—Bids are asked until Nov. 9 for erecting a 2-story brick school building. F. H. Goodjohn, Mayor.

SAN ANDREAS, CAL.—Bids are asked until Dec. 10 for erecting a new hospital building in Caleveras county, according to reports. A. L. Wyllie, Clerk.

BERKELEY, CAL.—Press reports announce that about $4,500,000 is probably to be given to the University of California by a number of residents of this State. The money will be used chiefly in the erection of new buildings. Pres., Dr. Martin Kellogg. It is stated that Mrs. Phoebe A. Hearst, of San Francisco, besides giving a large amount of money, will contribute cash to obtain plans by international competition, and to pay Prof. B. R. Maybeck to explain the project to Eastern and European architects.

SANTA CRUZ, CAL.—Press reports state that F. E. Webb, of San Francisco, is making arrangements for the purchase of the Sea Beach Hotel and the Pacific Ocean House, for about $150,000. A new company will be organized to make repairs, erect a number of cottages on the grounds and otherwise make improvements to the property.

SANTA MONICA, CAL.—It is stated that an addition and repairs will be made to the Hotel Arcadia.

SAN FRANCISCO, CAL.—Baroness Hirsch is reported to have donated $50,000 toward the erection of a Jewish hospital in San Francisco. The project of a Jewish hospital in this city originated with Mrs. Fred L. Castle, but has never been carried out owing to the lack of funds.

MONTREAL, QUE.—Bruce Price, 150 Fifth Ave., New York, N. Y., has prepared plans for the proposed East End passenger station for the Canadian Pacific Ry. Co. The structure will be 300 × 66 ft., and is to be completed in about a year.

WATER-WORKS.

WATERBURY, VT.—C. L. Woodbury, of Burlington, has the contract for a water supply system for the state insane asylum at this place.

CAMBRIDGE, MASS.—An issue of $200,000 in 30-year 4% water bonds has been authorized.

HOLYOKE, MASS.—Bids are asked until Nov. 16 for furnishing 75 tons of pure soft lead for calking purposes, as stated in our advertising columns. J. C. Sullivan, Registrar.

BUFFALO, N. Y.—Rudolph Hering, of New York, has been employed to assist in locating the proposed new water plant and has recommended a location for an intake.

LANCASTER, N. Y.—The Depew & Lancaster Water-Works Co. has been granted permission to lay mains and place hydrants in this town.

SARATOGA SPRINGS, N. Y.—Bids are asked until Nov. 10 for constructing 12 and 18-in. water conduits. Jesse S. Mott, Village Engr.; James G. McNulty, Clk.

ASBURY PARK, N. J.—It is reported probable that $50,000 of additional water bonds will soon be issued.

TRENTON, N. J.—Charles A. Hague, 39 Courtlandt St., New York, has been engaged to design and superintend the construction of a 100,000,000-gallon reservoir of earth and stone construction, which will probably be constructed next year.

CORAOPOLIS, PA.—Bids are asked until Nov. 16 for the purchase of $22,000 in 4½% water bonds. John W. Arras, Pres. of Council; W. J. Neilson, Chn. Com.

PENNSBURG, PA.—The Pennsburg Water Co. was incorporated Nov. 2 with a capital stock of $25,000. Address Jonathan P. Hillegas, Pennsburg.

DELAWARE CITY, DEL.—The council is reported to have decided to accept the proposition of W. Taylor Leland and others, of Philadelphia, to construct works, as recently noted. It is expected that the construction will soon be commenced.

BALTIMORE, MD.—Bids are asked until Nov. 16 for furnishing 26,000 tons of cast-iron water pipe, as stated in our advertising columns. William L. Kenly, Engr.

PORT DEPOSIT, MD.—A water company has been organized at this place with a capital stock of $10,000, by Adam Peoples and J. M. Johnson, of this place, and others.

CHARLESTON, S. C.—Bids are asked until Nov. 30 for boring an artesian well on Sullivan Island, S. C., as stated in our advertising columns. Capt. Frederic V. Abbot, U. S. Engrs.

EATONTON, GA.—Bids are asked until Nov. 16 for constructing works, as stated in our advertising columns. Specifications may be examined at the New York and Chicago offices of Engineering News. Moore & McCrary, Engrs., Atlanta; C. M. Davis, Secy. Comrs.

ONEONTA, ALA.—Nothing definite has yet been done in regard to water-works, recently noted as proposed. E. C. Hall, Mayor.

HATTIESBURG, MISS.—It is stated that John A. Sutler, of Pass Christian, Miss., will construct works at this place.

BUCYRUS, O.—The Bucyrus Water Co. has had plans prepared by Geo. L. Wells, of Bay City, Mich., for a new reservoir; contracts will probably be awarded in the spring.

THREE OAKS, MICH.—The construction of water-works is again being discussed.

CHICAGO, ILL.—Bids are asked until Nov. 7 for laying water mains in four streets. Joseph Downey, Comr. Pub. Wks.

GILMAN, ILL.—It is hoped to commence the construction of municipal works soon; water supply will be pumped from artesian well to stand-pipe; estimated cost, $25,000.

ODELL, ILL.—A well is being sunk; it is now over 600 ft. deep.

OREGON, ILL.—Bids are asked until Nov. 6 for extending the water mains, according to reports. Address P. Dernier.

HARTLEY, IA.—S. A. Smith writes us that the well is now being drilled by the town; probable cost of works $5,000, if which $3,500 is secured.

KEOKUK, IA.—About two miles of new mains will probably be laid in the spring by the water company. D. W. Swartz, Supt.

DELANO, MINN.—The contract for constructing works has been awarded to C. W. Kerrick, according to reports.

DULUTH, MINN.—The D. Clint Prescott Co., of West Duluth, has been awarded the following contract: Pumps, $88,000; well pump, $450; electric plant, $1,300; overhead crane, $2,750. W. B. Patton, Cy. Engr.

MILACA, MINN.—The contract for constructing works has been awarded to A. Bryson, at $2,000. I. M. Balland, Village Recdr.

OMAHA, NEB.—The Fred Krug Brewing Co. is reported to have contracted with L. E. Nabergall to sink an artesian well 1,400 ft. deep at its brewery.

EL DORADO, ARK.—J. C. Wright, of this place, writes us that the question of water-works may be taken up again next spring and a plant constructed; probable cost $2,500.

GUTHRIE, OKLA.—The council is reported as considering the construction of water-works and an electric light plant,

ROSEBUD, S. DAK.—Bids are asked until Nov. 5 for constructing a water and sewer system for the boarding school plant now in course of construction at the Rosebud Agency. Charles E. McChesney, U. S. Indian Agent.

EL PASO, TEX.—The council is reported as in favor of accepting an offer of Z. T. White to furnish the city with a water supply from artesian wells, for $10,000.

VANCOUVER, WASH.—The Tirzalia Water Co. has been incorporated with a capital stock of $1,500, by L. Sohma and D. F. Schule.

MONMOUTH, ORE.—The Monmouth Water Co. proposes to construct works to cost $6,000. It is not known when contracts will be let. T. J. Beerz, Engr., Monmouth.

BERKELEY, CAL.—A. A. Richardson, of Lincoln, Neb., is said to be trying to organize a company to supply this city with water from artesian wells.

SAN DIEGO, CAL.—The validity of the $1,500,000 in bonds recently voted by the city for water-works has been decided in favor of the city by the courts; construction is now in progress.

SAN DIEGO, CAL.—The Laguna Water & Power Co. was incorporated Oct. 29 to supply water and electricity in San Diego county; ;capital stock, $3,000,000, commencing with $400,000; incorporators, J. W. Thompson, Edwin Parker, Chas. D. Long, E. E. Shaffer and H. C. Gordon, of San Diego.

SANGER, CAL.—Geo. P. Low, lessee Sanger Electric Light Co., intends to construct a $1,500 water-works plant in the spring. The water supply will be pumped from artesian wells to tank; steam plant and pumps already secured. Geo. P. Low, Engr., 421 Market St., San Francisco.

COWANSVILLE, QUE.—The council is reported as considering the construction of water-works. Councillor Mackinnon is interested.

LACHUTE, QUE.—The Lachute Aqueduct Co. intends next spring to put in a new system, using cast-iron pipe throughout. James W. Raitt, Secy.-Treas., writes us that several efforts have been made to secure municipal works, but the taxpayers have each time defeated the project.

GRIMSBY, ONT.—The by-law for the construction of water-works was defeated at the recent election.

VANCOUVER, B. C.—It is reported that the council is considering a by-law to borrow $60,000 for the extension and improvement of the water-works.

IRRIGATION.

QUINCY, FLA.—It is reported that the Owl Cigar Co. wants information in regard to the construction of an irrigation plant.

DENVER, COLO.—Press reports state as follows: Montezuma Valley Irrigation Co.'s ditches, laterals, tunnels, franchises, reservoir sites, etc., were sold at auction Oct. 20 for $60,000. Adding to this the taxes and penalties, the property stands the new owners about $80,000. Ex-Gov. James B. Grant was the trustee in whose name the property was bid in by F. L. Kimball, of the Colorado State Bank. The new owners will place the property on a business basis, and as the United States government will be forced to contract for water in perpetuity for the Ute Indians it necessarily enlists an expense of some $60,000 in way of enlarging ditches, completing reservoirs and running laterals. Senator H. M. Teller has looked the ground over thoroughly and will take charge of the appropriation bill in the senate. To this sum must be added an additional one for ditches in the Ute reserve, and jointly it means an expenditure of about $100,000 in Montezuma county and sections tributary.

EL PASO, TEX.—Denver, Colo., papers of Oct. 27 state as follows: Local advices from New Mexico state that at the recent meeting of the Rio Grande Land & Irrigation Co. a contract was let by Chief Engineer Campbell to W. C. Bradbury & Co., of Denver, who constructed the canals of the Pecos Valley and built some of the dams. The firm states that it will be ready to begin work as soon as the outfit can be shipped and the cement now on the way from London, Eng., arrives. This contract calls for the building of a weir dam at Selden, above Les Cruces, 500 ft. long and 10 ft. high above the surface. This work and certain canal work is to be completed within 120 days, at an estimated cost of $75,000. The company contemplates other dams at Elephant Butte and elsewhere. The canal system in connection with this dam will be 50 miles long, with a fall of 1 ft. in 5,000 ft. The first section is 12 miles long, reaching down the east side of the river, where there is to be a division, one branch being taken across the river bed by a heavy pipe. The main canal bottom will be 34 ft. wide and carry 5 ft. of water. The acreage to be irrigated will be 100,000 acres. At Elephant Butte, the dam will be 96 ft. high, 300 ft. long at the bottom and 600 ft. on the top, and will store 250,000 acre-ft. W. A. Hawkins, Gen. Attorney, Silver City, Colo.

FAIRHAVEN, WASH.—Bids are asked until Nov. 6 for cleaning, grubbing and ditching to be done for ditch No. 6. C. N. Adams, County Surv.; Ashabel Dillon, Clk.

SEWERAGE.

DEXTER, ME.—It is reported that this place is soon to build a sewer system.

BOSTON, MASS.—The apportionment commissioners under the Metropolitan sewerage acts have rendered their report to the supreme judicial court, distributing the apportionment of the five years ending 1900. They find in effect that the North Metropolitan system will cost $5,030,000; the Charles River system $800,000; and that both of these systems have been practically completed; that the Neponset River system has just commenced under an act which provides for a state loan of $500,000. Edmund E. Bennett, John E. Sanford and Everett C. Bumpus compose the committee.——The following bids were received Oct. 29 for constructing sewers in Columbus Ave.: Craig & Trumbull, $7,442; T. H. Connelly, $5,592; Thomas O'Leary, $5,196; H. A. Hanscom & Co., $7,265; John C. Coleman, $7,445; James Dolan, $6,664; J. P. O'Connell, $7,618; Charles Linnehan, $9,665; Daniel E. Lynch, $9,115. B. W. Wells, Supt. of Streets.

CAMBRIDGE, MASS.—The council has authorized the issue of $491,000 in 4% bonds, $75,000 of which is for the sewer department and $137,000 for the street department. L. M. Hastings, Cy. Engr.

WAKEFIELD, MASS.—The sewer committee has submitted its report on the proposed system. It is recommended that the filtration system of sewage disposal be adopted. The committee is composed of Louis E. Hawes, chairman; Henry H. Savage, F. A. Gowen, W. G. Strong, W. H. McCausland and E. A. Carlisle.

PEEKSKILL, N. Y.—Press reports from Albany state as follows: An investigation of the sanitary condition of the state camp at Peekskill has been completed by the state engineer and surveyor's department. As a result of this inquiry, a map is to be prepared showing all the main sewers and water-pipes running underneath the camp grounds. Using this map as a basis, the department will formulate an improved system of drainage for the camp. C. W. Adams, State Engr., Albany.

SYRACUSE, N. Y.—Bids are asked until Nov. 9 for constructing 15 and 12-in. pipe sewers in two streets. M. Z. Haven, Cy. Clk.——The council has decided to construct 48 × 32-in. brick and 15-in. pipe sewers in two streets.

BALTIMORE, MD.—Bids are asked until Nov. 9 for furnishing and delivering cast-iron pipe and special castings for the Druid Hill Ave. sewer. Janon Fisher, Cy. Comr.——The council has passed an ordinance appropriating $40,000 for sewers in Lanvale and Gilmor Sts.——The East End Improvement Association, at its meeting in the Casino, Patterson Park, Oct. 23, appointed as a committee Wm. A. Eisenbrandt, Joseph Schute, Chas. Milske and Thos. E. Sweeney to confer with the city commissioners with regard to constructing a sewer in the rear of the park.——The following bids were received Oct. 29 for constructing sewers in three streets, all bidders residents of Baltimore:

	Charles St. 893 ft. 36x 30-in. cast-iron pipe.	Camden St. 388 ft. 18-in. terra cotta pipe.	Henrietta St. 408 ft. 18-in. terra cotta pipe.
Croak, Horner & Co.	$5,279	$921	$1,060
Jas. P. McGovern	4,991	849	890
P. Flanigan & Co.	4,834	698	874
P. Reddington	*4,353	...	...
P. Keelty	4,887	*490	*645
P. J. Morton	...	780	940

*Awarded contract.

WASHINGTON, D. C.—The district commissioners have decided to ask Congress for an appropriation of $1,300,000 for constructing sewers during the coming year.

WASHINGTON, D. C.—Bids are asked by the district commissioners until Nov. 16 for constructing sewers, as stated in our advertising columns.

COLUMBUS, O.—The construction of sewers or the extension of the trunk sewer in Glenwood Ave. to relieve Skidmore and Mound Sts. is being considered. Josiah Kinnear, Cy. Engr.

MIDDLETOWN, O.—Bids are asked until Nov. 18 for constructing 7,943 ft. of brick and 2,651 ft. of lateral sewers. Lilbern Martin, Secy. Bd. Sewer Comrs.

CRAWFORDSVILLE, IND.—Alvord & Shields, 1140 The Rookery, Chicago, Ill., have been engaged to make a survey and to prepare plans and specifications for a sewer system. Preliminary surveys are well under way and it is expected that the design will be completed this fall. F. Hoffman, Cy. Engr.; J. C. Hutton, Chn. Com.; Wm. McCampbell, B. F. Hutchings, Com.

HOLLAND, MICH.—It is reported that plans will probably soon be completed for a system for this place. C. J. De Roo, Pres. Pub. Wks.

CHAMPAIGN, ILL.—The council has passed an ordinance authorizing an issue of $15,000 in sewer bonds. The contract for constructing this sewer system, as advertised in Engineering News, was awarded Aug. 4 to Todd & Murphy, of Wabash, Ind, at $42,748. The itemized bids were published in our issue of Aug. 13. Joseph O'Brien, Cy. Engr.; C. J. Strahle, Cy. Clk.

MADISON, WIS.—Bids are asked until Nov. 13 for laying 1,200 ft. of 24-in. cast-iron sewer invert from 10 to 11 ft. below water level, as stated in our advertising columns. McClellan Dodge, Cy. Engr.; O. S. Norsman, Cy. Clk.

KANSAS CITY, MO.—Daniel O'Flaherty, Kansas City, has prepared plans for turning the course of the O. K. Creek into a channel to be built on 25th St. It is proposed to make better use of this creek in draining a portion of the city.

ST. LOUIS, MO.—The board of public improvements has decided to build a 24-in. pipe sewer in the Des Peres district; estimated cost, $9,400.

DENVER, COLO.—The chief engineer has been directed to prepare plans for a new sewer in 16th St. to cost about $3,000. T. J. Milner, Ch. Engr. Bd. Pub. Wks.

SAN FRANCISCO, CAL.—The presidents of Holly Park and Mission districts have petitioned the supervisors to build a sewer system in that section of the city lying south of 30th St. to the county line. N. C. Weinholz, of the Holly Park Improvement Club, 33d and Mission Sts., and Joseph Tuohey, of the Fairmount Club, are interested.

SAN FRANCISCO, CAL.—The associated improvement clubs is discussing the question of issuing bonds for building sewers. Secretary Frend can be addressed.

UKIAH, CAL.—Bids are asked until Nov. 6 for constructing a sewer in State St. W. E. Deering, Cy. Clk.

SALT LAKE CITY, UTAH.—Bids are asked until Nov. 20 for constructing sewers to connect the sewer system in Fort Douglas with the system of this city. Maj. E. B. Atwood, Ch. Q. M., Salt Lake City.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked until Nov. 9 for 6,700 sq. yds. of macadam paving in Geneva Road, with 3,800 lin. ft. of edgestone, about 5,000 sq. yds. of gravel sidewalks, granite gutters, etc. Benj. W. Wells, Supt. of Streets.——Next spring the metropolitan park commission will decide upon the continuation of the Parkway, so as to enter the State Fells reservation. It is probable that the boulevard will pass over the hillside at a point between Washington and Mount Vernon Sts., though a strong argument has been presented to the commission in an effort to induce it to consider the feasibility of continuing the boulevard to Woburn. A bill will be presented to the legislature to carry forward this plan.

GLASTONBURY, CONN.—Marcus H. Holcomb, of Southington, Conn, C. W. Cowles, of Manchester, Conn., and S. W. Robbins, of Wetherfield, Conn., the committee appointed by superior court recently to lay out two roads in this place, have submitted their report.

ALBANY, N. Y.—The question of paving First St. from Judson to Quail Sts. with asphalt blocks is being discussed.——The finance board has passed a resolution authorizing the issue of $373,000 in 4% bonds for street improvements and $30,000 in 3½% sewer bonds. Horace Andrews, Cy. Engr.; Chamberlain Haskell can be addressed.

BROOKLYN, N. Y.—Bids are asked until Nov. 12 for Belgian block paving in 41st St.; surety, $2,500. Theo. B. Willis, Comr. Pub. Wks.

BROOKLYN, N. Y.—Bids are asked until Nov. 25 for macadamizing about two miles of the new shore road, as stated in our advertising columns. Edwin C. Sweezey, Engr., 3d Ave. and 39th St.

LONG ISLAND CITY, N. Y.—H. C. Johnson, Jr., J. W. Lee, Thos. Collum and John Maley have been appointed a committee by the general improvement commission to canvass certain streets in Ward No. 3 for signatures for improving the streets. Owen Woods, Comr.

NEW YORK, N. Y.—The Sicilian Asphalt Paving Co., Times Bldg., has been awarded the contract by the park department for asphalting the circle at 59th St. and 8th Ave. at a cost of about $30,000.

SYRACUSE, N. Y.—Bids are asked until Nov. 9 for grading a portion of Cannon St., and for constructing sidewalks on both sides of the streets. M. Z. Haven, Cy. Clk.

WHITESTONE (L. I.), N. Y.—The election held in this village Oct. 30 resulted in favor of issuing $50,000 in bonds for macadamizing the principal streets. Dr. A. C. Griffin can be addressed.

WILTON, N. J.—The county commissioners are considering routes for a road from Berlin to Hammonton.

CRAFTON, PA.—Bids are asked until Nov. 5 for grading, paving and curbing Bonnet St. F. R. C. Perrin, Clk.

PHILADELPHIA, PA.—The highway committee is considering the question of opening Comly St. through the Cornelius property for a distance of 1,000 ft. J. M. Adams, Chn. Com.

SCRANTON, PA.—Bids will probably be opened Nov. 5 for paving a portion of Mulberry St. with asphalt, but the contract is not likely to be let before December. J. P. Phillips, Cy. Engr.

WASHINGTON, D. C.—The district commissioners have completed estimates for next year's paving, which will cost about $275,000.

MIAMI, FLA.—It is reported that the Bricknells are to have a 25-ft. road built for a mile along the bay front property. Other improvements to the property are now being made.

ST AUGUSTINE, FLA.—The council has agreed with the property owners on St. George St. with regard to repaving the street at once. The city will pay one-third and the owners two-thirds of the cost. A. J. Watts, Alderman; B. Genovar and C. F. Sulgner are interested.

NEW ORLEANS, LA.—The city engineer estimates the cost of paving Claiborne St., from Canal to Toulouse Sts., with brick, at about $50,500. A. C. Bell, Cy. Engr.

NEW ORLEANS, LA.—The city engineer has been directed to prepare plans and specifications for paving Jackson Ave.

CINCINNATI, O.—Bids are asked until Nov. 10 for brick paving in two streets, and until Nov. 24 for brick paving also in two streets. Aug. Herrmann, Pres.; A. P. Butterfield, Clk. Bd. Administration.——The board has rejected the bids for brick sidewalks, and have asked for new bids.

CLEVELAND, O.—The park board has awarded to Brennan & De Celle the contract for improving Doan Brook boulevard, between Superior St. and Wade Park Ave., at $35,000.

SALEM, O.—The following bids were received Oct. 20 for 7,555 sq. yds. of brick paving. F. W. Allison, Cy. Clk.

Samuel Buell, Salem, O. (accepted)	$11,489
John Hadley, Canton, O.	14,576
Landers Bros., Wooster, O.	12,776
Liphart & Winterhalter, Detroit, Mich.	13,229

HELENA, MONT.—The county commissioners received the following bids Oct. 24 for grading the approaches to the proposed bridge over the north fork of the Dearborn River:

	Rock.	Earth.	Total.
M. Conniff	$3,440	$1,380	$4,820
John Duffy	2,494	776	3,220
*Kirkendall & Son	2,537	644	3,181
Lind & Franklin	2,356	848	3,204
C. J. Lundin	2,468	855	3,303
B. J. Townsend	2,683	690	3,373
Louis Johnson	2,365	1,012	3,377
**J. H. Carmichael	2,016	182	2,198

*Awarded contract. ** Informal.

KANSAS CITY, MO.—The Parker-Washington Paving Co. has been awarded the contract for asphalt paving in Broadway, and also for granitoid paving. H. A. Wise. Cy. Engr.

SPRINGFIELD, MO.—The property owners are considering the question of brick paving in South St. E. P. Johnson, Cy. Engr.

VELASCO, TEX.—It is reported that the citizens of this place are raising money to aid in the construction of a shell road from this place to Oyster Creek.

SACRAMENTO, CAL.—The city trustees are considering the question of improving a portion of J St.

MANUFACTURING PLANTS.

BOSTON, MASS.—Press reports state that a 5-story building will soon be erected at Beach and Utica Sts. by the American Tool & Machine Co.

NEW HAVEN, CONN.—Brown & Von Beren, Archs., have completed plans for the rebuilding of the Forsyth dye works in Westville. The engine house is to be rebuilt and extensive improvements made. J. N. Leonard has been awarded the contract.

BUTLER, PA.—A board of trade is being organized at this place to further the industrial interests. It is stated that several large manufacturing plants will locate in the near future.

MILLVILLE, N. J.—A meeting of the trustees of the building and loan associations was recently held to consider the advisability of advancing $30,000 to erect a window light factory. Bennett & Co., glass manufacturers of Spring City, Pa., desired to settle in this city and this amount is needed to start the plant. While nothing definite was settled, it is thought that the loan will be granted.

HARRISBURG, PA.—The Boll Bros. Mfg. Co. will erect a 5-story brick addition, 40 × 80 ft., for the manufacture of brass and iron bedsteads, and it is reported will purchase new machinery.

NEW CASTLE, PA.—It is stated that the New Castle Street Car Co. has purchased additional ground and will soon begin the erection of a large car barn and machine shop. The building is to be 160 × 70 ft., built of iron and pressed brick. Improvements are also being made in the electric light plant.

PHILADELPHIA, PA.—It is understood that extensive improvements are contemplated at the John T. Lewis & Bros.' white lead works, to cost $125,000. Two large buildings, one four stories in height, 140 × 45 ft., and another three stories, 60 × 60 ft. will be erected. A new 500-HP. engine will give a combined force of 1,200-HP. New machinery will also be introduced.——A. J. Balfour has taken out a permit to make repairs to the American Wood Paper Mills, on River Road, above Washington St., Manayunk, which he has recently acquired. He will build a two-story brick boiler house, 46 × 65 ft.——Wm. H. Odenatt, 3534 North 18th St., is preparing plans for a boiler house for John Hamilton, to be 37 × 28 ft., and built of brick, with a tin or slag roof.

PITTSBURG, PA.—The American Food & Oil Co. has been incorporated with a capital stock of $60,000, of which $7,000 is paid in. The company intends to build a factory for extracting oil from peanuts and converting the residue into food. Incorporators: Lawrence Dilworth, Samuel D. Ache, John K. McKee, Robert Mortland and Michael J. Alexander, of Pittsburg, and Thos. R. Mackey and Wilson E. Weatherly, of Allegheny.

HUNTINGTON, W. VA.—It is stated that the shops of the Ohio River R. R., at Central City, two miles west of this place, will be moved to Kenova in the near future. This will also change the end of the division from Central City to Kenova.

GARYSBURG, N. C.—The large saw and planing mills of the Garysburg Lumber Co., destroyed by fire last week, will be rebuilt and equipped at once.

HAW RIVER, N. C.—The Cora Mfg. Co., of this place, will double the capacity of its cotton mill plant at an early day, including an electric plant for lighting.

GREENWOOD, S. C.—The new cotton mill building being erected at this place by D. A. P. Jordan and associates will be ready to receive its machinery between Jan. 1 and March 1. An electric light plant, as well as some of the mill machinery, it yet to be purchased.

LAURENS, S. C.—J. H. Kennedy and associates will build a cotton mill of about 5,000 spindles capacity, to cost $60,000 to $75,000; work on same to begin within 60 days. It will be equipped with the latest improved machinery, including an electric light plant.

MACON, GA.—The Georgia Southern & Florida R. R. will build at this place a new freight and passenger depot; also, new railway machine shops. The plans have already been drawn and accepted, and work will begin at once.

ATHENS, GA.—A movement is on foot to erect a cotton mill at this place. J. J. C. McMahon, James Caruthers and W. S. Hollman are interested. A $150,000 plant is proposed, to be operated by electricity.

EASTMAN, GA.—A representative of a Northern syndicate which intends building a 10,000-spindle spinning and weaving cotton mill in this vicinity, has decided upon a location at this place, according to reports.

CLEVELAND, O.—The Cleveland Steel Co. has commenced work on the erection of an open hearth plant, and will be able to furnish slabs for its sheet and plate mills. The main building will be of iron construction, 70 × 250 ft. Two 15-ton furnaces will be built for the manufacture of high grade acid open hearth steel. Under patents taken out by John A. Potter, Supt., it is stated that these slabs, which will be 3 × 24 × 24 ins., will be cast in the absence of air and a uniform fibrous steel secured, avoiding piping, segregation and other defects. This company recently commenced rolling copper sheets and plates and orders have been taken for 50,000 to 60,000 lbs. of material. The company is prepared to furnish plates and sheets in copper from 1-in. down to 20 gage.

CHICAGO, ILL.—It is reported that plans are being prepared by Julius H. Huber for a large addition to the McGuire Mfg. Co.'s workshops at Sangamon, Morgan and Kinzie Sts. The new addition will be 164 × 116 ft., and six stories high. The estimated cost is $90,000.

CHICAGO, ILL.—Bids are asked until Nov. 13, for furnishing all labor and material to complete the masonry, carpentry, cut stone, and concrete work for the repair shops to be built on Ashland Ave.,south of 22d St. Joseph Downey, Comr. Pub. Wks.

EAST MOLINE, ILL.—The Brown & Hayward Co., of St. Paul, with a warehouse at Davenport, Ia., is figuring on building a glass factory at East Moline, Ill., to cost $60,000, and to employ 100 men.

SAN DIEGO, CAL.—Bids are asked by the San Diego Brewing Co., for one ice factory and one bottling house, according to reports. Bids to be in lump sum; terms of payment, half brewery stock, half cash.

GAS PLANTS

JAMAICA PLAIN, MASS.—The Jamaica Plain Gaslight Co. has purchased additional land opposite its works.

PROVIDENCE, R. I.—Bids are asked until Nov. 7 for furnishing and caring for about 1,400 gasoline lamps for three years. H. K. Blanchard, Chn. Com.; Oliver E. Greene, Supt. of Lights, City Hall, Providence.

JAMAICA (L. I.), N. Y.—The Jamaica Gaslight Co. petitioned the town board for a 50-year franchise for laying pipes in all parts of the town of Jamaica. Justice Wood and Town Clerk McCook were appointed a committee Oct. 31, to investigate as to the powers of the town board and highway commissioners in the premises.

RICHMOND HILL, N. Y.—The Richmond Hill & Queens County Gas Co. was recently given until Nov. 15 in which to complete the laying of its mains in this village and the commencement of the work was noted last week. A writ of attachment has since been issued against the pipes, tools, etc., of the concern and these were advertised to be sold at auction, Nov. 4. It is reported probable that the village will now grant an electric light franchise.

MONTCLAIR, N. J.—The contract for street lighting has been awarded to the Montclair Gas Co. A newspaper report states that the opposition of the new electric light company has brought down the gas company's charge materially. During last year the town paid for its street lights $18 for each lamp burning up to 1 a. m., and $21 for each lamp burning all night, and the town provided its own lamp posts. Next year the town will pay only $17 for lamps burning all night, and the company will provide fixtures. The electric company submitted an offer at $16 per lamp, but was unable to guarantee that it would provide poles unless the council rescinded or modified its recent electric light ordinance.

PATERSON, N. J.—The new contract with the United Gas Improvement Co. is at $19 a year for each of the 413 street gas lamps now in use and $18 a lamp a year whenever the number shall exceed 500. The price heretofore has been $20 a lamp a year.

TIFFIN, O.—The trustees of the gas works and city council have received bids for the sale of the city's natural gas plant, and the indications are that the sale will be effected. R. G. Curlin and Patrick Dowling bid $70,000 and James P. Davis $85,000. The plant, including leases, gas wells and pumping machinery, is said to have cost the city over $180,000, and has been in operation since 1887.

YOUNGSTOWN, O.—The Mahoning Gas Fuel Co. has commenced work on the construction of its new gas line from Youngstown into Pennsylvania, where it will connect with the main of the Oil City Supply Co. near West Middlesex.. An official of the company is quoted as saying that the line will be laid without delay in order that it may be connected and gas turned in before cold weather so that the company will have it in case the present supply should run short.

SIOUX CITY, IA.—The Sioux City Gas Light Co. has completed its season's work as far as laying mains is concerned. The company had expended about $40,000 in improvements in this city this season, and has put down over six miles of mains. Over two miles of new mains now on hand will be laid at the opening of next season. L. L. Kellogg, Supt.

ABERDEEN, S. DAK.—The Aberdeen Gas & Electric Light Co. was incorporated Oct. 27 with a capital stock of $75,000, by Fred A. Bartholomew, J. S. Bartholomew, Geo. B. Clifford and others.

SACRAMENTO, CAL.—Bids are asked until Nov. 23 for a franchise to lay mains and furnish illuminating and fuel gas in any and all the streets of this city for 25 years. The Pacific Gas Light & Fuel Co. has petitioned for such a franchise. Chas. E. Leonard, Pres. Trustees.

MISCELLANEOUS CONTRACTS.

DITCH.—Rose, Minn.—Bids are asked until Nov. 16 for constructing a ditch in Rose. D. M. Sullivan, County Audr.

LEVEE WORK.—Port Allen, La.—Bids are asked until Nov. 9 for the enlargement of Bayou Goula levee, 16,000 cu. yds. A. D. Barrow, Secy. Bd.

BATTERY.—Baltimore, Md.—Bids are asked until Nov. 27 for building a gun battery at Hawkins Point. Col. Peter C. Hains, U. S. Engrs., 9 Pleasant St., Baltimore.

TELEPHONE FRANCHISE.—Amherst, Mass.—The Northfield Telephone Co. has begun work on its proposed system in this city, a franchise for which was recently granted.

CRIB BULKHEAD.—Brooklyn, N. Y.—Bids are asked until Nov. 12 for building a crib bulkhead on piles at the foot of Amity St., East River; surety, $1,500; T. B. Willis, Comr. Cy. Wks.

PIER WORK.—Milwaukee, Wis.—Bids are asked until Nov. 27 for constructing crib and pile pier extensions, as described in our advertising columns. Capt. Geo. A. Zinn, U. S. Engrs.

BATTERY.—Newport, R. I.—Bids are asked until Nov. 24, for constructing a gun battery on Dutch Island, R. I., as stated in our advertising columns. Maj. D. W. Lockwood, U. S. Engrs.

BREAKWATER.—Philadelphia, Pa.—Bids are asked until Dec. 10 for constructing stone breakwater in Delaware Bay, Del., as stated in our advertising columns. Maj. C. W. Raymond, U. S. Engrs.

SHORE PROTECTION.—Bids are asked until Nov. 14 for constructing 3,000 ft. of shore protection on Raritan Bay, N. J., as stated in our advertising columns. N. F. Barrett, 50 Wall St., New York city.

BATTERIES.—St. Augustine, Fla.—Bids are asked until Nov. 24 for building gun and mortar batteries at Key West Fla., as stated in our advertising columns. Lt. Col. W. H. H. Benyuard, U .S. Engrs.

BATTERY.—Charleston, S. C.—Bids are asked until Nov. 30 for furnishing material and constructing battery at Sullivan Island, S. C., as stated in our advertising columns. Capt. Frederic V. Abbott, U. S. Engrs.

BOILERS, ETC.—San Francisco, Cal.—Bids are asked until Nov. 23 for furnishing two steel fog-signal boilers and two sets of steel doors for same. Maj. Chas. E. L. B. Davis, U. S. Engr., 89 Flood Bldg., San Francisco.

FERRY APPROACH.—Galveston, Tex.—The county commissioners awarded a contract to L. P. Featherstone to build the approaches to the proposed Bolivar ferry, at $53,900. The ferry is to be used jointly by the county and the Gulf & Interstate R. R. Co.

DOCK AND DREDGING.—Menominee, Mich.—It is reported that the United States Leather Co. is receiving bids for constructing 1,850 lin. ft. of dock and for dredging 1,930 lin. ft. of channel in the Menominee River 8 ft. deep and 60 ft. wide; estimated cost, $12,000.

TELEPHONE FRANCHISE.—Seneca Falls, N. Y.—The board of trustees is considering the question of granting a franchise to a telephone company which proposes to connect this place with Auburn, Waterloo, Geneva, Canandagua and other places. P. W. Bailey, Pres.

NAVAL SUPPLIES.—Washington, D. C.—Bids are asked until Nov. 10 for furnishing pulleys, screws, lathe chucks, brick, steel shafting, forgings, etc., for the Washington, New York and Norfolk navy yards; and until Nov. 24 for supplies for the Mare Island, Cal., navy yard. Edwin Stewart, Paymaster Gen., Washington, D. C.

DREDGING.—Wilmington, Del.—Bids are asked until noon, Dec. 2, for dredging in Rock Hall Harbor and inner harbor of Rock Hall, Queenstown harbor, Choptank, Chester, Manokin, Wicomico, Pocomoke and Warwick Rivers, Md.; Broad Creek, Del.; and Nanticoke River, Del. and Md. Wm. F. Smith, U. S. Agent, Wilmington.

WHARF.—San Francisco, Cal.—Fontana & Co. have made a contract with Warren & Malley for improvements to the woolen mill property near the foot of Van Ness Ave., purchased a few months ago. These will consist in the building of a wharf 150 ft. long, the construction of a bulkhead and the filling in of two 50-vara lots. Work will be commenced at once, and will cost about $15,000.

GUN FORGINGS.—Washington, D. C.—Bids are asked until Nov. 14 for furnishing the Department the following material: Rough bored and turned forgings for breech-loading rifles, viz.: 1 set 12-in.; 14 sets 13-in. For forms of proposal, information concerning shapes and weights of the gun forgings, the specifications governing the manufacture and the test for the acceptance of the same, and for all other particulars, apply to the chief of the bureau of ordnance, Navy Department, Washington. H. A. Herbert, Secy.

MORTAR BATTERY.—North Point, Md.—The following bids were received by Col. Peter C. Hains, Baltimore, Oct. 26, for constructing a mortar battery at North Point:

Isaac S. Filbert, Baltimore, Md.	$111,972
Owen Patterson, Baltimore, Md.	119,949
Henry Smith & Sons, Baltimore, Md.	108,597
Nardin & Anderson, McDonogh, Balt. county	102,757
Sanford & Brooks, Baltimore, Md.	91,513
James M. Douglas, 45 Builders' Exch., Baltimore.	71,482

REMOVAL OF PIERS.—New York, N. Y.—The contract for the removal of piers at 12th, Jane and Horatio Sts., North River, was awarded Oct. 30 to P. Sanford Ross, the bids being as folows; Geo. S. Terry, Secy. Dept. of Docks:

P. Sanford Ross, 277 Washington St., Jersey City	$775
Andrew A. Bouker, 110 Wall St. New York city	974
Spearin & Preston, 87 W. 4th St., Bayonne, N. J.	1,200
Bernard Rolf, Oakland pl., Tremont, N. Y.	1,233
R. G. & J. S. Packard, 130 Pearl St., New York	1,445

LEVEE WORK.—New Orleans, La.—Bids are asked until Nov. 12 for the following levee work: Abattoir, 790 cu. yds.; Roy, 8,840 cu. yds.; New Home, 3,300 cu. yds.; Story, 500 cu. yds.; Irving, 2,150 cu. yds.; Marritt, 3,150 cu. yds.; Caernarvon, upper, 3,160 cu. yds.; Caernarvon, 5,325 cu. yds.; Orange Grove, 2,340 cu. yds.; Company canal, section 1, 19,250, and section 2, 19,750 cu. yds. The total allotment of work amounts to 72,575 cu. yds., and until Nov. 13 for work amounting to 78,390 cu. yds., as follows: St. Clair, Mon Plaisir, Greenwood, Bertrandville, Woodlawn, Belair, Fairview, Bon Sojour, Harlem, St. Sophie to Harlem, Gotzinger to Bell, Oakville and Magnolia, NAVY YARD IMPROVEMENTS.—Philadelphia, Pa.—Naval Constructor Feaster has asked the navy department for $408,000 for improveing the buildings in the navy yard. It is recommended that a new boat shop be built at a cost of $130,000, and that $40,000 worth of tools, such as lathes, planers, drill presses, etc., be bought. It is proposed also to install an electrical traveling crane of 20 tons capacity to cost, with its accessories, $22,500. Mr. Feaster has made plans also for two smitheries, which will cost $310,000. One building will be used for heavy forging and angle smithery; the other for general shipsmith work. The aggregate of cost of the improvements recommended is $408,571.

FIRE ENGINE, ETC.—Hazleton, Pa.—Bids are asked until Nov. 20 for furnishing a fourth-class steam fire engine with rotary pump and a pumping capacity of 500 gallons a minute, an approximate weight of 4,800 lbs., and with platform springs; also a chemical fire engine with two 60-gallon horizontal tanks, and 200 ft. best 4-ply chemical hose, one 16-ft. ladder, pike poles, fire axes, etc.; also one hand extension ladder truck, provided with one 60-ft. extension ladder, one 40-ft. extension ladder, one 30-ft., one 25-ft., one 20-ft., and one 16-ft. single ladder, two 14-ft. roof ladders, one 12-ft., one 14-ft. and one 16-ft. scaling ladders, two life belts, pike poles, crow bars, lanterns, etc. John W. Klinger, Cy. Clk.

FORTRESS IMPROVEMENTS. — Washington, D. C. — Press reports state as follows: Under the head of fortifications in his annual report Gen. Wm. P. Craighill, Ch. of Engrs., says that detailed projects have been approved for the artillery defense of Portland, Me.; Portsmouth, N. H.; Boston, Narragansett Bay, eastern entrance to Long Island Sound (partial), New York, Philadelphia, Baltimore, Washington, Hampton Roads, Wilmington, N. C.; Charleston, Savannah, Key West, Pensacola, Mobile, New Orleans, Galveston, San Diego, San Francisco, mouth of Columbia River, and Puget Sound. In these projects use is made of the existing old type fortifications which are either strengthened and given in part modern armament or utilized as an adjunct of the newer and stronger works. Gen. Craighill urgently recommends an appropriation of $100,000 for the preservation and repair of fortifications, saying that as a result of the failure of Congress to make proper provision in the past for their care, the ungarrisoned fortifications and reservations are now in a deplorable state, with the perishable portions now almost worthless, and the heavy masonry work slowly being destroyed.

NAVY YARD IMPROVEMENTS.—Brooklyn, N. Y.—The annual report of Commodore E. O. Matthews, chief of the bureau of yards and docks, contains the following recommendations for improvements at the Brooklyn Navy yard: For the enlargement of the berthing capacity of the wall at the entrance to the new drydock, No. 3, which will require the dredging of all the upper part of the Wallabout channel, $75,000; for a piece of retaining wall between the new dock and the old bridge, $20,000; completion of the causeway between the mainland and the Cob Dock, according to the plans calling for the larger number of culverts, $25,000; completion of the eastern quay wall of the Whitney basin to within 180 ft. of the causeway, $18,000; a building for the storage of ship steel, $20,000; coal shed, $5,000; to grade the ground between drydock No. 3 and Clinton Ave., $10,000; six sanitary latrines, $38,000; additional dynamo and engine, $12,000; an erecting shop to be built on as a wing to the main building, No. 28, $65,000. The temporary structure used for this purpose has burned down once, resulting in a large loss. The presence of the electrician is required in the yard at night, and it is suggested that a suitable house be erected for his accommodation, to cost $5,000. Commodore Matthews also outlines a scheme for the combining of the steam generators of the yard into one central group. In order to do this a new boiler-house will be necessary, which can be constructed for $22,542, and $31,500 is also recommended for the building of ten new boilers and piping for the yard.

CANAL WORK.—Albany, N. Y.—Geo. W. Aldridge, Supt. Pub. Wks., awarded four contracts Oct. 29 for canal work, as advertised in Engineering News, the bids being as follows: Contracts No. 1, for improving Erie Canal, from Ferry St., Buffalo, to Commercial Slip, and Slips 1, 2 and 3, and Commercial Slip, in Buffalo; No. 2, for improving Erie Canal, from McDonald culvert to Ferry St., Buffalo, a distance of 18 miles; No. 3, for improving Erie Canal, from head of Lockport locks to McDonald's culvert, a distance of 5 miles; No. 4, for building the Cartersville waste weir and spillway:

Contract No. 1, Western Division:	
Barber Asphalt Paving Co., New York	$417,160
*Donnelly Contracting Co., Buffalo, N. Y.	394,955
Michael J. Dady, Brooklyn, N. Y.	505,085
McNaughton & Bapst, Buffalo, N. Y.	438,200
Contract No. 2, Western Division:	
*Buffalo Dredging Co., Buffalo, N. Y.	$291,686
Barber Asphalt Paving Co., New York	293,278
Michael J. Dady, Brooklyn	345,109
Hingston & Woods, Buffalo, N. Y.	777,930
Contract No. 3, Western Division:	
Dawson & Lymmes, St. Catherine's, Ont.	$298,540
Lauer & Hagaman, Rochester, N. Y.	276,055
Hughes Bros. & Bangs, Syracuse, N. Y.	298,691
Michael J. Dady, Brooklyn, N. Y.	528,354
Chas. A. Danolds, Eagle Harbor, N. Y.	822,775
John Miller, Buffalo, N. Y.	289,274
Furnaceville Iron Co., Rochester, N. Y.	235,043
Barber Asphalt Paving Co., New York	298,211
Mason, Hoge, King & Hanger, Frankfort, Ky.	231,715
*Chas. F. Parker & Co., New York City	188,542
Contract No. 4, Western Division:	
Randerson & Seward, Albany, N. Y.	$9,151
H. N. Cowles, Rochester, N. Y.	15,467
James Robinson, Rochester, N. Y.	15,467
John Calnan, Rochester, N. Y.	10,672
Geo. W. Moore, Buffalo, N. Y.	12,200
Chambers & Casey, Rochester, N. Y.	11,568
Brayer & Albaugh, Rochester, N. Y.	9,392
*Whitmore, Rauber & Vicinus, Rochester, N. Y.	8,545
B. P. Smith, Rochester, N. Y.	12,799

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*Awarded contract.

CONTRACT PRICES.

BREAKWATERS.—New London, Conn.—Capt. Smith S. Leach received the following bids Oct. 28 for constructing breakwaters, as advertised in Engineering News:

At New Haven, 100,000 tons:	Per ton.
Hughes Bros. & Bangs, Syracuse, N. Y.	$0.88
S. & E. S. Belden, Hartford, Conn.	1.07
J. J. Shipman, 1310 Q St., Washington	1.08
At Duck Island, 25,000 tons:	
J. Frank Quinn, 149 Broad St., New York	.65
S. & E. S. Belden, Hartford	.93
John J. Shipman, Washington	1.40

JETTY AND LEVEE.—San Diego, Cal.—Maj. Chas. E. L. B. Davis, U. S. Engrs., San Francisco, received the following bids Oct. 22 for constructing jetty and repairing levee at San Diego harbor:

Bids for Constructing Jetty and Repairing Levee, San Diego, Cal.

Bidder.	Trestle wrk with dble trck railway.	Per lin. ft. of trestle. Repair wrk, 1-7th of a pile. Price, per pile.	1-7 pile.	Brush mattress, 2 cu.yds. Per cu. yd.	Stone, 24 tons, per ton.	Total cost, lin. ft.
Jetty:						
Waldo S. Waterman, San Diego	$5.00	$10.00	$1.43	$2.50	$2.20	$64.23
California Construction Co., San Francisco	6.50	10.00	1.43	1.90	2.35	68.13
William H. Healy, San Francisco	6.50	12.00	1.71	2.40	2.28	67.73
Cotton Bros. & Co., Oakland	7.40	12.00	1.71	2.98	2.86	83.71

Levee:	Earth filling, 2,680 cu. yds.	Cobble-stn, 400 cu. yds.	Revet-m't, 600 cu. yds.	Total.
William Osburn[1]	$0.23	$1.40	$3.95	$3,546
Simpson & Pirnie[1]	.65	2.10	5.20	5,702
Goodbody & Roesner[1]	.18	1.45	3.48	3,150
John Englebret[1]	.38	.71	4.48	3,990
William S. Healy[2]	.20	1.68	4.28	3,776
Cotton Bros. & Co.[3]	.23	1.90	4.80	4,256

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[1]San Diego. [2]San Francisco. [3]Oakland.

RETAINING WALL.—Youngstown, O.—D. N. Simpkins, Secy. Water Bd., writes us that the contract for constructing a retaining wall of stone masonry on the river bank at the pumping station has been awarded to Christ. Manser, at $4 a perch; Thos. Lightbody bid $6.50; Geo. A. Thornton, $4.05; and Frank McMasters, $4.95 a perch, and Chas. H. Connell, $5.50 a cu. yd.; all local bidders.

PIPE SEWERS.—Allegheny, Pa.—The contract for a lateral sewer in Perrysville Ave. and Riverview Park has been awarded to Harvey Sloan, at the following prices: 18-in. pipe, 2,300 ft., 85 cts. a ft.; 15-in., 6,800 ft., 85 cts.; 16-in., iron pipe, 300 ft., $1.65; manhole shafts, 40, $15 each; total, $8,830. Chas. Geyer, Mayor.

BRIDGE.—Cleveland, O.—The lowest bid for constructing the Willow St. bridge was that of the King Bridge Co., at $28,801, the itemized bids being as follows; D. E. Wright, Dir. Pub. Wks.; M. E. Rawson, Cy. Engr.; Jas. T. Pardee, Engr. Bridges:

Bids for Willow St. Bridge, Cleveland, O., Oct. 29.

Quantities.		King Bridge Co.	Groton Bridge Co.	Pittsburg Bridge Co.	Detroit Bridge & Iron Wrks.	Variety Iron Works Co.	Milwaukee Bridge & Iron Works.	Massillon Bridge Co.	Toledo Bridge Co.	Wisconsin Bridge & Iron Co.	Wrought Iron Bridge Co.
Steel and iron super	400 tons	$56.60	$64.00	$64.50	$66.40	$67.00	$67.60	$71.00	$71.23	$89.55	$98.00
Counterweight	95 "	10.00	8.00	40.00	17.00	8.00	19.00	14.00	15.00	17.25	15.00
Electrical equipment		3,400	4,000	4,876	3,600	3,400	3,000	4,500	4,100	4.030	4,000
Timber	53 M. ft.	27.00	24.00	29.50	25.00	25.00	26.00	22.00	25.00	29.00	.....
Medina paving	960 sq. ft.	.30	.35	.40	.33	.30	.35	.35	.35	.33	.35
" curb	96 lin. ft.	.36	.50	.60	.50	.36	.75	.50	.50	.40	.50
Flagging	572 sq. ft.	.10	.15	.20	.15	.10	.35	.15	.15	.12	.15

PIPE SEWERS.—Marietta, O.—W. P. Mason, Cy. Engr., writes us that the contract for constructing pipe sewers, bids opened Oct. 26, has been awarded to D. W. Dye, of Marietta, the bids being as follows:

Items.	D. W. Dye.	T.B.Townsend Co.	J.Wilking.
4-in. pipe, per ft.	$0.16	$0.25	$0.23
8-in. " " "	.20	.27	.31
10-in. " " "	.25	.30	.33
18-in. " " "	.40	.60	.46
Manholes, each	25.00	25.00	25.00
Cast-iron pipe, per lb.	.03	.04	.03
Flushtanks, each	25.00	25.00	25.00
Lampholes, each	5.00	5.00	5.00
Total	$1,601	$2,110	$2,029

DREDGING.—Chicago, Ill.—Maj. W. L. Marshall received the following bids Oct. 24 for dredging Chicago River, as advertised in Engineering News; there is available for this work $50,000, and contracts to the amount of $700,000 have been authorized:

Bids Received Oct. 24 for Dredging Chicago River.

Bidder.	Main River and South Branch				North Branch			
	Dredging, 458,427 cu. yds.	Removing old piles, 100.	Removing old docks, etc., 250 cu. yds.	Total.	Dredging, 848,515 cu. yds.	Removing old piles, 100.	Removing old docks, etc., 250 cu. yds.	Total.
S. O. Dixon, Racine, Wis.	.....	.....	.....	.....	$0.12¼	$2.50	$3.00	$104,943
Carkin, Stickney & Cram, Detroit, Mich.	$0.15¾	$2.50	$3.00	$73,202	.13¾	2.50	3.00	117,671
Chicago Dredging & Dock Co., Chicago, Ill.	.....	.....	.....	.....	.12	1.50	.25	102,034
Chicago Dredging & Dock Co., Chicago, Ill.	.14	1.50	.25	64,392	...	....	....	.....
Green's Dredging Co., Chicago, Ill.	.109	1.00	.50	50,194	.099	1.00	.50	84,228
Lydon & Drews Co., Chicago, Ill.	.12¼	1.00	.13	56,290	.097	1.00	.13	82,438
FitzSimons & Connell Co., Chicago, Ill.	.15½	1.75	.30	71,306	.14	1.75	.30	119,042

DREDGING.—Norfolk, Va.—Capt. Thos. L. Casey received the following bids Oct. 26 for dredging in Elizabeth River, as advertised in Engineering News; each bidder agreed to commence work 30 to 60 days from date, and to complete the work in five months:

Bidder.	Price per cu. yd.	Daily* excvtn, cu. yds.
Virginia Dredging Co., Richmond, Va.	$0.087	3,000
Elijah Brainard, New York	.0875	2,000
American Dredging Co., Philadelphia	.092	2,000
Sanford & Brooks, Baltimore, Md.	.091	4,000
Rittenhouse R. Moore, Mobile, Ala.	.10	2,500
P. Sanford Ross, Jersey City, N. J.	.084	3,000
Chester T. Coler, Norfolk, Va.	.0987	2,000

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*Guaranteed.

BRICK PAVING.—Marietta, O.—W. P. Mason, Cy. Engr., writes us that the contract for brick paving in Fourth St. has been awarded to Wm. J. Berry, of Dilles Bottom, O., the bids being received Oct. 26 as follows:

	Paving.	Curb.
Wm. J. Berry, Dilles Bottom, O.	$0.70	$0.33
T. B. Townsend Co., Zanesville, O.	.69	.35
J. H. Kelley, Portsmouth, O.	.78	.44
John Wilking, Marietta, O.	.69	.33

LEVEE WORK.—New Orleans, La.—The state board of engineers has awarded the contract for the construction of 120,000 cu. yds. of levee work; 40,000 cu. yds. of which is in the enlargement and rebuilding of the cut-off bayou to Ashton levee, on Red River, and in Rapides parish, to Jordan Bros., at 7 cts. a cu. yd. The Overton levee, also on the Red River, will be enlarged and rebuilt to the extent of some 75,000 cu. yds., and the bid of M. L. Linnan, 8.73 cts. a cu. yd. was the lowest.

METAL MARKET PRICES.

FOUNDRY PIG IRON.—New York: $10.75 to $12.50. Pittsburg: $10.25 to $12. Chicago: $10.75 to $11.50.

LEAD.—New York: 2.85 to 2.9 cts. Chicago: 2.6 cts. St. Louis: 2.65 to 2.7 cts.

BARB WIRE.—Pittsburg: $1.75 to $1.80 for galvanized and $1.55 and $1.65 for painted in carload and less than carload lots at mill.

NAILS.—Pittsburg: $2.55 per keg for carload lots and $2.65 for less than carload lots of wire nails at mill; $2.30 and $2.40 for cut nails at mill. Chicago: $2.70 and $2.80 for wire nails, $2.45 and $2.55 for cut nails. New York: $2.70 and $2.80 for wire nails and $2.45 and $2.55 for cut nails.

SCRAP.—Car wheels, $10.50 to $11.50; wrought turnings, $8.50 to $9; cast borings, $7.25 to $7.75, all delivered at purchasers' works; hammered car axles, $16 to $17, delivered at New York; wrought pipe and tube, $7.50 to $8, delivered at New York; No. 1 railway wrought, $10.50 to $11.50; cast machinery, $11 to $11.50 at mill.

TRACK MATERIAL.—New York: angle bars, 1.2 to 1.3 cts.; spikes, 1.6 to 1.65 cts.; track bolts, 1.85 to 1.95 cts. with square and 1.95 to 2.05 cts. with hexagon nuts. Chicago: angle bars, 1.4 to 1.45 cts.; spikes, 1.65 to 1.75 cts.; track bolts, 1.95 to 2 cts. with square, and 2.05 to 2.1 cts. with hexagon nuts.

RAILS.—New York: $28 at eastern mills and $28.75 at tidewater; old rails, $12.50 to $13.50 for iron, and $11 to $12 for steel; light rails, $29; girder rails, $28 up to 7-in., and $30 for over 7-in. rails. Pittsburg: $28 for standard sections of 45 lbs. and over; old rails, $15 to $16 for iron, and $12 to $13 for steel. Chicago: $29 to $31 for standard sections, $28 for light sections; old rails, $13 for iron and $8 to $8.50 for steel.

IRON AND STEEL.—The "Iron Age" reports that prospects are encouraging for a marked revival in trade and a rise in prices. There has been more movement, notably in Bessemer pig, in the central West, and considerable business has been done at advancing prices. The rebate on bars has induced more purchasing. Some orders for structural material have been placed in Chicago, and more are in sight there and in other large towns. There have also been more inquiries for plates, with some sales, which have put the mills into better shape. In Chicago the outlook has improved considerably. Inquiries for large quantities of bridge material have been made, and large contracts for bridge and structural material are pending. At Pittsburg, pig iron has been active and prices have been rising, but the steel market is dull. There have been some small lots of sheet and tin-plate bars sold at pool prices, but very few orders are received for billets. The orders indicate that buyers are expecting higher prices in pig iron and structural material, and many mills are refusing to sell orders for next year at present prices. It is estimated that building work aggregating $60,000,000 in value is being figured on, for which a large amount of metal work will be required. Large orders for rails are expected in 1897, and a reduction in prices for rails is talked of.

LEAD, COPPER, AND TIN PLATE.—There has been a sharp advance in prices of lead, and the market is regarded as firm. Copper has been very irregular in price, and no very large orders have been made. The low prices for tin plate, due to the fight between steel works in and out of the pool, have led American mills to invade the Pacific Coast market, which was supposed to be open only to the Welsh works. Considerable blocks of tin-plate have already been shipped around Cape Horn and others are to follow.

INDUSTRIAL NOTES.

THE LACONIA CAR CO., Laconia, N. H., was recently placed in the hands of a receiver. The resources are stated to be $407,000 and the liabilities $617,000.

THE SEWICKLEY BRICK & STONE WORKS, West Newton, Pa., has been sold to Grantham & Humphries, Scottdale, Pa., for $15,000; the works will resume operations soon.

JAMES H. SWINDELL, Room 708 Publication Bldg., Pittsburg, Pa., designer and builder of furnaces and continuous water seal and drop gate gas producers, has opened an office.

THE POTTSVILLE IRON & STEEL CO., Pottsville, Pa., has successfully erected in one piece a stack 105 ft. high. It is intended to increase the output of the open-hearth steel furnaces.

JULES BERTERO, Granite Building, St. Louis, Mo., has recently completed the sinking of two artesian wells at Blue Island, Cook county, Ill., 1,400 ft. deep each, which give a supply of 600,000 gallons of water daily.

THE BETHLEHEM IRON CO., Bethlehem, Pa., on Oct. 28 made a shipment of armor plate for the Russian battle-ship "Rostislav." The plate will be tested in Russia. A big invoice of 13-in. gun material was also shipped to the Washington Navy Yard.

THE PUSEY & JONES CO., of Wilmington, Del., has contracted to build for the Hudson River Paper Mills Co., of Palmer's Falls, N. Y., a machine capable of producing paper 147 ins. in width. The Pusey & Jones Co. has just completed the shipment of a large paper machine to Glens Falls, N. Y., and has in course of construction a 145-in. machine.

P. KNUDSON & SON, 874 N, Washtenaw Ave., Chicago, have completed the laying of the 2,000 ft. of 16-in. water-works intake main into Lake Michigan for the U. S. Government at Fort Sheridan, Ill. Capt. F. P. Jones, U. S. A., was the engineer in charge.

THE HARBISON & WALKER CO., Pittsburg, Pa., is said to have received a contract to furnish all the high-grade material to be used in the construction of the new open-hearth plant of the Nicopol-Mariopol Mining & Metallurgical Co., of Russia, amounting to about 75 carloads.

THE BUFFALO STEAM PUMP CO.'S plant, North Tonawanda, N. Y., has been sold by the receiver, W. A. Joyce, to F. C. M. Lautz, of Buffalo. The sale is to be confirmed by the Supreme Court. It is understood that the shop will be run about the same as heretofore when the proper arrangements have been made.

THE DIAMOND MACHINE & TOOL CO., Toronto, Ont., has accepted a contract, it is said, for building all the machinery for a new nail plant in Ontario, west of Toronto. It has completed a new improved diamond nail machine, and is at work on the other machines. The one completed is built of cast steel parts and will turn out 350 3-in. nails per minute.

THE GILLETTE-HERZOG MFG. CO., Minneapolis, Minn., has recently completed the construction of a new engine and boiler house, 60 × 266 ft., to contain a battery of 30 boilers, for the Anaconda Smelting Co., of Anaconda, Mont. This is one of the four steel buildings which this firm has designed and built for the Anaconda Company. The entire structure is said to have been designed, built and erected in 90 days.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., has a contract for a car barn and shop building for an electric road at Port au Prince, Hayti. These buildings will be of steel throughout, having a steel skeleton frame work covered on the sides and roof with corrugated iron. The shop is 33 × 70 ft. and the car barn 40 × 160 ft. This building is one of the many which have been turned out by this company for export to foreign countries during the past few months.

THE SOUTH PITTSBURG PIPE WORKS. South Pittsburg, Tenn., has been awarded a contract for furnishing several miles of cast-iron water pipe to the city of Honolulu, Hawaiian Islands. This order was secured in a competition with a number of American as well as Belgium and English foundries. The company has just completed an export order of 1,600 tons of cast-iron water pipe to Costa Rica, Central America. Among other orders recently secured are contracts for furnishing pipe for water-works at Cherry Valley, N. Y.; Los Angeles, Cal.; Corry, Pa.; Stockton, Lena and Warren, Ill., and Elkader, Iowa.

THE BETHLEHEM IRON CO., Bethlehem, Pa., exhibited at the American Street Railway Association convention at St. Louis, one of its hollow forged, fluid, compressed open hearth steel shafts made for the Chicago St. Ry. Co. This is one of 12 shafts now being furnished to that corporation. It is 28 ins. in diameter in body; 22 ins. diameter in journals;; 11-in. hole; 22 ft. 6-in. long; weigh, 15 tons. Mr. H. F. J. Porter, M. Am. Soc. M. E., Manager of the western department, with office in the Marquette Bldg., Chicago, was in charge of the exhibit and delivered a lecture at the convention, illustrated with stereoptican views.

MR. CHARLES WARD, Charleston, W. Va., is said to be building eight large boilers each having 62½ sq. ft. grate and 2,515 sq. ft. heating surface, for the new line of ferryboats for the Pennsylvania R. R., to ply from Jersey City to 23d St., New York city. The boilers are said to be unlike anything heretofore built of the tubular type and were designed specially for this duty. It is expected that a third boat will be built shortly. Mr. Ward has recently rebuilt the two Thornycroft boilers of the United States torpedo boat "Cushing," having entirely retubed them and made other repairs. He has recently

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Improvement of Erie Canal, Middle Division—Contract No. 1.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from the east line of Oneida county to a point 100 feet below the lower hollow quoin of Lock No. 46.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the [illegible] provided they satisfactorily pass

direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $6,800; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of coneract, $47,600; the amount of bond for the faithful performance of contract, on execution of contract, $68,000. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope. "Proposal for the improvement of **the Erie canal, from the east line of Oneida county to a point 100 feet below the lower hollow quoin of Lock No. 46."** The right is **reserved** to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Erie Canal, Middle Division—Contract No. 2.

EW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from a point 100 feet below the hollow quoin of Lock No. 49 to a point 100 feet below the lower hollow quoin of Lock No. 50.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass
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Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $9,250; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $64,750; the amount of bond for the faithful performance of contract, on execution of contract, $92,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, from a point 100 feet below the lower hollow quoin of Lock No. 49 to a point 100 feet below the lower hollow quoin of Lock No. 50." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Erie Canal, Middle Division—Contract No. 3.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from a point 100 feet west of the upper hollow quoin of Lock No. 50 to 100 feet west of the center of Camillus Road Bridge.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $6,350; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $44,450; the amount of bond for the faithful performance of contract, on execution of contract, $63,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, from a point 100 feet west of the upper hollow quoin of Lock No. 50 to 100 feet west of the center of Camillus Road Bridge." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Erie Canal, Middle Division—Contract No. 4.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from 100 feet west of the center of Camillus Road "113" to 100 feet west of the center of Peru Road Bridge.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $6,950; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $48,650; the amount of bond for the faithful performance of contract, on execution of contract, $69,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for the improvement of the Erie canal, from 100 feet west of the center of Camillus Road "113" to 100 feet **west of the center of Peru Road Bridge." The right is reserved to reject any or all bids.**

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

shipped a 500-HP. water-tube boiler to Seattle, Wash., for the new revenue cutter "Golden Gate," being built by Moran Bros., of that city, it being the fifth boiler of this type which he has furnished for revenue cutters.

THE FRANK B. RAE ENGINEERING CO. has been formed in Chicago, with a capital stock of $2,500; the incorporators are: Frank B. Rae, W. H. Jones and Leslie A. Gilmore. Mr. Rae is an electrical and mechanical engineer located at 910 Fort Dearborn Bldg., Chicago.

THE BROWN HOISTING & CONVEYING MACHINE CO., of Cleveland, O., Chicago Office, Marquette Bldg., has sold one hand power jib crane to the Boston & Montana Consolidated Copper & Silver Mining Co., Great Falls, Mont.; also one 10-ton trolley for hand power traveling crane to the same firm. The company has also just completed the installation of four of Brown's latest improved rapid coal handling machines at Clybourne Ave. Docks, Chicago, for Coxe Bros. & Co.

THE ROSSIE IRON WORKS, New York city, has had Joseph P. Curtis appointed receiver. The company has mines at Rossie, St. Lawrence county, N. Y. Mr. Curtis is the treasurer of the company, and Anthony J. Thomas president. It was incorporated Nov. 23, 1894, and has a capital stock of $390,000, chiefly held in London. The manufacture of iron was abandoned in 1868, and mining ore in July, 1893, since which time the mines have been closed. The trouble was due to low prices of iron and iron ores, in consequence of destructive competition of Western ores. The liabilities are $17,275, and assets $16,242.

THE SHIFFLER BRIDGE CO., Pittsburg, Pa., is said to have received a contract for the iron work for five buildings to be erected by the Mariopol-Nicopol Mining & Metallurgical Co., Mariopol, Russia, as follows: Blacksmith shop 60 × 100 ft., of brick and iron; machine shop, main span, 45 ft. wide, two side sheds each 24 ft., the building to be 240 ft. long and equipped with an electric traveling crane; foundry building, 123 × 166 ft.; tube welding building, 80 × 250 ft.; open-hearth building, 90 × 210 ft., with 40-ton electric traveling crane; rolling mill building, 180 × 300 ft. The company has a contract for the erection of a blacksmith shop for the Boston & Montana Consolidated Copper & Silver Mining Co., at Great Falls, Mont.; also a contract for the iron frame work building for the Pintsch Compression Co., of Pittsburg, and a kiln house for the Pennsylvania Salt Mfg. Co., Natrona, Pa. A contract recently secured is for a brick and iron building 100 × 900 ft., to contain the open-hearth furnaces, soaking pits and rolling mills of the Buhl Steel Co., at Sharon, Pa.

NEW COMPANIES.—Rankin Prospecting & Developing Co., Fort Madison, Ia.; to prospect for oil, gas and minerals; $100,000, all paid in; W. H. McCune, N. J. Wambold.

Eagle Mfg. Co., Kansas City, Mo.; to manufacture farming implements; $100,000, commencing with $50,000; Hiram F. Devol, George H. Devol, Samuel B. Stockley.

Baron Mfg. Co., New York city; to manufacture and deal in metals, alloys, and compounds of metals; $50,000; Aime Baron, of Paris, France; Robert A. Cheseborough, William R. Garrison, Paul Fuller, New York city.

Lancaster Machine & Knife Co., Lancaster, N. Y.; to manufacture machines and machine knives; $25,000; Andrew Cant, William C. Hodge, R. J. Cant, of Buffalo.

Salt Lake Electric Supply Co., Salt Lake City, Utah; $20,000; R. W. Nicol, E. Mill, S. J. Weisel.

Webster Car Fender Co., Jersey City, N. J.; $100,000, commencing with $30,020; Jas. A. Nichols, 32 Nassau St., New York city; Nathaniel M. Nichols, 60 Arlington St., Haverhill, Mass.; Geo. W. Harrison, Jersey City, N. J.

Variety Machine Works, Cripple Creek, Colo.; $5,000; W. Newell Smith, Edwin A. Emery, and Alice T. Smith.

Boston Contract Co., Boston, Mass.; to construct railways, canals, telephone lines, etc.; $1,000,000, commencing with $1,000; Henry O. Reed, Boston, Mass.; Freeman Hunt, Cambridge, Mass.; Isaac S. Parsons, Newton, Mass.

Terry Mfg. Co., Chicago; to manufacture cooper's supplies; $25,000; George S. Terry, John C. Farwell, and F. A. Rogers.

American Carbide Co., New York city; to manufacture calcium carbide; $1,500,000, commencing with $100; Chas. C. Adams, Arthur W. Toberg, Benj. H. Moore, Philadelphia, Pa.

United States Bolt & Rivet Co., Jersey City, N. J.; to manufacture railway supplies; $125,000, commencing with $10,000; Geo. W. Hunt and Geo. W. Barmore, New York city; Edward Devlin, Jersey City, N. J.

Etna Chemical Co., New York city; $10,000; Adam Cook, Allen H. Still, Geo. Conrad Cook, of New York city.

Cold Storage Co., Locke, N. Y.; $5,500; J. L. White, Chas. B. King, I. J. Main, of Locke.

C. M. Warner Malting Co., Syracuse, N. Y.; to manufacture and sell malt; $100,000; Charles M. Warner, Grove E. Warner, Willard H. Losee, Cornelius M. Emerick.

The Comstock Telephone Co., Truthville, N. Y.; to connect Truthville, North Granville, Comstock and West Granville, Washington county, by telephone; $500; J. V. Baker, Jr., Geo. C. Baker, Charles K. Baker.

Fireproof Apartment Construction & Realty Co., of New York city; $25,000; Sigmund B. Steinman, Julius Bonner, of New York city, and Eugene Cohn, of Brooklyn.

Taber Pump Co., of Buffalo, N. Y.; $25,000; B. C. Taber, M. E. Taber and G. H. Dunston, of Buffalo.

Laurence Harbor Land & Improvement Co., Jersey City, N. J.; to construct water-works, gas-works, electric light and power plants; $5,000, all paid in; Laurence Lamb, Memphis, Tenn.; Francis Faxon, Madison, N. J.; Edward Cecil Mosby, New York city.

Clizbe Bros. Mfg. Co., Chicago; to manufacture machinery; $25,000; Adelbert R. Clizbe.

Circle Cycle Co., New York city; $500,000, commencing with $500; Benj. P. Ryder, Henry W. Brooks, Geo. W. Burnham, New York city.

South Branch Brick Co., Springfield, W. Va.; $100,000, commencing with $100; N. B. Guthrie, J. T. Wudson, S. C. Milleson.

South Amboy Marginal Ry., Dock & Ferry Co., South Amboy, N. J.; to operate a ferry between Perth Amboy,

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Improvement of Erie Canal, Middle Division—Contract No. 5.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y. until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for the improvement of the Erie canal from 100 feet west of the center of Peru Road Bridge to 100 feet west of the lower hollow quoin of Lock No. 51.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $7,050; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $49,350; the amount of bond for the faithful performance of contract, on execution of contract, $70,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposals for the improvement of the Erie canal, from 100 feet west of the center of Peru Road Bridge to 100 feet west of the lower hollow quoin of Lock No. 51." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,

43-3t Superintendent of Public Works.

Improvement of Oswego Canal—Contract No. 6.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for building a stone apron to a portion of Phoenix dam and work connected therewith on the Oswego canal.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $650; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $4,500; the amount of bond for the faithful performance of contract, on execution of contract, $6,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for building a stone apron to a portion of Phoenix dam, and work connected therewith on the Oswego canal." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,

43-3t Superintendent of Public Works.

Improvement of Oswego Canal—Contract No. 7.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for raising Braddock's dam on the Oswego canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $550; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $3,850; the amount of bond for the faithful performance of contract, on execution of contract, $5,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for raising Braddock's dam on the Oswego canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,

43-3t Superintendent of Public Works.

Improvement of Oswego Canal—Contract No. 8.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for raising Minnetto dam on the Oswego canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $685; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $4,795; the amount of bond for the faithful performance of contract, on execution of contract, $6,850. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for raising Minnetto dam on the Oswego canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,

43-3t Superintendent of Public Works.

N. J., New York and Tottenville, N. Y.; $60,000, commencing with $50,000; John L. Butman, South Amboy, N. J.; J. F. Whipple, New York city; Theo. H. Enis, Jersey City, N. J.

Ball Tire Co., New York city; to manufacture bicycle tires; $200,000, commencing with $50; Wm. A. Courtland, John D. Ducker, Richard Van Cott, New York city.

Kenevel Coking Process Co., Chicago, Ill.; to manufacture machinery, fire brick and tile; $1,000,000, commencing with $5; Fred R. Pratt, Frank F. Pratt, Geo. Ingersoll, all of Chicago, Ill.

Algona Construction Co., Cleveland, O.; to construct buildings, railways, etc.; $1,000,000, commencing with $1,000; Andrew Squire, Horace E. Andrews, H. A. Garfield.

Hydro-Carbon Burner Fuel Oil & Land Co., Los Angeles, Cal.; $200,000; N. A. Young, J. Hoagland, and J. W. Stansell.

Knight Lumber Co., Charleston, W. Va.; $100,000, com-Cal.; $200,000; N. A. Young, J. Hougland and J. W. Knight.

Jupiter Gravel Mining, Water & Electric Power Co., San Francisco, Cal.; $20,000,000, all paid in; Edward Lande, E. L. Atkinson, W. B. Murdock.

Excelsior Mfg. Co., Erie, Pa.; to manufacture tools, machinery, engines, motors, etc.; $5,000, commencing with $500; Treas., Geo. E. Barger, Erie, Pa.

H. H. Haeberly Co., Philadelphia, Pa.; to manufacture iron and steel; $12,000, commencing with $1,200; Treas., Harry G. McConnaghy, Germantown, Pa.

Chamouni Ferry Co., California, Pa.; to build a bridge over the Monongahela River; $1,500; Treas., W. S. Baker, California, Pa.

Beacon Light Co.,Chester, Pa.; $120,000; Engle Cochran, Jr., Henry B. Black, Chester, Pa.; J. George Koelber, Albert Will, Rochester, N. Y.

Mount Jewett Flint Glass Co,, Mt. Jewett, Pa.; $2,600; Murton J. Gallup, Samuel Philip, August Mellander.

Unversal Car Fender Co., New York city; $1,000; Isaac Macowsky, Myer Hillman, and Max Cohen, of New York.

Minnesota Automatic Lighting Co., St. Paul, Minn.; to deal in oils, stoves, lamps, etc.; $50,000; I. C. Morrill, W. L. Bray, F. M. Morrill.

New England Steel Castings Co., Camden, N. J.; to manufacture iron and steel castings; $100,000, commencing with $5,000; Henry T. Kent, Clifton Heights, Pa.; W. C. Henderson, Philadelphia, Pa.; Geo. W. Ring, East Orange, N. J.

Gibbs Electric Mfg. Co., Newark, N. J.; $100,000, commencing with $5,000; Jacob S. Gibbs, Chas. A. Clark, Hartford, Conn; Chas. B. Gibbs, Newark, N. J.

Macoris Dredging, Wharf & Storage Co., Jersey City, N.J.; to construct dredges, dredging machines, railways, bridges, etc.; $150,000, commencing with $25,000; Benj. Odio, New York city; Randolph Hurry, Larchmont, N. Y.; Chas. M. King, Jersey City, N. J.

Greater New York Signal Co., of New York city; $5,000; Jacob Fleischhauer, Allan Lexow, Charles K. Lexow, and others of New York city.

United States Portable Oven Mfg. Co., of New York city; $100,000; William F. Russell, James Blake, and Howard Spear, of New York city.

Bell Electric Co., New York city; to deal in electrical appliances; $150,000; Clifford E. Potter, Frank M. Bell, John R. Kein, of New York city.

Chattanooga Coupler & Supply Co., Chattanooga, Tenn.; George H. Pierce, M. T. Freeman, C. S. Wilkins.

Shaft Ventilation Stone Co., Chicago; to manufacture building material; $50,000; R. Schroeder, Robert Kliche and William Franke.

Arena & Union Grove Telephone Co., Arena, N. Y.; to maintain a telephone line 24 miles long, from Arkville, Delaware county, to Arena, Union Grove, Downsville, etc.; $2,000; W. S. Dickson, B. A. Miner and E. H. Dickson, of Arena and others.

WILL YOU HELP?

Suppose each of 10,000 readers of Engineering News who are not now sending items were to send us one good Construction News item in a year (one item in 52 weeks) we would be obliged to add two pages to our Supplement each week; if only 400 more of our subscribers will send us monthly reports of projected work of which they may hear and will also keep us informed in regard to all such work in which they are interested, the same result will be attained.

If more items are sent we shall print them and all our readers will share in the benefits to be derived from the increase in the amount of news. Also, the publication of your name in our news columns, stating either that you are making surveys, preparing specifications or have the contract for some proposed new work may result in much good to you. We ask you to send us all the desirable news items that you can.

Improvement of Oswego Canal—Contract No. 9.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for raising High Dam on the Oswego canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $900; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $6,300; the amount of bond for the faithful performance of contract, on execution of contract, $9,000. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for raising High Dam on the Oswego canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Oswego Canal—Contract No. 10.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for raising Oswego dam on the Oswego canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $2,165; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $15,155; the amount of bond for the faithful performance of contract, on execution of contract, $21,650. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for raising Oswego dam on the Oswego canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Oswego Canal—Contract No. 11

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for improving Lake Ontario level of the Oswego canal.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $1,650; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $11,550; the amount of bond for the faithful performance of contract, on execution of contract, $16,500. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for improving Lake Ontario level of the Oswego canal." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Improvement of Erie Canal, Middle Division—Contract No. 12.

NEW YORK STATE CANALS — NOTICE to Contractors—Office of the Superintendent of Public Works, Albany, N. Y., October 22d, 1896.

Pursuant to chapter 79, laws of 1895, and chapter 794, laws of 1896, sealed proposals will be received by the Superintendent of Public Works, at his office in Albany, N. Y., until Tuesday, November 10th, 1896, at 12 o'clock noon of that day, for improving Lock No. 46, Erie canal, and work connected therewith.

Plans, specifications, notices and form of contract may be seen from the date of publication of this notice to the date fixed for the receipt of proposals, at the office of the Superintendent of Public Works in Albany, N. Y., and at the office of Thomas Wheeler, Assistant Superintendent of Public Works, in Syracuse, N. Y., and at the office of R. G. Lay, Assistant Superintendent of Public Works, in Rochester, N. Y.

REQUIREMENTS — In the selection of cements to be used in the said work, those manufactured in this state will be given the preference, provided they satisfactorily pass the tests called for by the specifications.

In case any questions shall arise in relation to the accuracy of the cement tests as provided in the specifications for this work, the Superintendent of Public Works may require that said tests shall be repeated in the presence of and under the supervision of agents or experts employed by him to enable him to settle the questions thus raised.

The Superintendent of Public Works will require that all prices which shall be agreed upon between the contractor and resident engineer as compensation for materials and work furnished and done and for which no prices are fixed in the contract, shall be submitted to him for approval or rejection. The location and extent of all borrow pits and spoil banks, proposed to be appropriated outside of the present canal appropriation lines, must be determined by the Superintendent of Public Works before the resident engineer shall direct that materials shall be taken therefrom or deposited thereon.

The delivery of all materials and all other work must progress in such order, at such times and at such rates of speed as shall be satisfactory to the Superintendent of Public Works as is contemplated by chapter 794 of the laws of 1896.

The Superintendent of Public Works will employ inspectors to represent his department in and during the prosecution of the said work, and the orders and requirements of said inspectors must be observed by the contractor, and said inspectors must be furnished with every needed or required facility for the inspection of all materials and work under the contract.

This notice will be publicly exhibited at the letting of said work, and will be attached to and become a part of any contract which may be executed by the Superintendent of Public Works for said work, and shall have the same binding effect as any other part or portion thereof.

Every proposal for said work must be accompanied by a draft or certified check upon some good banking institution, of the city of New York or Albany, issued by a national or state bank in good credit within the state, payable at sight to the Superintendent of Public Works for the amount expressed below as required to be deposited with bid for the proposed work. The amount of deposit with bid for the same will be $825; and will be retained as a part of the security until the completion of the work; the amount of labor bond required on execution of contract, $5,775; the amount of bond for the faithful performance of contract, on execution of contract, $8,250. All proposals for the above work must be addressed to the Superintendent of Public Works at Albany, N. Y., and must be endorsed on envelope, "Proposal for improving Lock No. 46, Erie canal, and work connected therewith." The right is reserved to reject any or all bids.

GEO. W. ALDRIDGE,
43-3t Superintendent of Public Works.

Contract Work Should Always be Advertised in a Paper Read by Contractors.

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PERSONALS.

Mr. William Osborne, railway contractor, of Atchison, Kan., died at Waterville, N. Y., Nov. 9.

Mr. P. B. Winfree, City Engineer of Bradford, Pa., will be married Nov. 25 to Miss Mabel L. Wilbur.

Mr. M. M. Cannon, civil engineer, of Gloucester, Mass., was married Nov. 10 to Miss C. M. Chaney, of Malden.

Mr. J. H. Maddy has been appointed Press Agent of the Baltimore & Ohio R. R., with offices at Baltimore, Md.

Mr. Elmer Kirker has been appointed Secretary of the Water Department of Newport, Ky., to succeed Mr. Joseph M. Betz.

Mr. John T. Page has been appointed a member of the Board of Electric Light and Water Commissioners at Lansing, Mich.

Mr. Wm. T. Hart, formerly President of the New York & New England R. R., died in Boston, Mass., Nov. 17, at the age of 79.

Mr. John E. Jackson, civil engineer, in the employ of the Southern Pacific Ry., died of heart trouble, Nov. 7, at Los Angeles, Cal.

Mr. H. B. Mitchell, Engineer of the Fort Hall Indian Reservation, Idaho, died Oct. 27. He was at one time City Engineer of Topeka, Kan.

Mr. W. M. Brehm has been appointed Master Mechanic of the Missouri, Kansas & Texas Ry. lines north of Denison, with office at Parsons, Kan.

Mr. John Wigton, has been appointed Master Car Builder of the Missouri, Kansas & Texas Ry. lines north of Denison, with office at Sedalia, Mo.

Mr. John R. Murphy, Water Commissioner of Boston, Mass., gave an address on "Modern Progress in Large Cities," at Dorchester, Mass., Nov. 9.

Mr. A. F. Brown, Chief Engineer of the Carnegie Steel Co., Pittsburg, Pa., has resigned and Mr. F. H. Kindl has been appointed to fill the vacancy.

Mr. Joseph H. Hampson, President of the Mexico, Cuernavaca & Pacific Ry., was married Nov. 11, at Washington, D. C., to Miss Blanche Wilson.

Mr. W. P. Robinson, Jr., General Manager of the St. Joseph & Grand Island R. R., has been made General Manager also of the Kansas City & Omaha R. R.

Mr. W. B. Worral, civil engineer, in the employ of the Chicago, Rock Island & Pacific Ry., was married Nov. 11, at Davenport, Ia., to Miss Martha Neuhaus.

Mr. T. H. Russom has been appointed General Car Foreman of the shops of the Baltimore & Ohio R. R., at Mt. Clare, Md., succeeding Mr. C. H. Williams, resigned.

Mr. Gustave Michelet, President of the Permanent International Tramway Union, died at Brussels, Belgium, Nov. 4, at the age of 59, after a long and painful illness.

Mr. Arthur R. Sweet, Superintendent of Sewers at Woonsocket, R. I., will retire from that position on Dec. 1, and the work will be looked after by the city engineering department.

Mr. J. T. Odell has resigned his position as Second Vice-President of the New England R. R., and will devote his entire time to his duties as President of the Butler & Pittsburg R. R.

Mr. Charles S. Price has been elected President of the Johnstown Water Co., of Johnstown, Pa., to succeed the late Mr. James McMullen. Mr. Cyrus Elder succeeds Mr. Price as Vice-President.

Mr. Hakon Hammer, civil engineer, engaged on the work of the extension of the wheel pit of the power plant at Niagara Falls, N. Y., was killed Nov. 13 by a dynamite explosion on the works.

Mr. Wm. G. Swan, who was Superintendent of the Niagara Railway Suspension Bridge Co., at Niagara Falls, from 1865 to 1893, died Nov. 10 at Albion, N. Y. He was born at Galway, N. Y., in 1822.

Mr. E. H. Hinton, General Agent of the Panama R. R., at San Francisco, Cal., has been appointed a member of the Board of Administration of the Southwestern Traffic Association, to succeed the late Mr. Waldo.

Mr. C. H. Jenks, Superintendent of the Northern Division of the Great Northern Ry., has been granted leave of absence on account of ill health, and Mr. C. T. Kittredge will have charge of the operation of the division.

Mr. A. Langstaff Johnston has resigned his position as engineer of construction for the Richmond Traction Co., of Richmond, Va., and will remove to Philadelphia. He was tendered a dinner by the officers of the company on Nov. 9.

Mr. George A. Johnson has opened an office as civil engineer in the Derby Street Ry. Co. Building, Derby, Conn. He was with Hull & Palmer, of Bridgeport, for six years, and with the Ousatonic Water Co. for four years.

Mr. George Hornung, M. Am. Soc. M. E., has been appointed Superintendent of Water-Works at Newport, Ky., to succeed Mr. John Surran. He held that position from 1872 until it was consolidated with the position of City Engineer.

Mr. F. C. Cleaver, Master Mechanic of the Terre Haute & Indianapolis R. R., at Terre Haute, Ind., has been appointed Master Mechanic of the Louisville, Evansville & St. Louis Ry., with headquarters at Princeton, Ind., to succeed Mr. J. F. Sechler, resigned.

Capt. Alfred T. Mahan, U. S. N., has been placed on the retired list at his own request, after 40 years' service. He is well known as a writer on naval matters, his most important work being "The Influence of Sea Power on History." He entered the naval academy at Annapolis, Md., in 1856, and served through the civil war.

Messrs. William G. Deshler, of Columbus; John Tod, of Cleveland; Paul J. Sorg, of Middletown, and Thomas B. Paxton, of Cincinnati, have been appointed by Governor Asa Bushnell, of Ohio, a commission to have charge of the improvements of the state capitol, estimated to cost about $1,000,000. The plans of Yost & Packard, of Columbus, O., have been accepted for the work, as noted last week under Buildings.

Mr. William F. Brown has been appointed Superintendent of Public Works of Chatham county, Ga. He will assume the duties heretofore in charge of Mr. W. A. Dayton, County Engineer (this position having been abolished by the county commissioners), and Mr. Robert J. Wade, Superintendent of Public Roads. He will also be in charge of the convict gang employed on the roads. His office is at Savannah, Ga.

Mr. J. E. Spurrier, Superintendent of the Baltimore Division of the Baltimore & Ohio R. R., has been given charge of the First Division, including Brunswick Yard, the Curtis Bay, Washington, Alexandria, Metropolitan and Frederick branches, and the Washington County R. R. Mr. F. A. Husted has been appointed Superintendent of the Second and Third Divisions, including the Berkeley Springs and Potomac & South Branch railways, which will hereafter be known as the Middle Division. Mr. R. M. Sheats, Superintendent of the Parkersburg and Wheeling Division, will have charge of the Fourth and Fifth Divisions, including the Grafton Yard and the Grafton and Bellington Division.

Mr. J. Waldo, Vice-Chairman of the Southwestern Traffic Association, died at St. Louis, Mo., Nov. 7. He was born at Osceola, Mo., in 1839, and in 1866 he entered the service of the Houston & Texas Central Ry. as a freight clerk, rising to the position of General Passenger and Freight Agent in 1873. He was Traffic Manager from 1881 to 1883; Vice-President to 1885, and General Manager to 1889, being also Commissioner of the Texas Traffic Association from 1885 to 1889. From 1889 to 1891 he was General Traffic Manager of the Missouri, Kansas & Texas Ry., and 1892 to 1893 was Vice-President of the road. In December, 1894, he became President of the Galveston, La Porte & Houston Ry., and from January, 1896, to his death was general agent for the receivers of that road. During 1896 he has been Vice-Chairman of the board of administration of the Southwestern Traffic Association.

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ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

TACOMA SOCIETY OF CIVIL ENGINEERS AND ARCHITECTS.
Nov. 20. Secy., 201 Washington Bldg., Tacoma, Wash.

CHICAGO ELECTRICAL ASSOCIATION.
Nov. 20. "Daily Problems in Long Distance Telephoning," by C. L. Andrews. Secy., J. R. Cravath, 810 Old Colony Bldg.

ENGINEERS' CLUB OF COLUMBUS.
Nov. 21. Secy., M. S. Hopkins, 14½ N. High St., Columbus O.

ENGINEERS' CLUB OF PHILADELPHIA.
Nov. 21. "Professional Ethics Among Engineers," by Chas. Piez. Secy., L. F. Rondinella, 1122 Girard St.

WISCONSIN POLYTECHNIC SOCIETY.
Nov. 24. Secy., W. K. Means, Loan and Trust Bldg., Milwaukee, Wis.

ENGINEERING ASSOCIATION OF THE SOUTH.
Nov. 26. Secy., L. P. Brown, Nashville, Tenn.

INDIANAPOLIS ENGINEERING CLUB.
Nov. 28. Secy., C. C. Brown, Indianapolis, Ind.

COLUMBIAN ENGINEERING SOCIETY.
Dec. 1. Secy., F. W. Hart, 15th and H Sts., N. W., Washington, D. C.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 1, 2, 3, 4. At the Society House, New York. Secy., F. R. Hutton, 12 W. 31st St., New York city.

WESTERN SOCIETY OF ENGINEERS.
Dec. 2. Secy., N. L. Litton, Monadnock Block, Chicago.

ENGINEERS' CLUB OF ST. LOUIS.
Dec. 2. Secy., Wm. H. Bryan, Turner Bldg.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Dec. 2. Secy., C. W. Hunt, 127 E. 23d St., New York.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Dec. 4. Secy., O. Von Geldern, 819 Market St., San Francisco, Cal.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Dec. 7. Secy., C. L. Annan, City Engineer's Office.

ENGINEERS' SOCIETY OF WESTERN NEW YORK.
Dec. 7. Secy., Carleton Greene, Library Bldg., Buffalo.

DENVER SOCIETY OF CIVIL ENGINEERS.
Dec. 8. Secy., Walter Pearl, 36 Jacobson Bldg.

NORTHWEST RAILWAY CLUB.
Dec. 8. Secy., T. A. Foque, Soo Line, Minneapolis.

NORTHWESTERN SOCIETY OF ENGINEERS.
Dec. 8. Secy., D. W. McMorris, 635 Burke Block, Seattle, Wash.

NEW ENGLAND RAILROAD CLUB.
Dec. 9. Secy., Edwd. L. Jones, P. O. box 1158, Boston.

ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Dec. 10. Secy., James K. Zollinger, Norton Bldg.

NORTHWESTERN TRACK AND BRIDGE ASSOC.
Dec. 11. Secy., D. W. Meeker, St. Paul, Minn.

AMERICAN SOCIETY OF IRRIGATION ENGINEERS.
Dec. 11 and 12. Annual meeting in Denver. Secy., John S. Titcomb, Room 36, Jacobson Bldg., Denver, Colo.

MONTANA SOCIETY OF ENGINEERS.
Dec. 12. Secy., Forrest J. Smith, Denver Block, Helena.

ENGINEERS' CLUB OF KANSAS CITY.
Dec. 14. Secy., F. W. Tuttle, Baird Bldg.

NATIONAL IRRIGATION CONGRESS.
Dec. 15, 16 and 17. Annual meeting at Phoenix, Ariz. Secy., C. M. Heintz, Los Angeles, Cal.

ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
Dec. 15. Secy., Daniel Carhart, 410 Penn Ave., Pittsburg.

ENGINEERS' AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Dec. 16. Secy., F. Van Vleck, Los Angeles, Cal.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Dec. 16. Secy., J. A. Pilcher, Roanoke, Va.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Dec. 16. Secy., S. E Tinkham, City Hall.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Dec. 16. Secy., R. W. Pope, 26 Cortlandt St., New York city.

WESTERN FOUNDRYMEN'S ASSOCIATION.
Dec. 16. Secy., A. Sorge, Marquette Bldg., Chicago.

WESTERN RAILWAY CLUB.
Dec. 17. Secy., W. D. Crossman, The Rookery, Chicago.

ENGINEERS' CLUB OF CINCINNATI.
Dec. 17. Secy., J. F. Wilson, P. O. box 333.

NEW YORK RAILROAD CLUB.
Dec. 17. "The Relation of Track to Traffic on American and Foreign Railways," by E. E. Russell Tratman. Secy., W. W. Wheatly, 168 Montague St., Brooklyn.

ENGINEERS' CLUB OF MINNEAPOLIS.
Dec. 21. Secy., Elbert Nexsen, 1620 S. E. 4th St., Minneapolis, Minn.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Jan. 21. Kimball House, Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Dec. 31. Secy., C. H. McLeod, Montreal, Can.

CENTRAL RAILWAY CLUB.
Jan. 8. Secy., H. D. Vought, Buffalo "Courier," Buffalo, N. Y.

RAILWAY SIGNALLING CLUB.
Jan. 12. Secy., Geo. M. Basford, The Rookery Bldg., Chicago.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
Jan. 12. "Some Problems in Street Railroading," by C. H. Short. Secy., F. A. Colburn, Case Library Bldg.

LIVERPOOL ENGINEERING SOCIETY.—At the opening meeting of the season, the President, Mr. S. B. Cottrell, delivered the inaugural address, which dealt with the progress in steam and electric railways, and the possibilities of electric traction for the future.

ST. LOUIS RAILWAY CLUB.—At the meeting of Nov. 13, two papers were presented: "Increasing Locomotive Mileage by Lengthening of Runs," C. W. Eckerson; "The Mechanical Properties of Wrought Iron and Steel as Shown by Actual Tests," Prof. J. B. Johnson.

CENTRAL RAILWAY CLUB.—At the meeting of Nov. 13 reports were submitted on the following subjects: "What is the Best Method to Bring About the Adoption of M. C. B. Standards by Railroads?" "Apprentice Boys in Railway Shops," "Shall the Cubic Capacity of Ordinary Box-Cars be Increased; If so, What Shall be the Maximum Limit?"

WESTERN RAILWAY CLUB.—At the regular monthly meeting of the club held Nov. 17, the discussion was continued regarding the committee report upon "Some Difficulties Which Have Arisen Under the New M. C. B. Interchange Rules." A paper on "Some of the Uses and Advantages of Compressed Air" was read by Mr. J. H. McConnell, Snuperintendent Motive Power, Union Pacific Ry., and committee reports were presented on "Recent Developments in M. C. B. Couplers" and "Recent Developments in the Tonnage System of Rating Locomotives."

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting of Nov. 7 Mr. Allen J. Fuller presented a paper on the "Queen Lane Division of the Philadelphia Water Supply System." He stated that the per capita consumption per day in Philadelphia is 160 gallons, and this for 1,250,000 inhabitants means an enormous supply. The greatest average pumpage during any one month is 240,000,000 gallons per day, and this quantity may be better appreciated by the statement that if it were extended in a straight line through a pipe 1 sq. ft. in cross-section, it would reach from Philadelphia to California and half way back again. Prof. L. F. Rondinella read a paper on "Rapid Methods in Instrumental Drawing."

L. F. Rondinella, Secy.

WESTERN FOUNDRYMEN'S ASSOCIATION.—At the meeting held Nov. 18 the report of the Committee on Apprenticeship was taken up for discussion. There was also discussion on the following of the association's series of topical questions: (1) What is the proper amount of air, and pressure of same, to melt iron in a cupola, and what are the effects of too little and too much air? (2) Is it economical to ventilate a foundry artificially? What has been your experience? (3) What is the best method of lighting a foundry of modern design? (4) Have any members of this association had any experience with Thurston's Autographic Torsion Machine? If so, does it possess any merit over other forms of machines now in use for testing cast-iron? (5) In order to overcome the variation in size of test bars incident to molding, is machining down to size to be recommended? (6) What is your experience as to the effect upon coke of exposing same freely outdoors? (7) What is your experience as to the utility and efficiency of flexible shafting for use with grinders on heavy and intricate castings?

THE CIVIL ENGINEERS' CLUB OF CLEVELAND.—At the November meeting Mr. Joseph R. Oldham read a paper on "Structural Strength of Ships and Improved Arrangements for Repairing without Diminution of Strength," which treated the subject under the following heads: Progression by steps in engineering, Increase in steel lake tonnage, Bending moment and shearing stress, Strength of beams and girders, Straining of ships, Improved hatches, Useful weak ships, Joggling and lapping, Flush bottoms, Heavy ships, Light ships, A perfect mechanical structure. Messrs. Newman, Searles and Head followed in an interesting discussion.

F. A. Coburn, Secy.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.—The annual meeting was held in New York, Nov. 12 and 13. Twelve papers were read, as follows: "Test of an Experimental Turret of the United States Battleship "Massachusetts," Capt. W. T. Sampson; "Steel Canal Boats," Lewis Nixon; "Naval Practice in Ship Rivets and Riveting," J. H. Linnard; "American Fireboats," H. De B. Parsons; "Corn Pith Cellulose," Henry W. Cramp; "The New Battleships," Philip Hichborn; "Speed Trials of Screw Propelled Ferry Boats," F. L. Du Bosque; "125-Ton Hydraulic Shear Legs," Frank B. King; "A Method of Calculating the Stability of Ships Adapted to the Use of Standard Curves of Stability," Hugo Hammar; "Stability of a Ship in a Damaged Condition," James Swan; "Damaged Conditions of a Battleship as Affecting its Stability and Fighting Efficiency," T. F. Ruhm; "Screw Propellers," Geo. R. McDermott. The following officers were elected for the ensuing year: Pres., Clement A. Griscom; Vice-Pres., Charles H. Cramp, Philip Hichborn, Charles H. Loring, Richard W. Meade, William H. Webb, George W. Melville, George W. Quintard, Irving M. Scott, Francis A. Walker, and Frank S. Fernald; Secy. and Treas., Francis T. Bowles. On Friday evening the society held its annual banquet at Delmonico's, with Secretary Herbert as its guest.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—At the meeting to be held in New York city Dec. 1 to 4, the following papers will be read: "The Progress in the Manufacture of Iron and Steel in America, and the Relations of the Engineer to it," John Fritz, Pres.; "An Historical and Technical Sketch of the Origin of the Bessemer Process," Sir Henry Bessemer; "Ancient Pompeian Boilers," Wm. T. Bonner; "The Moment of Resistance," C. V. Kerr; "Work Done Daily by a Refrigerating Plant and Its Cost," Francis H. Boyer; "Promise and Potency of High Pressure Steam," R. H. Thurston; "Experimental Investigation of the Cutting of Bevel Gears with Rotary Cutters," F. R. Jones and A. L. Goddard; "The Calibration of a Worthington Water Meter," J. A. Laird; "Contraction and Deflection of Iron Castings," Francis Schuman; "A 200-Ft. Gantry Crane," John W. Seaver; "Washing of Bituminous Coal by the Luhrig Process," J. V. Schaefer; "Friction, Horse-Power in Factories," C. H. Benjamin; "Some Special Forms of Mechanical Computers," Frederick A. Halsey; "Rustless Coatings for Iron and Steel," M. P. Wood; "A Method of Shop Accounting to Determine Cost," H. M. Lane; "The Efficiency of the Boiler Grate,' W. W. Christie; "Efficiency of Boiler Heating Surface," R. S. Hale; "Paper Friction Wheels," W. F. M. Goss; "Steam Engine Governors," Frank H. Ball; "Metric vs. the Duodecimal System," George W. Colles, Jr.; "Aluminum Bronze Seamless Tubing," and "The Photographing of Machinery," Leonard Waldo. Arrangements have been made for visiting the following places: Morgan & Quintard Iron Works, North River Iron Works, Pond Machine Tool Works, Stevens Institute of Technology, Columbia College—School of Arts, Law, Mines; Columbia College—School of Medicine (College of Physicians and Surgeons), Pratt Institute, Washington Bridge, Ship Yards and Works: S. L. Moore & Sons Co., "World" Building, Equitable Building, Metropolitan Museum of Art, Museum of Natural History, Power house, The United Electric Light and Power Co., 28th and 29th St. stations; Power house, Broadway Cable Road; Eastern Power house, Brooklyn City R. R.

NEW PUBLICATIONS.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Second Annual Convention, Held at Cincinnati, Ohio, Sept. 11, 12, and 13, 1895. 8vo.; 142 pp. 25 cts.

This pamphlet contains the new constitution of the society, the business proceedings of the meeting and the following papers and discussions upon them: "Specifications for Vitrified Brick Pavement," by W. G. Wilkins; "Quality of Public Water Supply," by John W. Hill; "Water Supply of Newark, N. J.," by Henry E. Bailey; "Street and Sewer Work of Indianapolis," by W. B. Holton; "Collection and Disposal of Garbage," by Thomas D. de Yilbiss; "Street Paving in Newark, N. J.," by Harrison Van Duyne; "School Hygiene," by Dr. Mary E. Donahue; "Street Cleaning in Newark, N. J.," by Henry W. Bailey; "Electrolysis Prevention," by Harold P. Brown; "Street Cleaning, Street-Watering, Scavenging, etc.," by John Jones. Copies of the pamphlet can be secured by addressing the Secretary, Mr. D. L. Fulton, Allegheny, Pa.

Since the above was in type we learn that the proceedings of the third annual convention, held at Chicago, last month, are soon to be printed, and the price has been set at $1, which covers only the actual cost. The edition, however, is to be limited to the number of copies required for the members of the Association, and those who order copies in advance. A report of the proceedings of the convention was published in our issue of Oct. 22. Any of our readers not members of the Association, who desire to procure a copy of the official report, should remit $1 to Hon. August Herrmann, the President of the Association, Cincinnati, Ohio.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work. Place.	See Eng. News.
Nov. 19.	Bridge, etc., Buffalo, N. Y.	Nov. 12
Nov. 19.	Reservoir, Trenton, N. J.	Nov. 12
Nov. 19.	Water-works, St. Augustine, Fla.	Oct. 22
	Advertised, Eng. News, Oct. 22 to Nov. 12.	
Nov. 19.	U. S. building work, Chicago, Ill.	Nov. 12
Nov. 19.	Grading and paving, Brooklyn, N. Y.	Nov. 12
Nov. 19.	Macadamizing, etc., Baltimore, Md.	Nov. 12
Nov. 20.	Brick sewers, Frankfort, Ind.	Nov. 12
	Advertised, Engineering News, Nov. 12.	
Nov. 20.	Bridge bonds ($20,000), Cleveland, O.	Oct. 29
Nov. 20.	Postoffice building, Saginaw, Mich.	Nov. 5
Nov. 20.	Sewers, Salt Lake City, Utah.	Nov. 5
Nov. 20.	Electric light plant, Lakewood, O.	Nov. 5
Nov. 20.	Fire apparatus, Hazleton, Pa.	Nov. 5
Nov. 20.	Hospital, Frankfort, Ky.	Nov. 19
Nov. 20.	Remodeling school, St. Louis, Mo.	Nov. 19
Nov. 20.	Railway ties (50,000), Mobile, Ala.	Nov. 19
Nov. 20.	Underground cables, Cincinnati, O.	Nov. 19
Nov. 20.	Sewers, Rochester, N. Y.	Nov. 19
Nov. 21.	Heating, etc., Detroit, Mich.	Nov. 19
Nov. 21.	Gun emplacements, Wilmington, N. C.	Oct. 29
	Advertised, Eng. News, Oct. 29 to Nov. 19.	
Nov. 21.	Drill hall, Brooklyn, N. Y.	Nov. 12
Nov. 23.	Grading, etc., Toledo, O.	Nov. 12
Nov. 23.	Brick sewers, Toledo, O.	Nov. 12
Nov. 23.	Gun emplacements and wharf in Va.	Oct. 22
	Advertised, Eng. News, Oct. 22 to Nov. 12.	
Nov. 23.	Fog signal boilers, San Francisco,	Nov. 5
Nov. 23.	Gas franchise, Sacramento, Cal.	Nov. 5
Nov. 23.	Electric wiring, Brooklyn, N. Y.	Nov. 12
Nov. 23.	Levee work, Memphis, Tenn.	Nov. 19
Nov. 23.	State bonds ($8,225,000), Boston, Mass.	Nov. 19
Nov. 23.	Sewer bonds ($250,000), Hartford, Conn.	Nov. 19
Nov. 23.	Stairways for Boston Subway	Nov. 19
Nov. 24.	Fire engine and hose, Jersey City	Nov. 19
Nov. 24.	Cement (4,000 bbls.), New York, N. Y.	Nov. 19
Nov. 24.	Crib work, New York, N. Y.	Nov. 19
Nov. 24.	Bonds ($65,000), Taunton, Mass.	Nov. 12
Nov. 24.	Batteries at Key West, Fla.	Nov. 5
	Advertised, Eng. News, Nov. 5 to 19.	
Nov. 24.	Naval supplies, Washington, D. C.	Nov. 5
Nov. 24.	Battery on Dutch Island, R. I.	Nov. 5
	Advertised, Eng. News, Nov. 5 to 19.	
Nov. 24.	Brick paving (2 streets), Cincinnati, O.	Nov. 5
Nov. 24.	County jail and residence, Atlanta, Ga.	Oct. 1
Nov. 25.	Electric or gas lighting, Lancaster, Pa.	Oct. 22
Nov. 25.	Macadamizing (2 miles), Brooklyn, N. Y.	Nov. 5
	Advertised, Eng. News, Nov. 5 to 19.	
Nov. 25.	Brick sewers, Hoboken, N. J.	Nov. 12
Nov. 25.	Stable, Hoboken, N. J.	Nov. 12
Nov. 25.	Bridge bonds ($110,000), Jersey City	Nov. 19
Nov. 25.	Bonds ($37,000), Newark, Del.	Nov. 19
Nov. 25.	Street cleaning, garbage disposal, Phila.	Nov. 19
Nov. 25.	Building bonds, St. Joseph, Ind.	Nov. 19
Nov. 25.	Canal improvements, Albany, N. Y.	Nov. 19
Nov. 25.	Grading streets, Washington, D. C.	Nov. 19
Nov. 25.	Steel bridge, abutments, etc., Albany, N. Y.	Nov. 19
Nov. 25.	Brick paving, St. Augustine, Fla.	Nov. 19
Nov. 27.	Public lighting, Jamaica, N. Y.	Nov. 19
Nov. 27.	Stable, Brooklyn, N. Y.	Nov. 19
Nov. 27.	Protection crib, Cleveland, O.	Nov. 12
Nov. 27.	Pier extensions, Milwaukee, Wis.	Nov. 5
	Advertised, Eng. News, Nov. 5 to 19.	
Nov. 27.	Battery at Hawkins' Point, Md.	Nov. 5
Nov. 27.	Swing bridge, etc., Green Bay, Wis.	Nov. 12
Nov. 28.	Concrete battery, Sandy Hook, N. J.	Oct. 29
	Advertised, Eng. News, Oct. 29 to Nov. 19.	
Nov. 28.	Gun emplacements, New London, Conn.	Oct. 29
	Advertised, Eng. News, Oct. 29 to Nov. 19.	
Nov. 28.	County building, Ukiah, Cal.	Nov. 12
Nov. 28.	Sewer bonds, Sharpsburg, Pa.	Nov. 19
Nov. 30.	Gun battery, San Diego, Cal.	Nov. 19
Nov. 30.	Mortar battery, Galveston, Tex.	Nov. 19
	Advertised, Eng. News, Nov. 19 and 26.	
Nov. 30.	Bonds of telephone company, Baltimore.	Nov. 19
Nov. 30.	Army building, San Francisco, Cal.	Nov. 12
Nov. 30.	Water-works, Snow Hill, Md.	Nov. 12
	Advertised, Eng. News, Nov. 12 to 26.	
Nov. 30.	Bonds ($113,500), Philadelphia, Pa.	Nov. 12
Nov. 30.	Heating and ventilating, Boston, Mass.	Nov. 12
Nov. 30.	Breakwater extension, Buffalo, N. Y.	Oct. 15
	Advertised, Eng. News, Oct. 15 to Nov. 5.	
Nov. 30.	Buildings (32), Fort Hancock, N. J.	Nov. 5
	Advertised, Eng. News, Nov. 5 to 26.	
Nov. 30.	Battery at Sullivan Island, S. C.	Nov. 5
	Advertised, Eng. News, Nov. 5 to 26.	
Nov. 30.	Artesian well on Sullivan Island, S. C.	Nov. 5
	Advertised, Eng. News, Nov. 5 to 26.	
Dec. 1.	Franchise, gas and el. lights, Benicia, Cal.	Oct. 22
Dec. 1.	U. S. building work, St. Paul, Minn.	Nov. 5
	Advertised, Eng. News, Nov. 5 and 12.	
Dec. 1.	Hospital building, Brooklyn, N. Y.	Nov. 12
Dec. 1.	Supplies, Mare Island navy yard, Cal.	Nov. 12
Dec. 1.	Pipe sewers, Elizabeth, N. J.	Nov. 12
Dec. 1.	Paving, Elizabeth, N. J.	Nov. 12
Dec. 1.	Map, Brooklyn, N. Y.	Nov. 19
Dec. 1.	Sewers, Brooklyn, N. Y.	Nov. 19
Dec. 1.	Iron work, Charleston, W. Va.	Nov. 19
Dec. 1.	Laying water pipe, Jacksonville, Fla.	Nov. 19
Dec. 1.	Water-works franchise, Perth, Ont.	Nov. 19
Dec. 1.	Laying sewer pipe, Jacksonville, Fla.	Nov. 19
Dec. 2.	Grade crossing work, Buffalo, N. Y.	Nov. 19
Dec. 2.	Dredging, Wilmongton, Del.	Nov. 5
Dec. 4.	Swing-bridge span, Green Bay, Wis.	Nov. 19
Dec. 5.	Electric wiring, Buffalo, N. Y.	Nov. 19
Dec. 7.	Asphalt paving, Johnstown, N. Y.	Nov. 19
	Advertised, Eng. News, Nov. 19 and 26.	
Dec. 7.	Iron bridge (60 ft.), Lisbon, N. Dak.	Nov. 19
Dec. 9.	Water bonds ($20,000), Rockville, Md.	Nov. 19
Dec. 9.	Public lighting, Cleveland, O.	Nov. 19
Dec. 9.	Hospital building, Los Angeles, Cal.	Oct. 15
Dec. 9.	Gun carriages (12), Washington, D. C.	Nov. 12
Dec. 10.	Hospital building, San Andreas, Cal.	Nov. 5
Dec. 10.	Stone breakwater in Delaware Bay, Del.	Nov. 5
	Advertised, Eng. News, Nov. 5 to Dec. 3.	
Dec. 11.	Dike work, Evansville, Ind.	Nov. 19
Dec. 11.	Wooden protection crib, Cleveland, O.	Nov. 19
Dec. 15.	Water-works, Dothen, Ala.	Nov. 19
Dec. 15.	Pumping engine, Kansas City, Mo.	Nov. 19
	Advertised, Eng. News, Nov. 19 and 26.	
Dec. 17.	Dredging, New London, Conn.	Nov. 19
	Advertised, Eng. News, Nov. 19 to Dec. 10.	
Dec. 18.	Light plant, Frankfort, Ind.	Nov. 19
	Advertised, Eng. News, Nov. 19 to Dec. 3.	
Dec. 19.	Hire of dredging plant, Mobile, Ala.	Nov. 19
	Advertised, Eng. News, Nov. 19 to Dec. 10.	
Dec. 19.	Lighting fixtures, Auburn, Cal.	Nov. 12
Dec. 22.	Heating, etc., Port Townsend, Wash.	Nov. 19
Dec. 30.	Steel rails (150,000 tons), Sydney, N.S.W.	Aug. 6
	Advtsd, Eng. News, Sept. 3, Oct. 1, Nov. 5.	
Jan. 8.	Wooden bridge (220 ft.), Tillamook, Ore.	Oct. 8
Jan. 14.	College building, Iowa City, Ia.	Nov. 19

RAILWAYS.

East of Chicago.

ANN ARBOR.—A report from Frankfort, Mich., says that leases have been made for the right of way over the water front to the large warehouses of Woodward Bros. by the Ann Arbor Ry., which will lay a double track to the warehouse for bulk freight. The company will put on two more large steamers for its winter route between Kewaunee and Manitowoc, Wis., and this place. The harbor here, with 600 ft. of piers out into Lake Michigan, has just been completed by the government., with a depth of 18 ft.

BELLEFONTE CENTRAL.—It is stated that this railway is completed to within one mile of Pine Grove Mills, Center county, Pa., and is rapidly being pushed into the town. A large number of men and teams are now employed in grading; the road will be finished in a short time.

BUTLER & PITTSBURG.—Bids for the grading and masonry for the 12 miles between the rivers were received Saturday, Nov. 14. The steel work for the 14 bridges will be furnished by the Carnegie Steel Co. The bridge across the Allegheny River will be 3,000 ft. long.

COAST RY. OF NOVA SCOTIA.—S. H. Wheaton, Ch. Engr., Yarmouth, N. S., writes us that the projected length is 97 miles, touching Yarmouth, Tusket, Argyle, Pubnico, Barrington, Clyde, Shelburne and Lockport. Line surveyed and all right of way granted by towns and municipalities. Capital is all secured and the road is being built by the Nova Scotia Development Co., composed of Philadelphia capitalists; John A. Brill, Pres.; G. Martin Brill, Vice-Pres.; Geo. A. Fletcher, Treas. Fourteen miles are fully completed and equipped for operation; 16 miles additional are completed ready for tracklaying and ballasting, for which 1,700 tons of rails are now on the way. The steel bridges are supplied by the Central Bridge Co., of Peterboro, Ont.; grading, masonry and fencing are sub-let to H. J. Townsend & Co., of New Glasgow, N. S.

DETROIT & MACKINAC.—The Bay City, Mich., "Tribune" says that contractors Kennedy & Campbell have begun figuring on the work of grading an extension from Rogers City to Cheboygan and will submit their bids the latter part of the month. The election of Mr. McKinley settled the question of completing the road. It is now only a question of time when the line will be put through and trains running from this city to Cheboygan via the shore route. Ch. Engr., D. J. Casey, Bay City, Mich.

GOSHEN & WABASH.—A press dispatch from Ligonier, Ind., states that this company has passed into the control of F. G. Hubbell, C. W. Miller, Alfred Lowry and J. A. Beane, of Elkhardt county. A special election was to be held in Goshen, Nov. 17, for the purpose of voting on the proposition of extending aid equal to one-half of 1% on the assessed valuation of property for the construction of the proposed road.

PATTEN & SHERMAN.—P. C. Newbegin, Ch. Engr., Patten, Me., writes us that the projected length is 9 miles, connecting Patten, Crystal and Sherman. The entire line has been surveyed and 5¾ miles constructed and now under operation. The remainder of the line will probably be constructed next summer. Pres., A. A. Burleigh, Haselton, Me.

QUEEN ANNES.—The contract for building the line between Greenwood and Ellendale, Del., a distance of 10 miles, is said to have been awarded to Wade, Burns & Co., of Baltimore, Md. This firm has been building the road from Queenstown, Md., to Greenwood, and will probably secure the contract to complete it from Ellendale to the terminus at Lewes, on the Atlantic Coast, a distance of 15 miles. The road is now finished to within a mile of Denton. Pres. W. H. Bosley, Baltimore, Md. Another contract of 15 miles remains to be awarded. Ch. Engr., T. W. Troxel, Queenstown, Md.

WELLSVILLE & BUFFALO.—F. A. Goodyear, of Buffalo, N. Y., accompanied by James Rafferty, of Java, and Beckley Howes, of Bliss, are said to have made a tour of inspection, regarding the proposed railroad from Wellsville to Buffalo. The road, if built, will be an extension of a line running to Williamsport, Pa., and will be a shorter route to New York city.

Southern.

BELINGTON & ROARING CREEK.—A report from Elkins, W. Va., states that Caldwell & Dayton, Grafton, W. Va., the contractors, have begun work on the last five miles of this road along the Roaring Creek valley in West Virginia, and which connects with the Baltimore & Ohio and West Virginia Central & Pittsburg. A force of 150 men is employed. The work was stopped last July owing to a lack of money. The road opens up a 14-ft. vein of coal for 20 miles and 500,000 acres of timber land that lie on Roaring Creek. It is of standard gage.

BATH COUNTY IRON CO.—A report from Olympia, Ky., says that this company may construct a railway to its mines in the vicinity of Olympia.

MOBILE, JACKSON & KANSAS CITY.—A press dispatch from Mobile, Ala., says that this enterprise, begun nearly 30 years ago, and which first was brought to the point of construction last spring, will be put through without delay. Pres., F. B. Merrill, New York city, is quoted as saying that the construction will be pushed to completion.——Bids are asked until Nov. 20 for furnishing 50,000 cross ties. The road is to be 183 miles long. The immediate outlay in this section will be $1,800,000. For information address the Gulf City Construction Co., 62 St. Francis St., Mobile, Ala.

CHESTER & LENOIR.—A report from Chester, S. C., says that this railway has been sold to the bondholders represented by W. A. Clarke, of Columbia, S. C. The road may be extended from Newton to Hickory, N. C., by the present owners. The distance is 20 miles.

NORFOLK & WESTERN.—A press dispatch says that this company has secured the right of way to build from Kenova to Huntington, W. Va., and will soon commence the construction of a three-mile branch. Ch. Engr., W. W. Coe, Roanoke, Va.

SOUTHERN.—Condon & Henderson, of Knoxville, Tenn., have secured the contract to build a spur of the Southern Ry., from Spartanburg, S. C., to Beaumont, and have begun work.

Northwest.

OMAHA BRIDGE & TERMINAL.—It is stated that this company will proceed to make the improvements contemplated and conditionally contracted for some time since. They will involve approximately the expenditure of $500,000 and will include connections with all roads entering Omaha, South Omaha, and Council Bluffs, the building of freight depots, etc. The largest single improvement will be the construction of a connecting line with the Missouri Pacific.

Southwest.

PITTSBURG, WEIR & COLUMBUS.—This company has been incorporated at Crawford, Kan., wth a capital stock of $200,000 to build a railway. Incorporators; R. Simons, West Chester, Pa.; J. A. Nuttman, J. M. Lupman, J. Randolph and Saml. Barrett, Pittsburg, Kan.

Rocky Mountain and Pacific.

CRYSTAL RIVER.—A press report from Aspen, Colo., says that the roadbed, right of way and five miles of track of the Crystal River Ry. Co. have been sold to Orman & Crook, judgment creditors. The road is to tap a mineral section in both Pitkin and Garfield counties, and when completed will have a total length of 28 miles.

CRIPPLE CREEK.—A press dispatch from Colorado Springs, Colo., says that another short line railway to Cripple Creek is being projected and it is understood that active steps for its construction will be taken within a few days. The new road is to be nearly 60 miles long. The maximum grade is 3 ft. in 100. It has been given out that there will be about 35 tunnels, three or four of which will be of considerable length, and the remaining ones short. The estimated cost of the road is about $1,500,000.

SIERRA PACIFIC.—A press report from Stockton Cal., says that the directors of the Sierra Pacific R. R. met in San Francisco Nov. 6, to consider the issuance of $1,800,000 in bonds to be used in the construction of the line. Mr. Boggs, Supt. of Constn., has started over the line and on his return will make a report to the officers of the county and get matters in shape for the preliminary surveys.

Foreign.

CUERNAVACA & PACIFIC.—It is stated that 12½ miles south of Puente de Ixtla are in readiness for operation, and construction is being vigorously prosecuted to Buena Vista, 6¼ miles southward. It is the intention of the company to reach Buena Vista by Nov. 15. Two thousand men are employed beyond Puente Ixtla and 1,000 below Tres Marias towards Cuernavaca. Work is being crowded on this last section.

NICARAGUA.—A press dispatch from Managua, Nicaragua, says that President Zelaya has decided to grant a charter for a railway from Lake Nicaragua to the Caribbean Sea, a distance of about 70 miles, to two citizens of New York. This road is looked upon as certain to lead to a prompt development of the interior of the republic and should be of considerable assistance in the work of building the Nicaragua Canal.

STREET AND ELECTRIC RAILWAYS.

NORTH WATERFORD, ME.—Amos F. Gerald, Fairfield, Me., is said to be interested in a proposed electric railway to Norway. The distance is 15 miles. There are good powers at either end. It will cost about $10,000 per mile to construct the road.

BENNINGTON, VT.—It is stated that there seems to be but little doubt that work on the Bennington electric railroad will be begun in the coming spring. The charter for the road was obtained two years ago and already about $6,000 has been expended in preliminary work. The road will be nine miles long if built according to the terms of the charter, and at Walloomsac will connect with the Hoosick Falls road. A. E. Powers, of Lansingburgh, N. Y., is interested. The survey for the road was completed several weeks ago, and in several instances land damages were agreed upon.

BELLOWS FALLS, VT.—Representative Hadley, of Rockingham, Vt., has asked the Vermont legislature to amend the charter of the Bellows Falls & Saxtons River St. Ry. Co. so that the route may be changed. This company was incorporated two years ago to build a railway five miles long, but no work has yet been done.

CHARLESTON, VT.—Representative Prouty, of Newport, Vt., has introduced a bill in the Vermont legislature for the incorporation of the Clyde River Electric Ry. to operate in Newport, Derby, Charleston and Brighton, Vt. The capital stock is to be $150,000. Among those interested are C. S. Magoon, P. J. Farrel, G. H. Prouty, J. E. Farrell, Seymour Lane, C. C. Davis and C. A. Prouty.

POULTNEY, VT.—Representative Platt, of this city, has asked the Vermont legislature to incorporate the Western Vermont St. Ry. Co., with a capital stock of $100,000, to operate a street railway in the towns of Middletown Springs, Poultney, Fair Haven, West Haven, Benson, Castleton, Ira and West Rutland, in the State of Vermont. Incorporators: Leonidas Gray, A. Y. Gray, A. A. Greene, A. H. Varney, J. B. Beaman, E. H. Phelps and Jerome B. Bromley.

RICHFORD, VT.—Silas P. Carpenter, L. C. Leavens, W. S. Foster, A. K. Brown, F. W. Mitchell and J. N. Powell, of Richford, and J. M. Cobb, H J. Rublee, O. N. Kelton, C. T. Hall, J. C. Hutchins and H. O. Rowley, of Montgomery, have asked the Vermont legislature to be incorporated as the Richford & Montgomery Electric Ry. Co., with a capital stock of $75,000, to operate a street railway in the towns of Richford and Montgomery.

DOUGLAS, MASS.—Dr. Silas P. Holbrook informs us that the proposed Sutton & Douglas Electric St. Ry. is to commence in the town of Douglas, near the East Douglas station on the New England R. R., and to extend through the village of East Douglas to the village of Manchaug in the town of Sutton. Its length will be about five miles. The capital stock shall be $50,000. The incorporators are: Silas P. Holbrook, W. R. Wallis, Stillman Russell, Douglas, Mass.; Geo. D. Moore, C. L. West, Worcester, Mass.

FITCHBURG, MASS.—The Gardner, Westminster & Fitchburg Co. has been given a franchise. The line is to extend from this city to Gardner, through the town of Westminster, and will connect with the Fitchburg and Leominster and Gardner lines.

RANDOLPH, MASS.—The Randolph, Holbrook & Nantasket Beach St. Ry. Co. has been incororpated with a capital stock of $13,800 to build a railway 5½ miles long.

NEWTON, MASS.—F. G. L. Henderson, Supt., writes us that the Newton St. Ry. Co. is projecting additions 2½ miles long, right of way is granted, but no capital is yet secured for construction. Contracts will probably be let by the latter part of the winter. Pres., Winthrop Coffin, 620 Atlantic Ave., Boston.

NORWICH, CONN.—It is stated that a petition will be presented to the next legislature for permission to construct an electric railway between Norwich and Jewett City, passing through Preston. The road is to be built by an independent company, but at Norwich it will connect with the tracks of the Norwich St. Ry. Co. The money for construction, it is understood, will be forthcoming whenever the charter is granted.

BUFFALO, N. Y.—It is announced that the Buffalo Traction Co. will begin the construction of its road early next spring.

SYRACUSE, N. Y.—The State Railroad Commission has granted the application of the Onondaga Lake Ry. Co. to construct an electric railway from Syracuse to Onondaga Lake.

NIAGARA FALLS, N. Y.—The State Railroad Commission has granted permission to construct a street railway to the Niagara Falls St. Ry. Co.

KEARNEY, N. J.—The Consolidated Traction Co. has made application for permission to extend its present line up Kearney Ave. to the Belleville Turnpike, a distance of about a mile, and from Elm St. to the Harrison line, a distance of about 1½ miles.

ASHLAND, PA.—G. M. Smith, Pres., Shamokin & Mount Carmel Electric Ry. Co., is quoted as saying that the company will build an electric railway between Ashland and Centralia, and thus form a connecting link between the Shamokin-Mount Carmel Electric Ry., at Centralia, and the Schuylkill Traction Ry. at Ashland, and that the work of construction would be under way soon. Surveys are now in progress.

BRADDOCK, PA.—The council of Braddock has declared the rights of the Braddock Electric Ry. Co. to occupy Talbot Ave., between 2d and 13th Sts., forfeited. This is said to be for the purpose of allowing the Braddock & Homestead St. Ry. Co., which is to bridge the Monongahela River at Rankin, the privilege of getting through the town over this thoroughfare; it will have to pay the borough the sum of $5,000.

HELLERTON, PA.—Citizens are attempting to secure an extension of the South Bethlehem Electric Ry. to this place.

BALTIMORE, MD.—The Maryland & Columbia Ry. Co. between Baltimore and Washington, may be reorganized. This done the line will be completed. The company is in the hands of receivers. An issue of $75,000 of receivers' certificates to complete the Washington end of the line has been authorized. The motive power proposed is compressed air for Washington and overhead trolley for the other part of the line. James Bond and W. K. Schoepf are receivers.

HAGERSTOWN, MD. — The Hagerstown Electric Ry. Co. is said to be making active preparations to extend the street railway to the Crawford Bicycle Works. The railway company has secured from Robert S. Crawford, the necessary right of way. The extension will be about 2,000 ft. long. The company in the spring expects to build the Funkstown extension, about a mile long.

PARKERSBURG, W. VA.—The "State Journal" says that the projectors of an electric street railway are now purchasing materials. Mr. Wolf is interested.

CHARLESTON, S. C.—The Enterprise St. Ry. Co. will make an important extension of its line along East Bay, Broad and Meeting Sts.; Pres. Passailayne states that work will begin within a week. The newly chartered City Electric Ry., in which several New York capitalists are interested, and which will put in a system of overhead trolley, costing $200,000 or more, will begin work on its line in a few days.

CHATTANOOGA, TENN.—An electric railway is soon to be built from Chattanooga up Walden's Ridge, 13 miles, to the coal beds. It will cost about $200,000, and will carry both passengers and freight. Sixty-pound rails will be used. T. J. Nicholl has instructed Mr. Dietz, Ch. Engr., to resume the survey for the proposed railway.

COVINGTON, KY. — The "Commonwealth" says that the extension of the C., N. & C. St. Ry. lines over Banklick St., from Pike to 13th St., will be commenced upon the opening of spring. Mr. Jenkins, Supt., is quoted as saying that the long talked of extension of the road out the Lexington pike to Erlanger will come later.

AKRON, O.—The County Commissioners have granted a franchise to the Cleveland & Southern Electric Co. for an electric road from here, via Richfield and Bath, thence to Cleveland. The line will be in operation within a year.

CINCINNATI, O.—Citizens of Wyoming and Lockland are anxious to have the Main St. Electric Ry. extended to these villages. It is probable that the citizens of these villages will agree to raise a bonus of $2,500 for the extension, provided they are given a 10-cent fare.

CLEVELAND, O.—Jos. Roof, of Cleveland, and E. V. Hard, of Wooster, are projecting the Cleveland, Medina & Wooster Electric Ry. The company has contracted to pay the county an annual tax for 25 years of $50 a mile. This means $850 a year to the county, when the line is completed. The estimated cost of the road is $750,000. It will run from South Brooklyn, through Parma, Middleburg, Strongsville, Brunswick, Medina and Wooster. Work must be begun by March, 1897, and the road must be completed by 1898.

SANDUSKY, O.—Clark Rude, one of the projectors of the Sandusky, Bellevue, Monroeville & Norwalk Electric Ry. is quoted as saying that he has secured the right of way to Bellevue and North Monroeville, and also from Monroeville to Norwalk. He is still negotiating for the right of way between this place and North Monroeville.

TIFFIN, O.—New York capitalists have been in the city for the past few days, and it is said that the uncompleted Fostoria & Tiffin Electric R. R., on which no work has been done since 1892, will be transferred from the present owner, S. B. Sneath, to the Eastern capitalists, and work is to be resumed. The road was all graded and tracks laid for about three miles of the fourteen. From this city, it is hoped to continue the road to Fremont, and the men now considering its purchase are favorable to its extension.

BENTON HARBOR, MICH.—Mr. Dean, Vice-Pres. of the proposed Benton Harbor & Eastern Electric Ry., is quoted as asying that the construction of the line will commence at once. The projected road is to run from Benton Harbor to Decatur and thence to Allegan, by way of Paw Paw. The right of way has been secured to the latter place and the engineers have established the grade lines from Benton Harbor to Decatur. It is expected to complete the grading of the line during the coming winter.

BAY CITY, MICH.—A press dispatch states that a company has been formed in New York city for the purpose of building an electric railway from Bay City east to Fairgrove, in Tuscola county, with diverging branches from that place, one going north to Sebewaing and Unionville, and the other southeast to Cairo. The third rail system will be used.

MONROE, MICH.—A company has asked the city council for a franchise to operate a street railway in Monroe. The company is represented by Wm. C. Johnson and P. N. Jacobson. The council has referred the matter to the judiciary committee and city attorney.

PEORIA, ILL.—The Glen Oaks & Prospect Heights Ry. Co. has petitioned for privilege to extend its lines.

DES MOINES, IA.—The street railway company is understood to be figuring on some extensive improvements in the way of extensions for next year, among them being the construction of a line to Valley Junction. G. B. Hippe, Mgr.

LOS ANGELES, CAL.—The Pasadena & Pacific Ry. Co. has been incorporated to build a double-track electric railway 35 miles long, from Altadena to Santa Monica; capital stock, $500,000, commencing with $35,000; incorporators: E. P. Clark, W. D. Larrabee, M. H. Sherman, M. E. Hammond, T. C. Paxton, all of Los Angeles.——A press dispatch states that the directors of the Ventura & Ojai Valley R. R. Co. took initial steps Nov. 9 for the issuance of bonds to the amount of $100,000 to be used in construction.

NAPA, CAL.—A press dispatch says that a mass meeting recently held was addressed by the promoters of the Clear Lake Electric Power Co. The men at the head of this company have capital to build an electric railway from Napa to Lakeport and to develop electric power for Napa Valley and Vallejo. Their plans are contingent upon written promises of support after the plant is in operation.

RED BLUFF, CAL.—The Northern California Electric Ry. & Improvement Co. has filed a petition with the county clerk of Tehama county for a franchise over the county road from Red Bluff north to the county line for purpose of establishing an electric railway to be continued to the coast. The petition is filed by Frederick Eden, who engineered the Folsom scheme and who represents the company, which awaits action by the board of supervisors.

SAN FRANCISCO, CAL.—The Market St. Ry. Co. expects to begin work before long on the extension of the Mission St. electric system to the county line. About 1½ miles of double track will have to be laid south from Onondago Ave. to reach San Mateo county. A short extension will also be built on Sickels Ave. from Mission St. into Ocean View. It is the ultimate intention of the Market St. Ry. to extend the Mission St. system to the cemeteries in San Mateo county.

SANTA ROSA, CAL.—The board of supervisors has granted a 50-year franchise to N. W. Griswold, of Kenwood, for the construction of the Santa Rosa & Sonoma Electric Ry. Mr. Griswold's bid was for $250. Within the next 60 days a company will be incorporated and the work of building the road will commence at the Embarcadero landing on the Napa River. From there the line will be constructed to Sonoma, and from there, by way of Glen Ellen, Agua Caliente, Kenwood and Melita, to Santa Rosa.

SACRAMENTO, CAL.—It is stated that word has been received that the projectors of the Sacramento & Orangevale R. R. have determined to commence work immediately. The projectors of the road are Gen. J. F. Thompson, of Forest City, Ia.; Geo. Parker, Hastings, Minn., and W. J. Bonwell, of St. Paul. The road will have electricity as a motive power, and will tap the American River district. About $400,000 will be expended in the work.

ELECTRIC LIGHT AND POWER.

NEW HAVEN, CONN.—It is reported that the board of trustees of Yale University is considering plans for an electric light plant for the grounds and buildings.

BALLSTON, N. Y.—It is said that the Ballston Electric Light & Power Co. has decided to double the capacity of its plant. There will be added a 200-HP. boiler and engine and a 2,000-light dynamo.

BUFFALO, N. Y.—Bids are asked until Dec. 5 for electric wiring the new infirmary buildings of the Buffalo State Hospital. I. G. Perry, State Arch., Albany; F. W. Brown, Res. Supt., 1326 Guaranty Bldg., Buffalo; J. P. Dudley, Treas., 110 Franklin St.

JAMAICA, N. Y.—Bids are asked by the town board until Nov. 27 for lighting the Woodhaven lighting district with 1,200 c. p. arc lights, and 20 and 70 c. p. gas and naphtha lamps. The lights are to be ready by Jan. 1.

NEW YORK, N. Y.—The following bids were received by the treasury department at Washington, D. C., Nov. 9, for an electric light and power plant in the post office building in this city; (1) being for boilers, (2) dynamos and engines, (3) switchboard, (4) for entire plant, (5) removal of old boilers:

Burhorn & Granger, 136 Liberty St., New York: (1) $37,167, (2) $26,550, (5) $375.

Westinghouse Electric & Mfg. Co., Pittsburg, Pa.: (1) $47,250, (2) $29,690, (3) $34,125, (4) $111,065.

New York Electric Equipment Co., Duane and Elm Sts., New York: (1) $36,000, (2) $28,062, (3) $29,990, (4) $92,052, (5) $1,000.

Walworth Construction & Supply Co., 100 Pearl St., Boston: (1) $39,364, (1 and 2 combined) $64,333.

S. I. Pope Co., 207 Medinah Temple Bldg., Chicago: (1) $23,760.

Fisher Electrical Mfg. Co., Detroit, Mich.: (2) $24,690.

Westinghouse, Church, Kerr & Co., 26 Cortlandt St., New York: (1) $45,000, (2) $28,275, (3) $32,600, (4) $105,875.

Wallace & Cary, 131 4th Ave., New York: (1) $33,953.

Frank McSwegan & Son, 98 Liberty St., New York: (4) $89,000, (5) $300 and old boilers.

Ideal Electric Corporation, 36th and Houston Sts., New York: (1) $37,700, (2) $25,200, (3) $28,300, (4) $91,070.

Baker, Smith & Co., 5th Ave and Houston St., New York: (1) $35,575, (5) $1,000 and old material.

E. Keeler Co., Williamsport, Pa.: (1) $25,500.

McCay-Howard Engineering Co., 106 E. German St., Baltimore, Md.: (1) $33,800, (2) $28,225, (3) $20,745, (4) $81,995.

Campbell & Zell, Equitable Bldg., Baltimore, Md.: (1) $20,401.

Southern Electric Co., Hoen Bldg., Baltimore, Md.: (3) $18,834, (4) $90,109.

Commercial Construction Co., New York: (1) $45,000, (2) $28,275, (3) $28,290, (4) $101,987.

The Ball Engine Co., Erie, Pa.: $16,586 for engines only,

E. Rutzler, 178 Centre St., New York: (1) $36,361, (5) $1,000 and old material.

W. R. Fleming & Co., 203 Broadway, New York: (1) $37,070. (2) $24,543, (3) $31,000, (4) $91,113, (5) $736.

Triumph Electric Co., Cincinnati, O.: $15,394 for engines.

J. P. Hall, 143 Liberty St., New York: (1) $35,500, (2) $28,000, (3) $30,000, (4) $103,000, (5) $1,000 and old boilers.

Western Electric Co., Chicago, Ill.: (2) $26,508, (3) $27,000.

Coatesville Boiler Works, Coatesville, Pa.: (1) $46,365, (2) $27,175, (3) $33,309, (4) $105,803.

CAMDEN, N. J.—It is reported that the Camden Lighting & Heating Co. is receiving estimates for a new power plant through its architect, Henry D. Dagit, 706 Walnut St., Philadelphia. The plant will consist of a boiler-house, engine-house and generator room, located at 17th St. and Cooper Creek, Camden. The boiler-house will be 36 × 50 ft., and will contain four 200-HP. Fowden water-tube boilers connected to a steel stack 150 ft. high. The engine-house will be 40 × 160 ft., and will be 50 ft. high, with iron roof trusses. A ventilating monitor, 40 × 50 ft., and 8 ft. high, is designed to carry off the heat from the engines. This room will eventually contain 3,000 HP., but at present only 800 is being installed. The generator room wil be 60 × 180 ft. The entire work will be under the supervision of H. D. Dagit, and the power and electrical installation under Mr. Fowden, the company's engineer.

BEAVER FALLS, PA.—The Valley Power & Light Co., Beaver Falls, which was recently incorporated with a capital stock of $3,000, will purchase some new machinery in the near future. W. A. McCool and H. W. Reeves are interested.

YORK, PA.—Press reports state as follows: One of the largest electric plants in this country will soon be established at York Haven, at the cost of about $3,000,000. The capacity will be about 20,000 HP. It will be under the supervision of H. L. Carter, present owner of the York Haven paper mill, of Philadelphia, and Mr. Severy and Mr. Einstein, of New York. The plant will distribute electricity throughout the nearby towns, such as Harrisburg, Lancaster, York, Manchester and all the towns within a radius of 30 or 40 miles. It is said that the plant will be the means of the establishment of three or four large mills at this place. Early in the spring about 1,000 men will be put on the work in order to hasten its completion. It is thought that it will take about three years to complete the plant.

WASHINGTON, D. C.—The United States Electric Light Co. has voted to receive estimates for remodeling and improving the B St. and 13½ St. station. It is stated that about $300,000 will be spent in extending and improving the machinery of the different plants. Pres., A. A. Thomas; Secy., S. W. Tulloch; Treas., A. F. Marsh.

WESTERNPORT, MD.—It is stated that this place proposes to erect an electric light plant.

CHARLESTON, S. C.—The court has granted the Charleston Electric Light Co. permission to purchase a 150-K-W. machine, to cost $2,500.

NEW ORLEANS, LA.—Receivers Badger and Whitney, on Nov. 9, in the United States Circuit Court, filed an application for permission to issue receiver's certificates for the purpose of placing additional machinery and apparatus in the Louisiana electric light plant. Judge Pardee granted the application.

COAL CREEK, TENN.—R. M. Edward & Co. are reported as interested in a projected electric light plant for this place.

CLEVELAND, O.—Bids are asked until Dec. 9 for lighting the streets, alleys, etc., with 500 arc lights, for one year from Jan. 1, and also for 4,650 gasoline lights, etc. D. E. Wright, Dir. Pub. Wks.

LAKEWOOD, O.—Bids were opened Nov. 18 for the purchase of $20,000 of 6% bonds for erecting an electric light plant. Wm. F. Closse, Clk.

YOUNGSTOWN, O.—The board of water-works trustees has decided to add an electric light plant to the waterworks. The plant will furnish 6 arc and 25 incandescent lights. J. H. Morris is a trustee.

FRANKFORT, IND.—Bids are asked until Dec. 18 for constructing an electric light system or a Welsbach gas system, as described in our advertising columns. Alonzo J. Hammond, Cy. Engr.

HARTFORD, WIS.—Portz Bros. and J. B. Hahn of this city are reported as considering the advisability of putting in an electric light plant in Hartford. They are now getting estimates and a sufficient guarantee from the council and the citizens, and if everything is found satisfactory, the city will soon be lighted by electricity.

OCONTO, WIS.—It is reported that the council has voted to have plans prepared for a new electric light plant.

MINNEAPOLIS, MINN.—Press reports state that in about 20 days specifications for the electric power plant for the St. Anthony Falls Power Co. will be prepared and then bids for the dynamos and switchboards will be received. The plant, the dam for which will be located below St. Anthony Falls, will furnish over 10,000 HP. It is said that about 60 carloads of machinery will be needed. Ch. Engr., Wm. de la Barre, Minneapolis; Asst. Engrs., Foree Bain, Monadnock Bldg., Chicago, and Chas. Armstrong, Chicago, Ill.——A building permit has been taken out by the St. Anthony Falls Water Power Co., for a 100 × 207-ft. two-story power station, to cost $110,000.

CENTRALIA, MO.—We are informed that J. K. Fyfer, of Columbus, Mo., has been granted a franchise for an electric light plant. A 750-light alternating plant will be installed by Jan. 1. Plans were prepared by A. L. McRae, 309 Oriel Bldg., St. Louis, Mo.

ST. JOSEPH, MO.—The St. Joseph Ry., Light, Heat & Power Co. will soon make improvements to its light plant. W. T. Van Brunt, Gen. Mgr.

MODESTO, CAL.—Judge A. Hewel, W. H. Hatton and W. A. Harter have submitted a report of their investigation upon the proposition to install an electric light plant in this city. They recommend that Hassen & Hunt be employed to visit this city and make surveys for a plant and submit a report.

SACRAMENTO, CAL.—Bids for the electric motor, power pump and electricity to furnish 70 lights for the county hospital were opened Nov. 18 by the supervisors.

MEXICO, MEX.—Plans and specifications are reported as about completed for furnishing this city with electric power by way of the Tequixquiac Tunnel. It is said that about $8,000 HP. will be furnished the city. Thos. W. Orbison, Ch. Engr. Electric & Irrigation Co., and Francisco Espinoza, 1038 Third Calle Colon.

NEW COMPANIES.—Sunapee Electric Light & Power Co., Sunapee, N. H.; $4,000; A. F. Stocker, William C. Stocker, C. E. Trow, W. W. Trow, Joseph Russell.

Standard Light & Power Co., Fort Worth, Tex.; $100,000; John C. Harrison, Wm. B. Harrison, George E. White, R. J. White.

Cheney Water, Light & Land Co., Cheney, Wash.; $100,000; Knox Johnston, C. B. Hopkins and others.

Barre Electric Light & Power Co., Barre, Vt.; $150,000; Frank G. Howland, H. K. Bush, W. A. Perry, Geo. J. Reynolds.

BRIDGES

PROVIDENCE, R. I.—We are informed that the following bids were received Nov. 5 for constructing a steel superstructure for the Manton Ave. bridge over the Woonasquatucket River, as advertised in Engineering News; Robt. E. Smith, Comr. Pub. Wks.:

Bidder.	Steel work, complt.	Addit'n'l for stl. sidewlk beams.	Extra steel work, per lb.	Total.
Toledo Bridge Co.	$2,570	$175.00	$0.0341	$2,745
Wr't Iron Bridge Co.	2,495	190.00	.035	2,685
King Bridge Co.	2,440	200.00	.035	2,640
R. F. Hawkins	2,748	198.00	.0365	2,946
N. J. Steel & Iron Co.	2,748	148.00	.036	2,896
Edge Moor Bdg. Wks.	2,500	175.00	.035	2,675
Youngst'n Bridge Co.	2,860	300.00	.03	3,160
F. R. Long, New York	2,600	170.00	.0375	2,770
Springfield Cnst'n Co.	2,383	153.00	.034	2,536
Berlin Iron Brdg Co.	2,500	180.00	.038	2,680
Vermont Const'n Co.*	3,240	140.00	.0237	3,380

*St. Albans.

WOONSOCKET, R. I.—The Youngstown Bridge Co., Youngstown, O., has been awarded the contract for constructing a steel bridge over the river, as advertised in Engineering News. There were 14 bids, ranging from about $12,000 to about $16,500. Frank H. Mills, Cy. Engr.

NEW HAVEN, CONN.—The city has been ordered to build at once the proposed bridge at East Chapel St. over the tracks of the New York, New Haven & Hartford R. R. The order for the building of the bridge, which now stands with slight modification, was passed by the Railroad Commissioners in June, 1886, and approved by the superior court in July of the same year. It provides that the city shall build the bridge, the embankments and abutments. The bridge is to be 15 ft. above the tracks, which the railway company must lower 20 ins. The damage assessed to property owners will be paid by the city and the railway, jointly.

HARTFORD, CONN.—The New York, New Haven & Hartford R. R. Co. has been directed to rebuild its bridge over its tracks at Broad St. at once.

ALBANY, N. Y.—Bids are asked until Nov. 25 for constructing a steel swing bridge over the Black River at Lowville, and also for rebuilding the bridge over Black River at Glendale. Thos. Wheeler, Asst. Supt., Syracuse, N. Y.; Geo. W. Aldridge, Supt. Pub. Works.

BUFFALO, N. Y.—Bids are asked until Dec. 2 for constructing the superstructure and postbents of the Chicago St. viaduct, between north line of Carroll St. and south abutment of the Hamburg Canal, also the ramp approach in Exchange St. connecting with the viaduct; prices required for each span and approach separately and for sum total. Edward B. Guthrie, Ch. Engr. Bureau of Engineering; Geo. E. Mann, Eng. Grade Crossing Comrs., Municipal Bldg.; R. B. Adam, Chn.

BUFFALO, N. Y.—The contract for the substructure for the Chicago St. grade crossing viaduct has been awarded to Christopher Smith at $78,000.

WATERTOWN, N. Y.—Press reports state that the citizens of Lmye have petitioned the secretary of war for an order compelling the New York Central R. R. Co. to construct a draw in its bridge across Chaumont Creek, so that the stream will be navigable to Depauville. Maj. W. S. Stanton, U. S. Engr., Oswego, N. Y., is said to have been taking evidence.

JERSEY CITY, N. J.—Bids are asked until Nov. 25 for the purchase of $110,000 of 4% bridge bonds. Hugh Dugan, County Collector, 317 Grove St., Jersey City; John Boyd. Clk.

COLUMBIA, PA.—Press reports state as follows: Information from a reliable authority has been received here that the Western Maryland R. R. Co. has decided to bridge the Susquehanna River at Chickies, two miles west of Columbia, connecting with the Reading & Columbia branch of the Philadelphia & Reading R. R. at Columbia, the terminus of the branch line. J. M. Hood, Pres. and Gen. Mgr., Baltimore, Md.

PITTSBURG, PA.—The steelwork for the 14 bridges on the new Butler & Pittsburg Ry. will be furnished by the Carnegie Steel Co. This includes the Allegheny River bridge, 3,000 ft. long, and all bridges between it and Butler, Pa. J. H. Reed, Chn. Bd; F. E. House, Ch. Engr., Pittsburg.

YORK, PA.—The city officials and the Northern Central Ry. Co. are considering the question of constructing a bridge over the tracks at College Ave. H. E. Passmore, Supervisor, York; J. G. Durbin, Cy. Engr.

BERKLEY SPRING, W. VA.—It is reported that the question of erecting an iron bridge over the Cacapon River, near Great Cacapon, at a cost of $12,000, was defeated at the election on Nov. 3.

ASHLAND, KY.—Press reports state that the plans submitted by the Chesapeake & Ohio Ry. Co.'s engineers for the proposed railway bridge over the Ohio River at this point, have been adversely reported by the United States engineers, and new plans with a larger channel span as recommended by the Pittsburg rivermen will be prepared at once. With this change the engineers will doubtlessly accept them without objections. Gen. Mgr., G. W. Stevens, Richmond, Va.; E. M. Hoardley, Asst. Engr., Ashland.

CINCINNATI, O.—The county commissioners' board of control and engineer have decided that either a bridge or culvert must be built at Cincinnati Ave. and North Bend.

DAYTON, O.—Frank C. Osborn, Hickox Bldg., Cleveland, O., has recommended the construction of a new steel bridge at Third St. A new bridge is also proposed at Main St.

HAMILTON, O.—The commissioners of Butler county, O., and of Franklin county, Ind., are considering the question of building a new superstructure to the bridge at Scipio. S. A. Dillon, County Surv., Hamilton.

MARIETTA, O.—It is stated that F. Folkel, Consult. Engr., of Pittsburg, is making estimates for a bridge across the Ohio River at this point, the original survey of which was made three years ago. The bridge will cost about $3,000,000, and will be for railway, vehicle and foot travel. William Jutte, 247 Water St., Pittsburg, Pa., is said to be interested in the enterprise.

CHICAGO, ILL.—Alderman Knudson has introduced an ordinance authorizing the construction of a bridge over the Chicago River at North Carpenter St.

GREEN BAY, WIS.—Bids are asked until Dec. 4 (postponement from Nov. 27) for constructing the 182½-ft. steel swing span of the Main St. bridge, as stated in our issue of last week. Engr., E. L. Shaw, Marinette, Wis.; J. F. Rothe, Chn. Com.

LISBON, N. DAK.—Bids are asked until Dec. 7 for building a 60-ft. combination iron and wood bridge over the Sheyenne River at Owego, according to reports. Thos. J. Harris, County Audr.

DENVER, COLO.—Local papers state that the board of public works has decided to advertise for objections in regard to the construction of the 14th St. viaduct. T. J. Milner, Ch. Engr.

LOS ANGELES, CAL.—The Los Felis bridge (to be built over the Los Angeles River) matter is still held by the bridge committee of the council, and probably will not be brought up again. The total bids were published in our issue of Nov. 5.

MONTREAL, QUE.—It is reported that at a meeting of the board of trade, held Nov. 10, it was resolved to petition the council to ask Parliament to authorize the city to issue bonds not to exceed $1,000,000 as a subsidy for the Quebec Bridge Co.

OTTAWA, ONT.—Press reports state that work will be begun on the proposed bridge between this city and Hull at once, as at least $50,000 worth of work must be done before Jan. 1.

BUILDINGS

BAR HARBOR, ME.—J. E. Clark is reported to have been awarded the contract for constructing a $30,000 addition to the Chatwold, the residence of Joseph Pulitzer, of New York, N. Y. The construction of a $25,000 stable is also being considered by Mr. Pulitzer.

NEW BEDFORD, MASS. — Francis Hopkinson Smith, of New York, is reported to have been awarded the contract for constructing the light-house at Butler Flat. The bids received Nov. 9 by Maj. W. R. Livermore, U. S. Engr., Boston, were as follows:

Francis H. Smith, New York	$34,000
John L Grim, Philadelphia, Pa.	39,200
C. H. Houston, Philadelphia, Pa.	35,475
G. A. Lancaster, Boston	75,710
Glover & Spear, Rockland. Me.	36,400
Stewart & McDermott, New York	35,650
Sooysmith & Co., New York	37,900
Charles E. Davis, New Bedford	35,890
Arthur J. Brennan, Boston	50,710

SOMERVILLE, MASS. — The council has directed Architect Gould to prepare plans for a new city armory to cost about $55,000. Councilman Burroughs can be addressed.

HARTFORD, CONN.—The council is considering an ordinance for erecting an addition to the high school building and also a new structure.

BROOKLYN, N. Y.—Bids are asked until Nov. 27 for erecting a training stable on Canton St., near Bolivar St.; surety, $15,000. Wm. C. Bryant, Comr. Dept. of Fire.——It is reported that bids are being received by James Burke, 189 Montague St, for erecting a 4-story apartment house on De Kalb Ave.; estimated cost, $30,000. Arch., J. L. Young, 1239 Bedford Ave.

BUFFALO, N. Y.—The following bids were received Nov. 5 for the masonry work for an 8-room school building on Fays Ave., all the bidders being from Buffalo. R. G. Parsons, Secy.:

Rohde Brothers, 52 Berlin St.	$21,300
Henry Rumrill, Jr., & Co., Builders' Exchange.	21,619
Watson & McGinness	22,014
John Lannen, 32 Builders' Exchange	22,049
John L. Frank, Jr.	22,474
Henry Schaefer's Sons, 578 Elm St.	22,710
George Kempf, 99 Locust St.	22,812
Mosler & Fitzpatrick, 1266 Seneca St.	23,200
Hildebrandt & Frank	23,275
W. M. Savage	24,000
J. H. Tilden, 14 Henry St.	25,519

BUFFALO, N. Y.—It is reported that the New York Central & Hudson River R. R. Co. is to spend $50,000 on improving its passenger station in this city. John M. Toucey, Gen. Mgr., New York.

KINGS PARK, N. Y.—P. J. Carlin & Co., Brooklyn, have been awarded the contract for constructing the new group of buildings for the Long Island state hospital at $311,323. Wm. M. Tobin, of Syracuse, N. Y., who was reported to have been awarded the contract for heating, ventilating, plumbing, sewer, steam pipes, etc., as advertised in Engineering News, at $19,209 we are informed, has withdrawn. The lowest bidders were James Harley, 288 Flatland Ave., Brooklyn, plumbing, at $4,242; E. Rutzter, 178 Centre St., New York, steam pipes, at $17,920; and Gaylord & Eitopence, Binghamton, N. Y., at $8,040. The group of buildings consists of an administration building, seven cottages, a dining-room and dormitory building, kitchen building containing necessary rooms, a general bathing apartment, sun-rooms, connecting corridors, etc. W. E. Sylvester, Gen. Supt., Brooklyn.

NEW BRIGHTON, N. Y.—The taxpayers voted Nov. 11 to erect a new school building to cost $75,000. Spire Pitou, John L. Dobson and John Irving are on the committee to secure plans.

NEW YORK, N. Y.—It is reported that arrangements are being made for erecting an armory, to cost $120,000, for the First Battery, which is commanded by Louis Wendel, 280 Broadway.——Plans have been filed by Weil & Mayer, 227 East 60th St., for four 6-story brick stores and tenements, at 246 to 254 Mott St., to cost $100,000.——Jardine, Kent & Jardine, 1262 Broadway, have been directed to prepare plans for remodeling the building at Broadway, Canal and Lispenard Sts.——J. C. Lyons, a builder, 81 East 125th St., is reported to have decided to erect a 10-story office building at 596 Broadway.——Henry McNally, 287 4th Ave., is reported to have received the contract for erecting the Trinity Ave. school building at $126,900.——D. H. Hayes, of Chicago, Ill., is reported to have been awarded the contract for the stone and brick work, roof covering, interior finish, etc., of the appraiser's warehouse at $322,500.

NEW YORK, N. Y.—Plans have been filed for the following buildings: Two 5-story brick flats on 123d St., for the Equitable Savings Society; Arch., F. T. Camp, 114 Nassau St.; cost, $50,000. Four 5-story brick flats, on 123d St.; owner and architect as above; cost $100,000. Six 2-story dormitories on Blackwell's Island for the city of New York; John W. Marshall, architect, 111 Broadway; cost, $165,000. Four 5-story brick flats on 117th St., for William H. Hall, Jr.; Neville & Bagge, architects, 217 West 125th St.; cost. $92,000. Five-story brick school building on St. Nicholas' Ave., for the city of New York, to cost $250,000, and a 3-story brick theatre, office and hall, at 116th and 120th Sts. and Amsterdam Ave., for the Columbia University. The structure will be 260 × 175 ft., and the first three stories are estimated to cost $600,000. Four additional stories are to be added, plans for which have not yet been prepared. Archs., McKim, Mead & White, 5th Ave.; Norcross Bros., 160 5th Ave., are reported to have been awarded the contract.

OGDENSBURG, N. Y.—It is reported that the state armory commission will soon ask for new bids for constructing the state armory in this city, to cost $40,000.

NEW CASTLE, PA.—The treasurer of the board of education is selling $40,000 in bonds for a new school building, according to reports.

PHILADELPHIA, PA.—Wilson Bros. & Co., Drexel Bldg., have submitted plans for the Philadelphia Dental College, prepared by them, to the building inspection bureau. The structure will cost about $90,000. Geo. F. Payne & Co. are the general contractors.

PITTSBURG, PA.—Plans have been completed for six branch library buildings of the Carnegie Library. W. N. Frew, Pres.

PITTSBURG, PA.—It is understood that the National Bank of Western Pennsylvania has accepted plans for the building to be started early next spring, corner of Penn Ave. and 9th St.

LANCASTER, PA.—H. N. Breneman & Son are reported to have been awarded the contract for constructing an annex to the county court house, as advertised in Engineering News, at about $62,000. W. W. Greist, Clk. County Comrs.

WASHINGTON, D. C.—The district commissioners in their annual report have urged the construction of a new municipal building.

AIKEN, S. C.—The following bids were received Nov. 5 by the county commissioners for putting in 16 iron and steel cells in the jail:

Hall's Safe & Lock Co., of Cincinnati, O.	$7,978
Detroit Safe Co., Detroit, Mich.	8,000
Van Dorn Iron Works, Cleveland, O.	7,947
Pauly Jail Mfg. Co., St. Louis, Mo.	8,775
E. T. Barnum, Detroit, Mich.	7,400
Diebold Safe & Lock Co., Canton, O.	7,400
Mosler, Bahmann & Co., Cincinnati, O.	6,815
Stewart Iron Works, Cincinnati, O. (accepted)	5,946

CLARKSBURG, W. VA.—It is reported that the Baltimore & Ohio R. R. Co. has decided to erect an $18,000 passenger station at this place.

PARKERSBURG, W. VA.—It is stated that Senator J. N. Camden has made his plans to build a $30,000 hotel at Webster Springs, to be in readiness for guests next spring.

FRANKFORT, KY.—Bids are asked until Nov. 20 for erecting a building for the institution for the feeble-minded, according to reports. Samuel R. Smith, Chn.

CLEVELAND, O.—The cornerstone of the proposed west wing of the St. Alexis Hospital was laid Nov. 9; estimated cost of extension $100,000. Arch., J. H. Harks, New England, Cleveland; M. J. Kelley has the contract for the masonry work.

COLUMBUS, O.—We are informed that Yost & Packard, Archs., Capitol Square, East Columbus, O., will not be ready to advertise for bids for constructing an addition to the capitol building until about March 1. The Governor on Nov. 9 appointed the following as a committee to superintend the improvements: Wm. G. Deshler, Columbus; John Tod, Cleveland, O.; Paul J. Soy, Middletown, O., and Thos. B. Paxton, Cincinnati.

HAMILTON, O.—The Pauly Jail Building & Mfg. Co., St. Louis, Mo., and the Herring-Hall-Marvin Co., New York, N. Y., are reported as the lowest bidders, at $11,059 and $11,700, respectively, for putting in the cells in the Butler county jail.

INDIANAPOLIS, IND.—Plans are being prepared for a 9-story building for the Odd Fellows' Lodge; estimated cost, $200,000.

ST. JOSEPH, IND.—Bids are asked until Nov. 25 for the purchase of $273,000 of 4½% county gold bonds, to pay for the construction of a county court-house. W. H. Oren, Treas.

DETROIT, MICH.—Bids are asked until Nov. 21 for furnishing a heating apparatus for the county jail, etc. Archs., John Scott & Co., 67 Moffat Block; Wm. Rickert, Chn. Com.

DETROIT, MICH.—Frank H. Bamlet has decided to erect a 5-story building at Grand River Ave. and Rowland St., at a cost of $35,000. Archs., Spier & Rohns, 115 Chamber of Commerce.

PORT HURON, MICH.—Aldermen Cooley and Moore and Frank Beard, F. J. Haynes and A. D. Bennett have been appointed to secure plans for a $20,000 auditorium, according to reports.

CHICAGO, ILL.—The Geo. A. Fuller Construction Co., Chicago, has been awarded the contract for erecting a $1,000,000 addition to the Fair. Work will be commenced on one section Jan. 1.——Work will probably soon be begun on a $100,000 building on Plymouth Place for R. R. Donnelly & Sons. Archs., Howard V. Shaw, 115 Monroe St., and S. A. Treat, 58 Wabash Ave.——Neils Buck, Watson Bldg., has prepared plans for a $40,000 flat building at Perry St. and Belle Plaine Ave.

MILWAUKEE, WIS.—It is reported that the trustees of the J. B. Martin estate will erect a 6-story brick and stone building at East Water and Wisconsin Sts., to cost about $250,000, plans for which have already been prepared. Archs., Crane & Barkhausen, 89 Wisconsin St.——Bids will probably soon be asked by the public library and museum building committee for the purchase of $200,000 building bonds.

IOWA CITY, IA.—Bids are asked until Jan. 14 for constructing buildings for the State University of Iowa in this city; estimated cost, $50,000. Archs., Josselyn & Taylor, Cedar Rapids, Ia.; Pres., C. A. Schaeffer.

DES MOINES, IA.—It is stated that the announcement was made Nov. 11 that a contract has been closed between the Des Moines Union R. R. and the Chicago, Great Western & Wabash, Chicago & Northwestern, Des Moines Northern, and Chicago, Milwaukee & St. Paul roads, by which the local company is to build a $200,000 union station on Cherry St., between Fifth and Seventh Sts., next spring. The Des Moines Union will also build extensive shops, and the Great Western will build a big freight depot, to cost $50,000.

ST. LOUIS, MO.—Link & Rosenheim, Union Trust Bldg., have prepared plans for a $75,000 Y. M. C. A. building to be erected on the property of the Terminal Railroad Association. Plans are also being prepared for a building in East St. Louis, Ill. Bids for the first structure will probably soon be asked. Geo. T. Coxhead, Gen. Secy., Y. M. C. A., St. Louis.

ST. LOUIS, MO.—Bids are asked until Nov. 20 for remodeling the Simmons school building. John Kissner, Chn.

GALVESTON, TEX.—We are informed that the county court contemplates adding an addition to its jail and an addition to its court house, but plans and specifications have not yet been prepared. A ferry and railway approach on the Bolivar peninsular is under construction by the county at a cost of $53,900, as stated under Miscellaneous Contracts in our issue of Nov. 5. Wm. B. Lockhart, County Judge; address Geo. H. Low, Jr., County Clk.

PORT TOWNSEND, WASH.—Bids are asked until Dec. 22 for the heating apparatus and power boiler for the U. S. marine hospital building at Port Townsend. Wm. Martin Aiken, Supervising Arch., Washington, D. C.

SEATTLE, WASH.—The Northern Pacific Ry. Co. has purchased property at Madison and Columbia Sts., on which it is proposed to erect a new passenger station.

MADERA, CAL.—It is reported that this county will soon vote on the question of issuing $50,000 in bonds for a jail.

SACRAMENTO, CAL.—The board of supervisors has accepted the plans of G. A. West for the new cells of the county jail, and the clerk has been instructed to advertise for bids for the work.

SANTA BARBARA, CAL.—Joel A. Fithian and others intend to erect a $100,000 theatre in this city in the near future, adjoining the Fithian Block.

SAN JOSE, CAL.—Curtis M. Barker, Cy. Engr., writes us that at the election Oct. 30 it was voted to issue $75,000 in bonds for erecting a new high school building. The bonds will be sold as soon as possible and the work pushed to completion.

WINNIPEG, MAN.—It is reported that Geo. W. Gouinlock, 53 King St., Toronto, Ont., has prepared plans for improving the building at Notre Dame and Main Sts. at a cost of $40,000. T. G. Cox, of Toronto, is interested.

WATER-WORKS.

AUBURN, ME.—The water commissioners are considering the construction of a new reservoir on Merrill Hill, at an estimated cost of $10,000.

BANGOR, ME.—The Cumberland Mfg. Co., 220 Devonshire St., Boston, Mass., has been awarded the contract by the water board for a new filter.

DEERING, ME.—At a meeting Nov. 13 the mayor appointed a committee of eight to consider the advisability and, if practicable, to apply for a charter for a water supply from Duck Pond, six miles distant. I. W. Barbour, Cy. Engr.

NEW CASTLE, ME.—At the election Oct. 28 action was postponed on the proposed uniting with Damariscotta in the construction of water-works It is stated that enough private takers have been secured, however, and that the Twin Village Water Co. has already purchased materials for the extensions in this village.

WINTER HARBOR, ME.—A press report states that enough subscribers have been obtained to warrant the construction of works this fall.

MANCHESTER, N. H.—The council has voted to issue $100,000 in 20-year 4% refunding water bonds.

CASTLETON, VT.—A bill has been introduced in the state legislature empowering Fire District No. 1, in Castleton, to construct dams, reservoirs, lay pipes, etc., to bring water into said district, and to issue bonds for the expense thereof.

ISLAND POND, VT.—Z. M. Mansur, E. M. Bartlett, and others, have petitioned the legislature for a charter for the Brighton Aqueduct Co.; capital stock, $40,000.

NORWICH, VT.—A bill to incorporate the Norwich Aqueduct Co. is reported to have passed both branches of the legislature.

ROCHESTER, VT.—Representative Martin, of Rochester, has introduced a bill in the legislature authorizing this place to issue bonds for a water supply.

HOLYOKE, MASS.—It is stated that the plans and specifications for the new pipe line and system will not be completed before spring.

MELROSE, MASS.—The town has voted to issue $12,000 in additional water bonds.

REVERE, MASS.—A local paper states that the questions of water and street lighting continue to agitate the citizens.

SHEFFIELD, MASS.—It is expected that works to cost $20,000 will be constructed in the spring by the Sheffield Water Co. Pres., H. S. Andrews; Secy., T. C. Wickwire.

SOUTH BRAINTREE, MASS.—The New York Hydraulic Co. has sunk three wells to increase the water supply, but it is reported probable that the experiment will not prove a success.

WALTHAM, MASS.—The board of aldermen has voted to issue $24,000 in water bonds, of which $19,000 will be used to purchase the 6,000,000-gallon Worthington pumping engine used at the Atlanta Exposition.

BOONVILLE, N. Y.—The question of water-works has not yet been submitted to a vote of the people, but probably will be soon.

CALEDONIA, N. Y.—The citizens have voted to issue $20,000 in bonds for municipal work; supply from wells; plant will include stand-pipe, gas engine for daily use and steam pump for emergencies; contracts to be let this winter and construction commenced in the spring; no engineer had been engaged Nov. 14; population, 1,000. James C. Foote is a member of the committee.

LANSINGBURG, N. Y.—A test well has been driven to a depth of 245 ft. and only a small amount of water has yet been secured. There is talk of abandoning the idea of increasing the supply from artesian wells.

TARRYTOWN, N. Y.—A New York city paper states that the water commissioners are receiving bids for a large reservoir at East View, to cost nearly $100,000.

ROCHESTER, N. Y.—No new work of consequence is contemplated at present. During the winter the mains now laid under the Erie Canal at several streets will have to be lowered in anticipation of the proposed deepening of the canal. Work for next season is not yet decided upon. E. Kuichling, Ch. Engr.; Thomas J. Neville, Clk. Executive Bd.

SHERBURNE, N. Y.—This city intends to take up 4-in. mains and replace with larger pipe. W. E. Davis, Supt.

EGG HARBOR CITY, N. J.—The Egg Harbor City Water Co. has been granted a charter; capital stock, $50,000; incorporators, R. F. Smith, T. J. Kraft, Geo. Pfeiffer, Jr., of Camden, N. J., and others. Mr. Pfeiffer has the franchise for works at this place, as noted some time ago.

ASBURY PARK, N. J.—It is reported that an election will be held this week to vote on the question of issuing $48,000 in additional water bonds. for new machinery, a well 1,000 ft. deep, purchase of additional land, etc. R. I. Sloan, Water Comr.

CAMDEN, N. J.—George Leathwhite has been awarded the contract for erecting a pumping plant at the county buildings, at $3,400.

FRANKLIN, N. J.—The township committee is reported as considering the adoption of the meter system.

NEW CASTLE, PA.—A local paper states that a 10-year franchise has been granted to a new company organized by County Commissioner Stewart Thompson, Henry Wettich, John Hays and Isaac D. Hughes. A plant will be constructed to supply West New Castle with water from the Mahoning River.

ROCKAWAY, N. J.—This borough will probably construct works to cost $25,000 in the spring. J. C. McGrath, Clk.

WOODBRIDGE, N. J.—J. B. Newhall, of Stapleton, S. I., and others have talked of constructing works to supply this place and Carteret; supply from the South Branch of the Rahway River. It is hoped to take up the matter in the spring and construct the works.

AVOCA, PA.—Works to cost $3,500 will probably be built in the spring. A. Reese, Engr., Parsons, Pa.

COATESVILLE, PA.—The borough council is reported to have decided to submit the question of borrowing $20,000 for increasing the water supply to a vote of the people next month.

DALTON, PA.—The North Abington Water Co. will probably commence the construction of gravity works to cost $8,000 in May 1897; the franchise is for sale. F. M. Francis, Secy.

MAHAFFEY, PA.—Miles Wrigley writes us that the proposed $15,000 water-works has been postponed on account of the hard times; question will be taken up later on.

PATTON, PA.—The Patton Water Co. is reported to have been awarded a contract for fire protection at $20 a year for each hydrant. Twelve hydrants will be put in.

DELAWARE CITY, DEL.—George B. Money, Mayor, writes us that arrangements for works have not yet been completed. The plant will be built by a company. Water supply will be pumped from wells to a stand-pipe; population, 1,200. C. Taylor Leland, Engr. and Mgr., Quakertown, Pa.; David Stillman, Cy. Clk.

BROOKLYN, MD.—A company will probably be organized to construct works this winter. John H. Glis can give information.

ROCKVILLE, MD.—Bids are asked until Dec. 9 for the purchase of $20.000 in 20-year 4% water bonds. John L. Brunett, Cy. Clk.; Geo. Cadogan Morgan, Engr., Chicago.

PORT DEPOSIT, MD.—A press report states that M. M. Dreibelbis, Engr., has completed surveys for the proposed water-works and will have charge of the construction.

ABBEVILLE, S. C.—The $25,000 in bonds, noted last week, will be issued Jan. 1. Contracts will be awarded as soon as bonds are sold. Pownall & Minshall, Engrs., St. Louis; B. S. Barnwell, R. W. Cannon and J. F. Lyon are the commissioners. The water supply will be from wells; population, 3,000.

COLUMBIA, S. C.—W. A. Neal, Supt., writes us that an independent water supply for the state penitentiary will not be attempted until next year; nothing definite yet decided upon.

JACKSONVILLE, FLA.—Bids are asked until Dec. 1 for hauling and laying 60,000 ft. of 12 to 4-in. cast-iron water pipe, setting valves and hydrants, etc. R. N. Ellis, Engr.; B. F. Dillon, Chn. Bd.

SPRINGFIELD, FLA.—A press report states that work on the new artesian well has been progressing nearly a year and the well is not yet completed.

DOTHEN, ALA.—Bids are asked until Dec. 15, according to reports, for constructing works to cost $10,000.

COVINGTON, KY.—A 30-in. water main burst Nov. 7.

CLEVELAND, O.—Bids are asked until Dec. 11 for furnishing all material and constructing and placing in position in Lake Erie a wooden protection crib. D. E. Wright, Dir. Pub. Wks.

ELKHART, IND.—The water company is said to be about to spend $30,000 for improvements and extensions estimated to increase the supply 5,000,000 gallons daily.

ALPENA, MICH.—The intake pipe of the Alpena City Water Co. is to be extended 1,000 ft. into Thunder Bay, according to reports; there is some talk of municipal works. J. S. Canfield, Recdr.

BURLINGTON, MICH.—An artesian well has been sunk at Crapo Park to a depth of 1,050 ft., but the desired flow of water has not been secured.

MUSKEGON, MICH.—The city proposes to repair the crib next year. John McCullom, Supt.

THREE OAKS, MICH.—E. K. Warren, Recdr., writes us that material has been all purchased and construction of works is in progress; water supply from wells.

CHICAGO, ILL.—The mayor has reported that there is imperative need of additional pumping machinery at the Lake View works; the present supply from this station is inadequate for the territory dependent upon it; bids for additional pumping machinery for the station will probably soon be asked.——A local paper states that the secretary of war has granted the city authority to maintain a temporary crib for three years in the lake three miles out from the foot of Oak St., to be used in building the new northwest tunnel.

HENNEPIN, ILL.—The Challenge Wind Mill & Feed Mill Co., of Batavia, has been awarded the contract for works at this place.

MILFORD, ILL.—Contracts were awarded Nov. 10 as follows. for work advertised in Engineering News: H. D. Hallett, Aurora, Ill., pipe and specials, $6,194, and laying mains $3,465, less 8% for cash; Rensselaer Mfg. Co., Troy, N. Y., hydrants, $665, and valves and boxes, $335, cash price. Jacob A. Harman, Engr., Peoria, Ill.

KAUKAUNA, WIS.—The supreme court has decided void the franchise granted about two years ago to Wells, Reichert & Co. for water-works, on the ground that indebtedness to exceed 5% of its valuation was being incurred by the city. It is stated that the city is in need of water-works.

ROSEBUD, S. DAK.—B. P. Egan, of Nebraska City, Neb., has been awarded the contract for constructing water-works and sewers at the Rosebud Indian Agency; plant will include a 12 × 60-ft. steel stand-pipe, boiler, pump, feed pump and a filter.

MINNEAPOLIS, MINN.—The proposed issue of $400,000 in bonds to complete the new reservoir was carried at the recent election.

KANSAS CITY, MO.—Bids are asked until Dec. 15 for constructing and delivering a 12,000,000-gallon pumping engine, as described in our advertising columns. R. M. Godfrey, Secy. Bd. Pub. Wks.

UNIONVILLE, MO.—This city proposes to construct works to cost $15,000; water supply will be pumped from deep well to stand-pipe. Stephen Hall, Engr., Kirksville, Mo.; Lorenzo Jones, Mayor.

WHARTON, TEX.—H. Kleim, Mgr., writes us that it is proposed to lay 7,000 or 8,000 ft. of additional mains and erect hydrants as soon as the legislature meets and a new city charter is secured; about 2½ miles of mains are now in use.

BUTTE, MONT.—A press report states that the water supply is unfit for domestic use and that the council has voted to prohibit the water company from collecting water rents for the supply now being furnished.

PUEBLO, COLO.—The contract for building the new pumping station was awarded Nov. 6 to C. S. McCarthy, at $19,250: contract for pump to the Frank P. Lannon Foundry Co. at $26,000. It is reported that bids will soon be asked for reservoir work. E. W. Hathaway, Cy. Engr.

SANTA BARBARA, CAL.—The council has adopted an ordinance providing for the issuance of $50,000 in water bonds, as voted in September.

PERTH, ONT.—Bids are asked until Dec. 1, according to reports, for a water-works franchise. John A. Kerr, Town Clk.

RENFREW, ONT.—It is reported that the question of constructing water-works will be voted upon in January.

WINDSOR, ONT.—A local paper states that Macdougall Sons & Co., of Montreal, have been awarded a contract for a polarite filtering system to cost $20,000.

SEWERAGE.

LOWELL, MASS.—The sewer committee has been petitioned to construct sewers in a number of streets. Geo. Bowers, Cy. Engr.

WORCESTER, MASS. — The committee has voted to construct sewers in five streets.

HARTFORD, CONN.—Bids are asked until Nov. 23 for the purchase of $250,000 of 3½% 25-year gold sewer bonds. These bonds are to pay for the construction of an intercepting sewer in the valley of the Park River and its branches. C. C. Strong, Cy. Treas.

BROOKLYN, N. Y.—Bids are asked until Dec. 1 for constructing sewers in Lott St., Ward No. 29. T. B. Willis, Comr. Cy. Wks.

JAMESTOWN, N. Y.—An election will probably soon be held to vote on the question of extending the sewers at a cost of about $50,000. This question was submitted to the voters last summer but was defeated. There is some talk of constructing sewage disposal works at the city limits. Aldermen Sessions and Cooper can be addressed. J. E. Conway, Chn. Bd. Pub. Wks.

NIAGARA FALLS, N. Y.—Bids for eight sewer contracts, amounting to 14,696 ft. of pipe were opened Nov. 16. Ritzman & Miller, of Buffalo, bid lowest on contracts amounting to $11,000; Ryan & Spillman, of Tonawanda, $5,000, and John Harrer, of Buffalo, $3,324.

ROCHESTER, N. Y.—It is proposed to construct a sewer in Park Ave. to cost $10,500. Edwin A. Fisher, Cy. Engr.

ROCHESTER, N. Y.—Bids are asked until Nov. 20 for constructing sewers in two streets. Thos. J. Neville, Clk.

HOBOKEN, N. J.—Work will probably soon be begun on the proposed Ravine Road sewer. Thos. McCann, Engr., Hoboken.

NEWARK, N. J.—Bids are asked until Nov. 19 for constructing about 3,200 ft. of 15 to 6-in. pipe sewers. J. C. Mundy, Gen. Supt. of Wks.

LANSDOWNE, PA.—Bids were opened Nov. 18 for the purchase of $13,000 of 4% sewer bonds. H. L. Warren, Secy.

SHARPSBURG, PA.—Bids are asked until Nov. 28 for the purchase of $62,000 of 4% sewer bonds. Geo. L. Walter, Chn. Finance Com.

JACKSONVILLE, FLA.—Bids are asked until Dec. 1 for hauling and laying about 117,000 ft. of 24 to 6-in. terra cotta sewer pipe and about 5,000 ft. of 16 to 8-in. cast-iron sewer pipe; check, $2,500. R. N. Ellis, C. E., Supt.; B. F. Dillon, Chn.

AKRON, O.—Sewer Commissioner Stife is quoted as stating that there is likely to be more than $10,000 worth of sewer pipe used within the next year, as there are two trunk sewers to be constructed—the one in South Akron, for which legislation has already been provided, and the East Akron sewer, which is to extend from the East Market St. bridge near Case Ave., northerly to the Old Forge. The legislation for that sewer is to begin soon. Last year the city used a trifle more than $5,000 worth of pipe. Within the next two years it is likely that the cost will exceed $20,000. The bids received for sewer pipe are given under Contract Prices. S. W. Parshall, Cy. Engr.

WHEATON, ILL.—Plans are being prepared for additions to the sewerage system to cost about $6,000. Contracts will be let early in the spring. J. S. Pierrornett, Mayor.

MADISON, WIS.—We are informed that the following bids were received Nov. 13 for laying 1,200 ft. of cast-iron sewer pipe. O. S. Norsman, Cy. Clk.; Nicholas Quinn, Madison, Wis., $4,267, and Fetter & Crosby, La Crosse, Wis., $4,437. The contract was not awarded Nov. 13.

SAN DIEGO, CAL.—We are informed that this city voted Oct. 30 to issue $40,000 in bonds for extending the main outlet sewer to the Bay. The extension will be a 5-ft. brick circular sewer 1½ miles long. The bonds will be sold as soon as possible and the work pushed to completion. Curtis M. Barker, Cy. Engr.

ROSSLAND, B. C.—It is proposed to construct a terra cotta pipe sewer through the main business portion of Rossland to a point about 800 ft. south of the town. Sanitary Inspector Phillipps Wooley can be addressed.

GARBAGE DISPOSAL—STREET CLEANING.

ALBANY, N. Y.—The board of health has inserted an item in the annual budget of $15,000 for a garbage crematory. The question of garbage disposal has been debated for several years by the board. Dr. Curtis is chairman of the committee on garbage.

BROOKLYN, N. Y.—The contract for the removal and disposal of garbage during the five years beginning Jan. 1, 1897, was awarded on Nov. 17 to the Brooklyn Sanitary Co., of which F. D. Cranford is president and W. J. Cranford, secretary and treasurer. The garbage will be disposed of by the Arnold system of garbage reduction; plant to be erected on Barren Island, where an Arnold plant is now being erected for the garbage of New York city. The bids received by the city of Brooklyn for this work were published in our issue of Oct. 8. T. B. Willis, Comr. Cy. Wks.

LOCKPORT, N. Y.—The lowest bid received Nov. 9 for sprinkling and cleaning improved streets during 1897 was that of C. N. Stainthorpe, at $3,489. All bids were rejected and the work will be done by the superintendent of streets, as was done some years ago, unless the mayor vetoes the action of the council.

PHILADELPHIA, PA.—Bids are asked until Nov. 25 for cleaning streets and the removal and disposal of garbage, etc., during 1897. Thos. M. Thompson, Dir. Pub. Wks.

STREETS AND ROADS.

PLYMOUTH, MASS.—Bids are asked until Nov. 19 for grading a road in this town. There will be about 16,000 cu. yds. of excavation. T. C. Mendenhall, Pres. Massachusetts Highway Comn., Worcester, Mass.; Chas. Mills, Ch. Engr., 4 Mount Vernon St., Boston.

BROOKLYN, N. Y.—T. B. Willis, Comr. Cy. Wks., is reported as about to begin work on macadamizing and otherwise improving a number of streets in Gravesend. A contract for work in this section amounting to about $15,000 has been awarded to Theo. S. Jenkins, of the 31st Ward. Geo. W. Tillson, Asst. Engr. Street Construction, recently submitted a report on the proposed improvements.

JOHNSTOWN, N. Y.—Bids are asked until Dec. 7 for asphalt paving, as stated in our advertising columns. John T. Morrison, Cy. Clk.; J. W. Miller, Cy. Engr.

NIAGARA FALLS, N. Y.—The council has declared its intention to pave two streets with asphalt, at an estimated cost of $125,000. Plans are being prepared and bids will be asked for some time this winter. The work is to be done next spring. W. W. Read, Cy. Engr.

PALMYRA, N. Y.—The bicyclists of this place, Avon, Geneseo and Mount Morris are reported as discussing the question of constructing side-paths in this part of the state. It is said that the wheelmen of Newark, Lyons, Clyde and other places are having plans prepared.

WHITESTONE, N. Y.—This place is said to be considering the question of submitting to the voters the proposition to issue $16,000 in bonds for street improvements. This will be in addition to the $50,000 of street bonds voted for recently. G. A. Roullier, Engr.

CAMDEN, N. J.—The Camden and Stockton cycle clubs have organized the good roads committee of Camden. The committee is advocating the bonding of the city for street improvements, and also has recommended the paving and repairing of six streets with asphalt.

TRENTON, N. J.—It is stated that this county will soon be ready to sell $100,000 of 4% 10-year road bonds.

EASTON, PA.—Press reports state that Edward H. Laubach, J. S. Rodebaugh, Baxter B. McClure and W. M. Applegate, the committee to which was referred by the county commissioners the selection of suitable locations on which sample roads, looking towards permanent road making, should be given a trial, reported Nov. 13. They recommended that half-mile roads be built in Hanover, Lower Nazareth, East Allen, Forks, Palmer and Bethlehem townships. They also filed a supplemental report in which they suggested that no more than $1,500 a mile be expended on the improvement.——Councilman Magee has introduced an ordinance authorizing the committee to submit to the people at the election in February the question of issuing $155,000 in bonds for paving. Of this amount it is proposed to use about $93,000 for brick paving and the remainder for macadamizing and grading. H. R. Fehr, Cy. Engr.

JOHNSTOWN, PA.—Subscriptions are being secured to begin the construction of the proposed road for the Johnstown & Cramer Turnpike Co. John Fulton, Pres.; Dr. W. E. Matthews, Vice-Pres.

PITTSBURG, PA.—The county commissioners are about to make surveys for the proposed roads. Beginning with 1897 the county will spend $225,000 annually on road improvements. Chas. Davis, County Engr.

WASHINGTON, D. C.—Bids are asked by the district commissioners until Nov. 25 for grading certain streets.

BALTIMORE, MD.—The property owners on 23d St. are reported as about to petition the city commissioner to pave that street from Oak St. to York Road with asphalt. Janon Fisher, Cy. Comr.

SAVANNAH, GA.—The council has voted to advertise for new bids for sheet asphalt paving in South Broad St., and for maintaining the streets paved with asphalt.

ST. AUGUSTINE, FLA.—Bids are asked until Nov. 25 for brick paving in St. George St.; estimated cost, $8,000. Chas. Sperry, Acting Cy. Engr.

SHREVEPORT, LA.—Local papers state that Martin & Smith, of Memphis, Tenn., have been awarded the contract for brick paving in Jordan St. Kidder & McDonald, of St. Louis, Mo., were the lowest bidders for the work, but their bid was rejected. Maj. Paul Lowenthal, Chn. Com. Councilmen Wimbish and Quigles and Walter B. Jacobs, J. W. Soady and E. R. Herndon are members.

CINCINNATI, O.—The county commissioners have asked for bids for the purchase of $25,000 of road bonds. Frank Krug, Engr.

CINCINNATI, O.—Gus. Schmidt submitted the lowest bid received by the county commissioners Nov. 14 for repairing a portion of the Madisonville Pike at $8,228, and A. J. Henkel that for furnishing crushed stone at $12,066.

BEDFORD, IND.—G. C. Houston, County Engr., and V. V. Williams and A. B. Tresslar, Viewers, have submitted a report on macadamizing six sections, or 59,840 lin. ft. of road in Shawswick county, at an estimated cost of about $24,000. John B. Malott, County Audr.

MONTICELLO, IND.—Jarvis Duryea and Perry Godlove, Viewers, submitted a report Nov. 10 for the following county road work in Princeton township: About 5,000 ft. of 24 to 4-in. sewer pipe, to cost $285; 30.8 cu. yds. of rubble stone masonry, $243; three iron bridges of 14 ft. roadway—span 10 ft., $270; one iron bridge of 24 ft. roadway—span 10 ft., $140; 12,152 cu. yds. of crushed stone, first course, $15,191: 3,472 cu. yds. limestone screenings, $3,646; 4,792 cu. yds. of excavation, $336; 4,792 cu. yds. embankment, $336; 2,211 cu. yds. of excavation, $331; rolling ballast at $35 per mile, $311; total cost of road, $21,075. The election to vote on the question is to be held Dec. 15. M. J. Holtzman, County Audr.; W. P. Bushnell, County Surv.

MACKINAC ISLAND, MICH.—It is reported that the contract for constructing the first mile of the proposed boulevard has been awarded. The road will be about six miles long. John J. Roberts, of Grand Rapids, Mich., made the surveys.

CHICAGO, ILL.—A petition was filed Nov. 9 in the county court by the town of North Chicago for the improvement of the west half of the Lake Shore drive from North Ave. to Oak St., at an estimated cost of $14,000. The petition is the result of an arrangement with the Lincoln Park commissioners, who have agreed to pay for the improvement of the east half, the total cost of the work to be $22,658. The improvements are to consist of concrete walks and drives. J. M. Willard, Ch. Engr.

GRAND FORKS, N. DAK.—It is reported that the city auditor has asked for bids for paving portions of 11 streets. The work is to be begun in the spring.

KANSAS CITY, MO.—It is stated that the board of public works is considering the question of stone block paving in West 6th St., at a cost of $7,000. H. A. Wise, Cy. Engr.

ST. CHARLES, MO.—The city engineer has submitted plans and specifications for improving Third and Fourth Sts.

DENVER, COLO.—Local papers state that the board of public works has decided to at once grade and curb Capitol Hill district No. 1, at a cost of $159,702. T. J. Milner, Ch. Engr. Bd. Pub. Wks.

MANUFACTURING PLANTS.

LYNN, MASS.—The Lynn Incandescent Lamp Co. is increasing its plant. The extensions contemplate a plant with a capacity of 10,000 lamps per day.

BRIDGEPORT, CONN.—The firm of Hartley & Graham, who control the Remington Arms Co., the Union Metallic Cartridge Co., and the Bridgeport Gun Implement Co., is contemplating the removal of the plant of the Remington Arms Co., at Ilion, N. Y., to Bridgeport, Conn. The Remington Arms Co. manufactures bicycles, sewing machines and arms, employing 1,500 persons.

BRISTOL, CONN.—The E. Ingraham Co., it is stated, has decided to begin the manufacture of marine clocks. It will erect a new factory, 80 × 40 ft., two stories high. The contract has been let to William Linstead.

BINGHAMTON, N. Y.—Smith, Kearney & Co. are reported as preparing to build a new 5-story brick factory building.

CORNWALL LANDING, N. Y.—On Nov. 15 the paint shop of Mead & Taft, New York contractors and builders, at Cornwall Landing, was damaged by fire to the extent of $12,000.

LYONS, N. Y.—It is stated that a flouring mill and a glove factory are to be erected here.

NIAGARA FALLS, N. Y.—J. A. Francis & Co., paint manufacturers of Toronto, Ont., it is reported, have purchased a site on Bath Ave. and will build a factory.

NYACK, N. Y.—Fire destroyed the New Tompkins Cement Works, in the upper part of Rockland county, on Nov. 11. Loss, $12,000; insurance, $5,000.

PLAINFIELD, N. J.—The "Daily Press" says that the Standard Oil Co. will soon commence the work of doubling the refining capacity of its plant at Constable Point, N. J., and will spend $1,700,000 in the work.

EGYPT, PA.—The American Cement Co. is reported to have broken ground for its fourth mill, which will involve an expenditure of $200,000, and which will have a capacity of from 800 to 1,000 barrels of cement a day. Employment will be given to 150 hands.

HARRISBURG, PA.—The Boll Bros.' Mfg. Co. will erect a 5-story brick building, 50 × 100 ft., for the manufacture of brass and iron bedsteads, etc., according to reports.

OIL CITY, PA.—A meeting of the stockholders and directors of the Oil City Desk & Furniture factory was held recently at which it was decided to rebuild the factory, recently destroyed by fire. The plant will be erected near Oil City, and will consist of a main building, 60 × 100 ft.; storage house, 60 × 60 ft.; and boiler house, 20 × 30 ft. A 25-HP. gas engine will be installed, also a steam heating system.

STEELTON, PA.—The Steelton Brick Co. will increase its plant in the near future and purchase new machinery.

PARKERSBURG, W. VA.—J. N. Camden, of this city, representing a syndicate of capitalists, is said to have closed arrangements for the erection of pulp mills and other woodworking plants near Gauley; about $1,000,000 will be expended on the enterprise.

SPILMAN, W. VA.—On Nov. 13 ground was broken on the Ohio River R. R. by the Camden Clay Co. for a new brick and tile works. Senator J. N. Camden is at the head of the concern. The plant when finished will cost $30,000.

BALTIMORE, MD.—It is reported that the Baltimore & Ohio R. R. Co.'s improvements at the Mount Clare shops will include a locomotive repair shop, equipped with two 50-ton electric cranes and other new machinery.

ORANGEBURG, S. C.—It is reported that the directors of the Enterprise Cotton Mill have closed contracts for materials for the building of a new mill. Capt. D. W. Ayers will superintend the building. The ground will be broken soon, and the work will be rapidly pushed.

CONCORD, N. C.—W. C. Coleman, the chief promoter of the scheme to build a cotton mill at this place to be run by negro operators, states that $41,000 of the proposed $50,000 have been subscribed towards the capital stock, and that the building will be erected and equipped at an early date.

AUGUSTA GA.—The "Herald" states that the Union Point knitting mill will be rebuilt at once. The capital which was formerly $16,000 will be increased to $20,000.

BESSEMER, ALA.—It is reported that the Marvel City Machine & Foundry Co. will rebuild its burned works and put in equipment of new machinery.

CHATTANOOGA, TENN.—Fire damaged the Eagle Brass Works at 400 Boyce St., to the amount of $4,500 on Nov. 8. No insurance.

RALEIGH, TENN.—R. J. Griffin and associates will build and equip a cotton-batting mill at this place.

FINDLAY, O.—The Kellogg Weldless Tube Works are to be enlarged by the addition of $50,000 worth of new machinery, according to reports. The company expects to manufacture seamless tubes to be used in the construction of compressed air street cars, which are now being built at Worcester, Mass.

YOUNGSTOWN, O.—I. F. Taylor, Treas., writes us that the Brown-Bonnell Iron Co. has not definitely decided to build the reported new steel plant.

HOLLAND, MICH.—Citizens have raised $6,000 to aid in rebuilding the factory of Geo. P. Hummer, which was burned a few weeks ago, entailing a loss of $150,000.

NEW ALBANY, IND.—The Architectural Iron Works will soon begin the erection of a new factory, it is reported,

DES MOINES, IA.—A press report says that the Des Moines Union Ry. will build extensive shops, and the Great Western Ry. will build a large freight depot, to cost $50,000.

BLACK RIVER FALLS, WIS.—A dispatch states that James L. Gates, of Milwaukee, makes the proposition to build a $150,000 sugar factory, which will consume the product of 4,000 acres of beets, in consideration of a bonus of 2,500 acres of land.

SAN FRANCISCO, CAL.—The California Stone Brick Co. proposes, it is said, to expend $50,000 in the purchase of a site and the erection of buildings for the manufacture of brick from sand.

VANCOUVER, B. C.—The "News-Advertiser" says that H. Peck, who has been manager of the Reed & Currie Iron Works, has acquired the plant and will at once erect a new building, which will be heated with steam and lighted with electricity.

BERLIN, ONT.—D. Hibner & Co.'s furniture factory was burned Nov. 12; reported loss, over $75,000. About 150 hands are thrown out of employment.

ORIZABA, MEX.—A press report from the city of Mexico, says that a new cotton factory is about to be erected at a cost of more than $3,000,000, furnished by European capitalists.

GAS PLANTS

CHICOPEE, MASS.—The Chicopee Gas Co. will, early next spring, lay a new gas main from its plant to the corner of Springfield and Exchange Sts.

WALTHAM, MASS.—The council is negotiating with the gas company for the purchase of the gas plant.

WOBURN, MASS.—A press report states that the principal owners in Woburn of the stock of the Woburn Gaslight Co. have sold their stock to the gas combination of which R. J. Monks is treasurer.

FLATBUSH, N. Y.—The Flatbush Gas Co. has filed a certificate with the secretary of state by virtue of which it is said to be the intention of the company to extend its business to the city of Brooklyn and throughout Queens county.

JAMAICA, N. Y.—It is expected that the application of the Jamaica Gaslight Co. for a 50-year franchise, noted in our issue of Nov. 5, will be acted upon at the regular business meeting in December.——The town board is reported as to open bids Nov. 27 for lighting the new district of Woodhaven.

RICHMOND HILL, N. Y.—The franchise of the Richmond Hill & Queens County Gas Co., noted Nov. 5, will probably be revoked this week. The Brooklyn Gas & Construction Co. has petitioned for a franchise. Press reports state that the new company proposes to begin work within one week after signing the contract, and promises to finish its plant and furnish gas within 90 working days. The prices are to be not more than $1.25 per 1,000 cu. ft. for domestic use, and $1 for public use; street lamps to be not more than $18.50 a year; or, if Welsbach burners are used, not more than $21. The franchise to extend for 50 years, and contracts for street lighting to be made for five year periods. The village treasury is to receive 1½% of the gross receipts of the company. A sliding scale of prices is provided for, by which the price of gas will be lowered as the consumption increases.

KITTANNING, PA.—The Armstrong Natural Gas Co. was incorporated Nov. 16 with a capital stock of $10,000; Treas., John D. Reynolds, Kittanning.

NORFOLK, VA.—An ordinance has been introduced in the council granting the E. J. Acker Construction Co. an extension of time from Dec. 6, 1896, to Sept. 6, 1897, in which to construct gas works and an electric light plant.

GRAFTON, W. VA.—The Grafton Oil Co. was incorporated Nov. 7 with a capital stock of $50,000, commencing with $700, to bore for oil, gas, etc., and to construct and operate lines for transporting same; incorporators, John T. Graw, Albert J. Yoke, C. R. Durbin, and others.

CLEVELAND, O.—Bids are asked until Dec. 9 for furnishing and keeping in repair for one year 4,650 vapor, gasoline or oil lamps and all street gas lamps of the city. D. E. Wright, Dir. Pub. Wks.

NORWALK, O.—A local paper states that it is reliably reported that negotiations are about completed between a local company of capitalists and the Northwestern Ohio Natural Gas Co. for the purchase of the gas pipes in the ground in this city, lately used as a natural gas plant. The purpose is to erect a plant and make fuel gas by a new process which has been tested enough so that it is a success. The gas is to be made from crude oil and is to be furnished for both light and heat at a price low enough to insure its use by many consumers.

TIFFIN, O.—Other bids have been received by the council for the city gas plant, in addition to those previously noted; Hatcher & Yeager, of Tiffin, bid $85,000, but they offer no proposition as to furnishing gas for the consumers through the winter or after that time; Terrence McManus, of Tiffin, offers $87,500 and the bidder agrees to furnish gas in sufficient quantities in as short a time as it is possible to drill for more gas; in the event of his being unsuccessful, he will erect an artificial plant.

TOLEDO, O.—T. P. Brown, of Toledo, has submitted a proposition to the natural gas trustees of the city to lease the plant of the city for not less than 25 years. Mr. Brown offers to manufacture and furnish artificial gas enough to make a daily supply of at least 5,000,000 cu. ft. and will sell the same by meter measurement at 25 cts. per 1,000 cu. ft.; city to receive 10% of all gross earnings, which would bring the city $46,625 a year on a daily consumption of 5,000,000 cu. ft. or $91,250 if 10,000,000 cu. ft. could be disposed of daily. The natural gas plant of the city has cost the city over $1,000,000.

FRANKFORT, IND.—Bids are asked until Dec. 18 for lighting the streets of the city for three or five years by Welsbach gas lamps, or by electric lights, as described in our advertising columns. Alonzo J. Hammond, Cy. Engr.

PORTLAND, IND.—A press report from this city states that within the last week contracts for drilling new wells aggregating $25,000, have been let in the Indiana oil field. The Standard Oil Co., the Rowland Zeigler Co., W. S. Morton and others are at work. The Salamonie Natural Gas Co., which furnishes the city of Fort Wayne, is drilling 15 wells in the vicinity of Mill Grove.

CHICAGO, ILL.—The Chicago Acetylene Gas & Carbide Co. has been incorporated; capital stock, $2,500; incorporators, Howard M. Carter, Robert C. Chapman and William Garnett, Jr.

HOUSTON, TEX.—The Fuel Gas Co. has petitioned for a franchise. The "Post" states that action upon the application has been deferred until the mayor can advise himself upon the subject as to what concessions are accorded like companies in other cities and the benefits accruing from the use of the output of similar plants.

SALT LAKE CITY, UTAH.—The natural gas supply of the New American Gas & Fuel Co., which furnishes the Salt Lake & Ogden Gas & Electric Light Co. with its supply for this city, is said to be on the decrease. The mains of the electric light company are also said to leak badly.

SAN LEANDRO, CAL.—The recently organized San Leandro Gas & Electric Lighting Co. is said to have a new patent on manufacturing gas. A plant will probably be constructed.

MISCELLANEOUS CONTRACTS.

BONDS.—Newark, Del.—Bids are asked until Nov. 25 for the purchase of $37,000 of 4% refunding bonds. Geo. Williams, Secy. and Treas.

CEMENT.—New York, N. Y.—Bids are asked until Nov. 24 for furnishing about 4,000 bbls. of Portland cement. Geo, S. Terry, Secy. Dept. of Docks, Pier A.

STREET SIGNS.—Woonsocket, R. I.—F. H. Mills, Cy. Engr., has submitted estimates, etc., for 500 street signs to cost $1.15 to $1.75 each, according to design.

IRON WORK.—Charleston, W. Va.—Bids are asked until Dec. 1 for the iron work for lock gates on the Great Kanawha River. Col. Peter C. Hains, U. S. Engr.

DREDGING.—New London, Conn.—Bids are asked until Dec. 17 for dredging in six harbors, as stated in our advertising columns. Capt. Smith S. Leach, U. S. Engrs.

GUN BATTERY.—San Diego, Cal.—Bids are asked until Nov. 30 for constructing a gun battery near San Diego. Maj. Chas. E. L. B. Davis, U. S. Engr., Flood Bldg., San Francisco.

DIKE WORK.—Evansville, Ind.—Bids are asked until Dec. 11 for constructing dikes and bank protection in the Ohio River at and near this city. Maj. W. H. Heuer, Custom House, Cincinnati, O.

SURVEY.—Pleasantville, N. Y.—It is reported that at a recent meeting of the Pleasantville Library Association a committee was appointed to have a preliminary survey made with a view to incorporation.

MORTAR BATTERY.—Galveston, Tex.—Bids are asked until Nov. 30 for building a mortar battery at Fort Point Galveston, as stated in our advertising columns. Maj. A. M. Miller, U. S. Engr., Telephone Bldg., Galveston.

FIRE ENGINE AND HOSE.—Jersey City, N. J.—Bids are asked until Nov. 24 for furnishing one third-size steam fire engine, complete, and 4,000 ft. of 2½-in. rubber lined fire hose. Chas. Esterbrook, Clk. Fire Comrs., 244 Bay St.

BONDS.—Baltimore, Md.—Bids are asked until Nov. 30 for the purchase of 10 first mortgage gold bonds of the Best Telephone Mfg. Co., of $1,000 each. James Russell, Treas., Best Telephone Co., 159 to 179 Stockholm St.

HIRE OF DREDGING PLANT.—Mobile, Ala.—Bids are asked until Dec. 19 for hire of dredging plant to be operated on dredged channel of Mobile River and Mobile Bay, as stated in our advertising columns. Maj. Wm. T. Rossell, U. S. Engrs.

LEVEE WORK.—Memphis, Tenn.—Bids are asked until Nov. 23 for constructing levees in the 3d district of the Mississippi River improvement, containing 2,736,000 cu. yds. of work. Lt. H. C. Newcomer, U. S. Engr., 202 Union St., Memphis.

BONDS.—Boston, Mass.—Bids are asked until Nov. 23 for the purchase of $8,225,000 of state park, water, highway, state house, grade crossing and other 3½% gold bonds. E. P. Shaw, Treas. and Receiver Gen., Treasury Dept., State House, Boston.

COAL BREAKER.—Tuscarora, Pa.—It is reported that a 10-ft. vein of coal has been discovered at Tuscarora, near Pottsville, by prospectors in the employ of the Bell Colliery and that it will be necessary to erect a new breaker to prepare the coal.

UNDERGROUND CABLES.—Cincinnati, O.—Bids are asked until Nov. 20 for the manufacture, delivery and installation of underground cables for the electric and telephone circuits of the fire department. J. A. Cabot, Cy. Electrician; D. W. Shedd, Secy.

OIL WELLS.—Monmouth, Ill.—A press report announces that oil wells will be sunk on the farm of Zan Rankin, near Media, a $100,000 stock company having been organized for that purpose. A good flow has already been obtained from a well 500 ft. deep.

STAIRWAYS AND COVERINGS.—Boston, Mass.—Bids are asked until Nov. 23 for the erection and completion of eight stairways and coverings on Boston Common for the subway. Wheelwright & Haven, architects, 1129 Tremont Bldg.; B. L. Beal, Secy. Comn., 20 Beacon St.

CANAL IMPROVEMENT.—Fulton, N. Y.—It is reported that plans for canal improvement from Fulton guard lock, Oswego Canal, 2½ miles north, have been completed by the state engineer. The work will be advertised and let by the superintendent the coming winter; estimated cost, $70,000. Geo. W. Aldridge, Supt. Pub. Wks., Albany.

MAPS.—Brooklyn, N. Y.—Bids are asked until Dec. 1 for furnishing the Department of Assessment with maps for the 32d Ward, late the town of Flatlands, to be made in accordance with the block and lot number system as used in said department, and from official surveys, recorded deeds and maps on file to date. T. B. Willis, Comr. Cy. Wks.

DAMS.—San Francisco, Cal.—At the weekly meeting of the state debris commission, Nov. 2, permits for constructing dams were granted the Deer Creek mine, Wild Cat Mine, Nevada county; Quincy mine, Plumas county; and Jack's Ranch mine, Plumas county. The Dutch mine in Kern county was given permission to raise its present dam 20 ft.

PARKS.—Jersey City, N. J.—The 11th and 12th Wards of Jersey City are to have two parks. One will be located in Ogden Ave., between Liberty and Bower Sts., and will embrace about three acres. The other will contain 7 1-5 acres, and will be in Hudson St., between Germania and Manhattan Aves. Options have been secured on both properties and the bonds necessary to raise the money will be floated soon.

TELEPHONE SYSTEM.—Ellicott City, Md.—A press report from this city announces that a company is being organized to establish a telephone system in this county, to connect Gaither's, Hood's Mill, Cooksville, Glenwood, Gary, Roxbury Mills and Sunshine and ultimately to reach Lisbon, Poplar Springs, Mt. Airy, Long Corner, Florence, Daisy, Glenelg, Dayton, Highland, Clarksville, Guilford, Columbia, Ellicott City, Mayfield, Pine Orchard, West Friendship, Alpha, Mount View, Sykesville and other points. It is the intention to charge not to exceed 5 cts. for messages. The shares of stock will be $5, and persons securing a telephone will be required to take not less than three shares of stock.

CANAL IMPROVEMENTS.—Albany, N. Y.—Bids are asked until Nov. 25 for the following work in connection with the state canal improvements: Rebuilding east pier of Belgium bridge over Seneca River; rebuilding lock No. 49, Black River Canal; constructing a 36-in. cast iron pipe culvert under the Genesee River feeder, Rochester; for repairs to breakwater, piers, dam No. 1 and gates; also removing bars at Owasco Lake outlet; repairing and reconstructing slopes and banks the channel of Falls Creek, with grading, etc., Mountain Falls; protecting west bank of the Chemung River, Chemung, and for repairing culvert under the Oswego Canal, Oswego. Thos. Wheeler, Syracuse, and R. G. Lay, Rochester, Asst. Supts.; Geo. W. Aldridge, Supt. Pub. Wks., Albany.

CRIB WORK.—New York, N. Y.—Bids are asked by the department of docks until Nov. 24, for preparing for and building a crib-bulkhead in Sherman's Creek, on the Harlem River. Crib-bulkhead complete, containing about the following quantities: 576,113 cu. ft. of cribwork, complete, including fenders, mooring-posts and backing-logs, and measured from the under side of the backing-logs; piles to be driven in the rear bents of the cribwork, about 91 (it is expected that these piles will be from about 40 ft. to 70 ft. in length to meet the requirements of the specifications); rip-rap foundation for rubble-wall, 73 cu. yds.; dry rubble or large rip-rap wall, 1,195 cu. ft.; materials for painting, oiling, and tarring; labor of every description for about 767 lin. ft. of cribwork. Geo. S. Terry, Secy., Battery Place.

LIGHTHOUSE VESSELS.—Washington, D. C.—It is stated that in a short time the plans and specifications for three composite light vessels and two steel tenders for the lighthouse service will be ready for bidders, and will be sent by the secretary of the lighthouse board to all shipbuilders in the country, together with blank forms for bids. One of the light vessels will be located on Diamond Shoals, Cape Hatteras; another at Fire Island, New York, and a third at San Francisco bar. One of the tenders will be put into service in the second district, with headquarters at Boston, and the other will have headquarters at Key West, Fla. All of these vessels will be modern and first-class in every particular, with powerful masthead electric lights visible for 15 miles. There was appropriated $80,000 for each of the light vessels and $75,000 each for the tenders.

CANAL.—Boston, Mass.—Preparations are being made by the promoters of the Massachusetts Maritime Canal Co. to deposit $200,000 with the state treasurer to secure the right to construct the Cape Cod Canal. Press reports announce that the preliminary plans have been prepared and approved by the joint boards of railway and harbor and land commissioners, and the locations and other specifications prepared for presentation to the Barnstable county commissioners as soon as the deposit has been made with the state treasurer. The canal is to begin at some point in Buzzard's Bay, running through the towns of Bourne and Sandwich, or either of them, to some convenient point in Cape Cod or Barnstable Bay. It is to have a depth of not less than 25 ft. at mean high water, and a width of not less than 100 ft. at the bottom, with suitable slopes, and with a surface width of not less than 200 ft. Engr., Elmer L. Corthell, 71 Broadway, New York; Wendell G. Corthell, of Boston, is interested.

CONTRACT PRICES.

RAILWAY TRESTLE.—Sandy Hook, N. J.—Col. James M. Moore, Asst. Q. M., New York, received the following bids Nov. 14 for the construction of about 600 ft. of railway trestle at Sandy Hook, N. J.:

	Per lin. ft.
P. Sanford Ross, Jersey City, N. J.	$6.90
J. M. Briggs, New York city	8.92
Spearin & Preston, Bayonne, N. J.	7.45
W. W. Ryan, New York city	11.375
Hugh Hart, Long Island City	9.75
E. D. Ruggles, New York city	8.50
Aetna Construction Co., Brooklyn, N. Y.	5.90

SEWER PIPE.—Akron, O.—Bids for furnishing the city with sewer pipe for the next two years have been received as follows, the bid being the per cent. discount from list price for first-class and second-class pipe, respectively; price paid for the last two years was 78 and 88% discount, respectively, for the two classes:

	First class. %.	Second class. %.
Hill company	80	85
Robinson Bros. company	79½	83½
Harry Thompson	78	83
Buckeye company	79	84
Summit company	79	84

DREDGING.—New York, N. Y.—The contract for 85,000 cu. yds. of mud and sand dredging in Sherman Creek, Harlem River, was awarded Nov. 10, to the Morris & Cumings Dredging Co., 22 State St., New York, at 19.44 cts. a cu. yd.; P. Sanford Ross, 277 Washington St., Jersey City, bid 24 cts. Geo. S. Terry, Secy. Dock Dept.

DAMS AND SHORE PROTECTIONS.—Rock Island, Ill. —The following bids were received by Lieut.-Col. W. R. King, Nov. 10, for constructing dams and shore protections on Mississippi River, as advertised in Engineering News, price being per cubic yard for material in place:

Between Read's Landing, Minn., and Trempealeau, Wis.:

Bidder.	Rock, 25,000 cu.yds.	Brush, 75,000 cu.yds.	Total.
Fetter & Crosby, La Crosse, Wis.	$0.97	$0.17	*$37,000
J. Richtman, Fountain City, Wis.	1.00	.35	51,250
A. Kirchner, Fountain City. Wis.	.94	.19	37,750

Between Dubuque and Clinton Ia.:

Bidder.	Rock, 30,000 cu.yds.	Brush, 25,000 cu.yds.	Total.
A. Kirchner, Fountain City, Wis.	$0.90	$0.17	*$31,250
A. J. Whitney, Rock Island, Ill.	.94	.20	33,200
J. Richtman, Fountain City, Wis.	1.00	.50	42,500
Patterson Bros., Keokuk, Ia.	1.00	.20	35,000

Between Rock Island, Ill., and Muscatine, Ia.:

Bidder.	Rock, 25,000 cu.yds.	Brush, 25,000 cu.yds.	Total.
A. Kirchner, Fountain City, Wis.	$1.00	$0.19	$29,750
A. J. Whitney, Rock Island, Ill.	1.00	.20	30,000
Patterson Bros., Keokuk, Ia.	.84	.23	*26,750
James Short, St. Charles, Mo.	1.05	.35	35,000
J. Richtman, Fountain City, Wis.	1.10	.40	37,500

Between Keithsburg, Ill., and Nashville, Ia.:

Bidder.	Rock, 25,000 cu.yds.	Brush, 25,000 cu.yds.	Total.
A. Kirchner, Fountain City, Wis.	$1.00	$0.19	*$29,750
A. J. Whitney, Rock Island, Ill.	1.50	.30	45,000
Patterson Bros., Keokuk, Ia.	1.25	.25	37,500
James Short, St. Charles, Mo.	.95	.32	31,750
J. Richtman, Fountain City, Wis.	1.10	.40	37,500

Between Hamburg, Ill., and the mouth of the Illinois River:

Bidder.	Rock, 35,000 cu.yds.	Brush, 55,000 cu.yds.	Total.
A. Kirchner, Fountain City, Wis.	$1.00	$0.30	*$51,500
Thompson & Gray, St. Louis, Mo.	.80	.44	52,200
James Short, St. Charles, Mo.	1.10	.40	60,500
Golike & Rust, Alton, Ill.	1.04	.46	61,700
J. Richtman, Fountain City, Wis.	1.00	.40	57,000

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*Recommended for acceptance.

PAVING BRICK AND GRANITE CROSSINGS.—Nashville, Tenn.—The contract for furnishing paving brick, as advertised in Engineering News, has been awarded to the Evansville Pressed Brick Co., Evansville, Ind., at $15 per 1,000, f. o. b. Nashville; contract for granite crossings was awarded to John Bradley, Atlanta, Ga., at 46⅓ cts. a lin. ft., f. o. b., Nashville. J. A. Jowett, Cy. Engr.

BRICK AND ASPHALT BLOCK PAVING.—Savannah, Ga.—The following bids have been received for paving South Broad St.: Tennessee Paving Co., Chattanooga, $1.67 a sq. yd. for brick pavement, including all cost except curbing, with 5-year guarantee and offer to maintain pavement for 20 years after expiration of the 5 years at 3 cts. a sq. yd. a year; Virginia Paving Brick Co., Lynchburg, Va., $1.65 a sq. yd. for brick, with maintenance for 20 years at 3 cts. a sq. yd. a year; Hastings Pavement Co., 66 Broad St., New York, $67.50 per 1,000 for asphalt blocks, with 5-year guarantee.

CAST-IRON PIPE.—Springfield, Mass.—The water commissioners are reported to have contracted for 8 to 4-in. pipe for use next year, at $20.38 a gross ton.

RESERVOIR, ETC.—Morris Plains, N. J.—The following bids were received Nov. 12 for constructing a 5,000,000-gallon storage reservoir, with filter basins, etc., at the state hospital at this place; Geo. W. Howell, Engr.; Chas. H. Green, Secy. Bd., 21 Washington St., Morristown, N. J.:

Bids Opened at Morris Plains, N. J., Nov. 12, 1896, for a Dam and Filter Beds for the State Hospital.

Bidder.	Clay puddle, cu.yd.	Earth excav't'n, cu.yd.	Con-crete, cu.yd.	Rubble mas'ry, cu.yd.	Brick mas'ry, cu.yd.	Material, filter bed, cu.yd.	Drain tile, lin.ft.	Rip-rap, cu.yd.	Total.
Chas. A. Simms & Co.	$1.48	$0.59	$4.95	$4.70	$10.50	$1.95	$0.23	$1.00	$34,074
S. M. Neff	2.00	.47	5.15	4.00	10.00	2.00	.40	.85	30,068
L. Batte	1.00	.50	4.75	4.50	7.50	3.00	.25	.75	29,663
Thos. Malley and Paul F. Dunn	1.00	.43	3.90	2.50	7.00	2.20	.12	1.25	28,373
George M. Rusling	1.50	.35	5.00	5.00	10.00	2.00	.15	1.00	26,825
D. Cuozzo	.73	.36	6.00	4.50	11.00	2.25	.35	.60	24,981
R. A. Malone & Son	1.00	.38	5.00	4.50	10.00	1.00	.30	.50	24,075
F. C. O'Riley	.05	.28	4.50	4.00	9.00	1.80	.23	1.25	23,608
O'Connor & Co.	1.50	.34	4.00	4.00	15.00	.34	.15	.70	22,351
J. B. Salmon	.90	.35	4.50	3.25	10.00	2.50	.22	.43	21,823
Ira Judson Coe	.79	.31	5.58	3.00	7.10	2.25	.35	.48	21,609
H. I. Riley	.90	.29	4.60	4.00	10.00	1.87	.20	.50	20,498
A. Fagan & Co.	1.25	.26	4.00	4.00	10.00	2.00	.20	.40	18,940
Coon & Mooney	.74	.29	4.30	4.00	9.00	1.45	.06	.40	18,846
P. J. Conlon	.40	.25	4.00	3.50	8.00	2.00	.15	.60	18,665
E. D. Foster & Co.	.30	.27	2.90	3.30	9.60	1.30	.21	.59	17,750

SEWERS.—Washington, D. C.—The following bids were received by the district commissioners Nov. 16 for constructing sewers, as advertised in Engineering News:

Quantities.		A. McCandlish, Washington, D.C.	Guiney & Coyle, Washington, D.C.	E. G. Gummel, Eckington, D.C.
21-in. pipe,	610 ft.	$1.15	$1.30	$1.22
Manholes	3...	20.00	14.00	25.00
24-in. pipe	570 ft.	1.75	1.74	1.70
Manholes	3...	30.00	20.00	30.00
12-in. pipe	1,100 ft.	.75	.90	.81
Manholes	7...	20.00	14.00	25.00
Total		$2,814	$2,975	$2,944

PIG LEAD.—Detroit, Mich.—The water board has purchased 50 tons of pig lead, at 2.8 cts. a lb., according to local papers.

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INDUSTRIAL NOTES.

THE CLONBROCK STEAM BOILER CO., Brooklyn, N. Y., reports work as very brisk, and the future bright.

THE J. H. McEWEN MFG. CO., Ridgeway, Pa., has made an assignment, without preference, for the benefit of its creditors.

THE PITTSBURG LOCOMOTIVE WORKS, Pittsburg, Pa., is delivering several consolidation engines to the Baltimore & Ohio R. R.

THE DEAN BROS. STEAM PUMP WORKS, Indianapolis, Ind., is furnishing a compound duplex pumping engine for the water-works at Charleston, Ill.; capacity, 2,000,000 gallons per day.

THE JUTTE & FOLEY CO., Pittsburg, Pa., has closed a contract with the West Braddock Bridge Co. to build the bridge across the Monongahela River at Braddock, Pa.

THE BARNEY & SMITH CAR CO., of Dayton, O., has delivered to the Baltimore & Ohio R. R. 10 combination baggage and passenger cars, 60 ft. long. They are of the latest design, lighted by gas and heated by steam.

THE VAN DORN IRON WORKS CO., of Cleveland, O., is introducing a steel hanger for floor beams or joists. The hanger is a stirrup support with top flanges which can be built into a wall or supported upon a steel or wooden header beam.

THE VULCAN IRON WORKS CO., Toledo, O., has recently received orders for a steam shovel to go to Buffalo, N. Y.; a car load of furnaces to go to Denver, Colo., and a car load of railway castings for the central part of the state. The company looks forward to active trade.

THE CRANE CO., Chicago, has lately closed contracts for high pressure valves, fittings and pipe for five gold mines at Johannesburg, South Africa, the Chicago City Ry., for an electric power station at Yokohama, Japan, the McCormick Harvester Machine Co., Chicago, and for the Western Wheel Works, Chicago.

THE PROBST CONSTRUCTION CO., 160 5th Ave., New York city, has had its office taken possession of by the sheriff on an attachment from Phillips & Avery for $26,383 for balance claimed to be due on contract and extra work done by the Empire Fire Proofing Co., for the above-named company on the Siegel-Cooper Co. building. The total contract was $130,000 and the extras amounted to $7,311.

MR. JULES BERTERO, Granite Bldg., St. Louis, Mo., has recently completed the sinking of an artesian well at Morgan Park, Ill., 1,400 ft. deep, which has a daily flow of 600,000 gallons. He has also recently sunk a well 1,659 ft. deep at Astoria, Ill., which has a daily capacity of 200,000 gallons; and one for Mr. H. A. Alfrey's factory, at Poplar Bluff, Mo., 535 ft. deep, with a capacity of 100,000 gallons daily.

THE CLAYTON AIR COMPRESSOR WORKS, Havemeyer Bldg., New York city, has received a contract for 25 air compressors and 25 air receivers, of medium and small sizes, from one company, delivery of the entire order to be made within six months from date. It also reports sales of five air compressors of standard pattern during the first week in November, and the indications point to a decided revival of trade in air compressors.

MESSRS. S. D. PRICE, J. POTTER CLARK AND D. H. LEVAN, Mount Carmel, Pa., have formed a partnership for the purpose of engaging in the business of building breakers. Mr. Levan built the Midvalley breaker at Mount Carmel and has had extensive experience in breaker building.

THE YOUNGSTOWN BRIDGE CO., Youngstown, O., recently closed contracts for several bridges on the Erie Ry., and four buildings for a smelting plant in Arizona, consisting of convertor house, engine house and two boiler houses; also for two spans with paved floor at Woonsocket, R. I., and for the Fort Ave. bridge for the B. & O. R. R., consisting of four double track spans 105 ft. each, together with other work for the same company.

THE GILLETTE-HERZOG MFG. CO., of Minneapolis, Minn., has just completed the construction and erection of a large coal handling plant for the Tamarack Mining Co., of Dollar Bay, Mich. The main building has a storage capacity of 50,000 tons, and is an all steel structure 428 × 175 ft. The contract included the furnishing and erection of all machinery and towers necessary for unloading coal from boats and placing it in the building. The company has also recently completed for the same firm, the construction and erection of a steel boiler house and steel stamp mill. Among other contracts on hand are the manufacture of some steel flumes 12 ft. in diameter for the Helena Water & Electric Power Co., for its new plant at Canyon Ferry, Mont., and the stele work for the St. Anthony Falls Water Power Co., at Minneapolis, which includes the power house, bear trap dam, etc. The contract has just been closed for a 100 ft. water tower and steel tank for the Rice Milling Co., of New Orleans, La.

THE TERRY & TENCH CONSTRUCTION CO., Railroad Ave. and 135th St., New York city, has just completed the erection of the steel frame of the Central Syndicate Building, corner Pearl St. and Broadway, New York city; the three top floors and roof were put up in nine days. The firm has just secured the contract from Messrs. A. & P. Roberts Co., of the Pencoyd Iron Works, for the erection of the new Sherry Building, at the corner of 5th Ave. and 44th St., which will contain between 3,500 and 4,000 tons of steel.

THE LIDGERWOOD MFG. CO., of New York city, reports that it has been passing through a year which has been full of experiments, and that considerable development has been reached on account of these many experiments. The longest single span Lidgerwood cableways in existence is that at Holyoke, 1,650 ft. span, and the company has also made one with a span of over 1,300 ft. with one tower traveling, for use in connection with the Croton dam. This latter cableway is guaranteed to handle 10 tons and the head tower is mounted upon a car with the engines. The anchorage is moveable sidewise, radially, the center of the circle being the tail tower, over 1,300 ft. distant. A new form of scoop bucket,, adapted for working in the stiffest fire-clay has also been designed. Another interesting plant built during the year was that used by F. S. Pearson & Son, for use on the Mexican drainage canal of the city of Mexico. It was constructed after the manner of the Chicago drainage canal cableways, with traveling towers and carrying a Hayward bucket, of 1½ cu. yds. capacity. This cableway with its self-filling bucket was used for digging out the bottom of the canal which had been washed in after the work of the dredge had been done.

THE SNOW STEAM PUMP WORKS, Buffalo, N. Y., has just finished the work of erecting a four-cylinder triple-expansion crank and flywheel pumping engine for the Calumet & Hecla Mining Co., E. D. Leavitt, Consult. Engr., at its water-works plant at Calumet, Mich. The engine is pumping against a head of 1,000 ft. It has just finished the work of erecting a 3,000,000-gallon horizontal cross compound crank and flywheel engine for the city of Jackson, Tenn. It is putting on the finishing touches to the erection of a 3,000,000-gallon vertical duplex compound direct acting pumping engine, built for the East Pittsburg Water Co., at its plant at Port Perry, Pa. The work of erecting a 20,000,000-gallon vertical triple expansion crank and flywheel pumping engine for the Indianapolis Water Co., of Indianapolis, Ind., is progressing rapidly and it is expected to have the work completed and the engine under steam the fore part of the coming month. The performance of this engine will be watched with considerable interest by engineers. The company has just shipped two horizontal six-cylinder mine pumps to the Argentum & Juniata Mining Co., of Aspen, Colo.; these pumps are to work against a pressure of 440 lbs. It is constructing two engines of the same type, but of a little smaller size for the Rebecca Gold Mining Co., of Cripple Creek, Colo., to work against a head of 900 ft.; Mr. C. E. Palmer, of Colorado Springs, Colo., is consulting engineer for both of these companies. The company is now constructing three large oil line pressure pumps for the Indiana Pipe Line & Refining Co., of Chicago. It has just completed and is erecting three pressure pumps for the Fox Pressed Steel Co., of Pittsburg, Pa.; these pumps are to work against a pressure of 1,000 lbs. Recent contracts are for one large duplex compound water pump for the Andrews Bros. Co., Youngstown, O.: for a complete outfit of pumps for an oil refinery for export consisting of nine duplex pumps of considerable size.

NEW YORK VALVE AND HYDRANT EXHIBITION.—An exhibition of valves, hydrants and accessories was held under the auspices of the Department of Public Works, of New York city, at the Corporation Yard, 437 East 24th St., this week. Gen. Chas. H. T. Collis is Commissioner of Public Works, and Mr. Alonso S. Gear is General Foreman of Corporation Yards. The articles exhibited, with the names and addresses of the exhibitors, were as follows, some of the articles being shown by New York city:

Hydrants.

New York Case, New York city.
Double Nozzle "A," New York city.
Jonson, Jonson Engineering & Foundry Co., foot of East 118th St., New York city.
Engel, George Engel, Buffalo, N. Y.
Mathews, R. D. Wood & Co., Philadelphia.
Frost's, J. O. Frost's Sons Mfg. Co., Towanda, Pa.
Chapman Gate, Chapman Valve Mfg. Co., 15 Gold St., New York, and Indian Orchard, Mass.
Beaumont Gate, Richard Beaumont, Kankakee, Ill.
Mellert Compression, Reading (Pa.) Foundry Co.
Eley Post, Philip Eley, Bayonne, N. J.
Eley Flush and Connections, Philip Eley, Bayonne, N. J.
Tylers' Flush, A. J. Tyler, Passaic, N. J.
Shedd, J. H. Shedd, Providence, R. I.
Eddy Post, and Eddy Flush, with Box, Eddy Valve Co., Waterford, N. Y.
Rensselaer Flush and Box, and Rensselaer Post, Rensselaer Mfg. Co., Troy, N. Y.
Coulter & McKenzie Gate, Coulter & McKenzie Machine Co., Bridgeport, Conn.
Coffin, Coffin Valve Co., Neponset, Mass.
Kennedy Gate, and Kennedy Double Valve, Kennedy Valve Mfg. Co., 75 John St., New York city.
Holyoke Gate, Norwood Engineering Co., Florence, Mass.
Ludlow Gate, and Ludlow Flush, Adam & Smith, 62 Gold St., New York city; Ludlow Valve Mfg. Co., Troy.
Thompson Compression, J. Thompson & Co., Philadelphia.
Motley, Thornton N. Motley & Co., 43 John St., New York city.

Hydrants, Models Only.

Brentano's, S. Brentano, Union Square, New York city.
Gear; no address.
Fox, J. J. Fox, 1890 Washington Ave., New York city.

Indicator Posts.

Kennedy, Kennedy Valve Mfg. Co., 75 John St., New York city.
Ludlow, Adam & Smith, 62 Gold St., New York city; Ludlow Valve Mfg. Co., Troy, N. Y.
Wood, R. D. Wood & Co., Philadelphia.

Sprinkling Cart Attachment.

Wood, R. D. Wood & Co., Philadelphia.

Gates or Valves.

Motley, Inside Screw and Motley Outside Screw, T. N. Motley & Co., 43 John St., New York.
New York, Inside Screw, New York city.
Rensselaer, Inside Screw, Rensselaer Mfg. Co., Troy.
Ludlow, Inside and Outside Screw, Adam & Smith, 62 Gold St., New York city.
Chapman, Inside Screw, Chapman Valve Mfg. Co., 15 Gold St., New York city, and Indian Orchard, Mass.
Reading, Inside Screw, Reading (Pa.) Foundry Co.
Eddy, Inside Screw, Eddy Valve Co., Waterford, N. Y.
Kennedy, Outside Screw, and Kennedy Inside Screw, Kennedy Valve Mfg. Co., 75 John St., New York city.
Dart's Self-Lubricating Gear, E. M. Dart Mfg. Co., Providence, R. I.
McLean, Inside Screw, John McLean, 298 Monroe St., New York city.
Eley, Inside Screw, Philip Eley, Bayonne, N. J.
Coffin, Inside Screw, Coffin Valve Co., Neponset, Mass.
R. D. Wood, Inside Screw, R. D. Wood & Co., Philadelphia, Pa.
Walworth, Outside, and Walworth Inside Screw, Walworth Mfg. Co., 14 Oliver St., Boston, Mass.
J. O. Frost's, Inside Screw, J. O. Frost's Sons Mfg. Co., Towanda, Pa.
Thompson, Inside Screw, J. Thompson & Co., Philadelphia, Pa.
New York, with Metallic Packing, Union Metallic Rod & Flange Packing Co., 62 Sudbury St., Boston.
New York, Outside Screw, New York city.
Eddy, 30-in. Gate, and By Pass and Gearing, Eddy Valve Co., Troy, N. Y.
New York, 36-in. Gate and Gearing, New York city.

Hydraulic Power Gate.

T. N. Motley & Co., 43 John St., New York city.

Pipe Tapping Machines.

Smith's (small) and 36-in., with Gate, Sleeve and Accessories, A. P. Smith Mfg. Co., Newark, N. J.
Hall, Walworth Mfg. Co., 14 Oliver St., Boston.
Eley's, Philip Eley, Bayonne, N. J.

Steam Calking Machine.

O'Neil, A. P. Smith Mfg. Co., Newark, N. J.

Pipe Cutting Machines.

Walworth, Walworth Mfg. Co., 14 Oliver St., Boston.
French, B. C. Smith, New York city.

Cutting-in-Specials.

R. D. Wood & Co., Philadelphia.
Builder's Iron Foundry, Providence, R. I.

Lead Furnaces.

A. P. Smith Mfg. Co., Newark, N. J.
John McLean, 298 Monroe St., New York city.

Metallic Flange Packing.

Union Metallic Rod & Flange Packing Co., 62 Sudbury St., Boston, Mass.

Sectional Stop-Cock Box.

Reading Foundry & Machine Co., Reading, Pa.

Service Pipe.

Cast Iron, M. J. Drummond, 192 Broadway, New York city.
Lead-lined, Lead-Lined Iron Pipe Co., Wakefield, Mass.

Globe Special Castings.

Builders Iron Foundry, Providence, R. I., shown by M. J. Drummond, 192 Broadway, New York city.

The Donaldson Iron Co., Emaus, Pa., manufacturer of iron pipes and other goods, also entered as an exhibitor, but the character of its exhibit was not stated on the official records.

NOTICE.

As Thursday, Nov. 26, is Thanksgiving Day, Engineering News of that date will be printed and mailed on Wednesday. Tuesday, noon, is the latest at which any matter can be received for publication in this issue.

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PERSONALS.

Mr. Benjamin Wood, contractor, of Jackson, Mich., died Dec. 10.

Mr. Joseph McNanugher, contractor, of Pittsburg, Pa., died at Allegheny, Pa., Dec. 6, at the age of 60.

Mr. B. Schreiner has resigned his position as assistant in the office of the City Engineer of Des Moines, Ia.

Mr. George Z. Heuston, City Engineer of Winona, Minn., was married to Miss Bessie Hill, of that city, on Dec. 2.

Mr. Carroll S. Knapp, Superintendent of the gas works at Marblehead, Mass., will retire from that position on Jan. 1.

Mr. R. Willard Ware, M. Am. Soc. C. E., of Plainfield, N. J., was married Dec. 10 to Mrs. Ella Belle Ridley, of that city.

Mr. Herbert Wilcox has been appointed City Engineer of Aspen, Colo., succeeding Mr. Edward Higenbotham, resigned.

Mr. J. Carl Duke has been appointed General Agent of the Gettysburg & Harrisburg Ry., with headquarters at Carlisle, Pa.

Mr. J. H. Nelson has opened an office in the Larimer County Bank Building, Loveland, Colo., for practice as a civil and hydraulic engineer.

Mr. John A. Tilley has been appointed Assistant Engineer for the new East River bridge, New York, succeeding Mr. Hooper, who has resigned.

Mr. W. H. Maddock, mechanical engineer, and Superintendent for the James Rees & Sons Co., boat and engine builders, Pittsburg, Pa., died Dec. 7.

Mr. C. L. Mayne, Division Superintendent of the Fitchburg R. R., has been appointed Assistant General Superintendent, with offices at Fitchburg, Mass.

Mr. Charles Stewart Smith has been appointed a member of the Rapid Transit Commission of New York city, to fill the vacancy left by the death of Mr. Wm. Steinway.

Mr. Herman Webber, an engineer in the employ of Denver Tramway Co., Denver, Colo., has been appointed to a position with the Mexico, Cuernavaca & Pacific Ry.

Mr. W. S. Rudge has been appointed by the Board of Water-Works Trustees of Youngstown, O., as Inspector of Water Waste, to examine hydrants, house fixtures, etc.

Mr. A. J. McCabe, Division Superintendent of the Great Northern Ry., has been appointed Superintendent of the Butte, Anaconda & Pacific Ry., with offices at Butte, Mont.

Mr. R. Oshima, M. E., Chief Mining Engineer of the Hokkaido Colliery & Railway Co., Sapporo, Japan, is visiting the United States to inspect railways and mining plants.

Mr. Edward H. Hickey, until recently chief draftsman of the Union Bridge Works, Athens, Pa., died Dec. 7. He had been connected with the Athens works for about 25 years.

Mr. Wm. W. Taylor, who died at Kennett Square, Pa., Nov. 27, was one of the contractors on the old Western Maryland R. R., and also built the water-works of Westminster, Va.

Prof. A. D. F. Hamlin, of Columbia College, New York city, delivered a lecture on "The Architecture of London," at a meeting of the Brooklyn Institute, Brooklyn, N. Y., Dec. 10.

Mr. Kingsley L. Martin, Jun. Am. Soc. C. E., formerly an assistant engineer on the Brooklyn Bridge, has been put in charge of the construction of the caissons for the new East River bridge.

Mr. Charles O. Shields, M. Am. Inst. M. E., mining engineer, of Denver, Colo., died recently in Bolivia, South America, where he was engaged on work for the American Development Co., of New York city.

Mr. Andros B. Stone, who died in New York city Dec. 15, was President of the A. B. Stone Construction Co., and a director in the Henning Rapid Transit Co. and the New York & Jersey City Ry. Co.

Mr. John D. Parsons has been elected Vice-President and General Manager of the Union Traction Co., at Philadelphia, Pa. He now holds a similar position with the West Side Street Ry. Co., of Chicago.

Mr. Arthur Pew, M. Am. Soc. C. E., M. Inst. C. E., has just returned from Tumaco, Colombia, South America, where he has been for the past year as General Manager of the Playa de Oro Mining Co., of Ecuador.

Mr. Oliver Eldredge McClellan, formerly Superintendent of the Middle Division of the Pennsylvania R. R., with headquarters at Harrisburg, died at Germantown, Pa., Dec. 9. He retired from railway service some years ago.

Mr. J. W. Ledoux, M. Am. Soc. C. E., of Philadelphia, Pa., has returned from Mexico, where he was sent by several Philadelphia capitalists to report upon a river improvement concession, water-works and other projects.

Mr. F. S. Gannon, General Superintendent of the Baltimore & Ohio R. R., and General Manager of the Staten Island Rapid Transit R. R., has been appointed Third Vice-President and General Manager of the Southern Ry.

Mr. John F. O'Rourke, M. Am. Soc. C. E., is Chief Engineer for the Pneumatic Mail & Transportation Co., which has a contract for laying a pipe line across the Brooklyn Bridge, connecting the central post offices of New York and Brooklyn.

Mr. R. G. Mathews, formerly General Superintendent of the Buffalo, Rochester & Pittsburg Ry., has accepted the position of General Sales Manager for the block and train-order signal equipment of the Mozier Safety Signal Co., of Cleveland, O.

Mr. Michael Rickard, a member of the New York State Board of Railroad Commissioners, died of heart disease at Albany, N. Y., Dec. 12. He was about 65 years of age. Previous to his appointment he was an engineman on the New York Central R. R.

Mr. John T. Bishop, contractor, of Baltimore, Md., died Dec. 6, at the age of 83. He was born at Columbia, N. H., and went to Maryland when 21 years of age. He was contractor for several tunnels on the Baltimore & Ohio R. R., and afterwards erected a number of public buildings in Baltimore.

Messrs. George M. Hawes and E. I. Marvel have opened an office as civil and mechanical engineers, at 81 Bedford St., Fall River, Mass. Mr. Hawes has been employed on the Boston Subway, and Mr. Marvel has been employed by the Metropolitan Sewerage Commission, and as assistant civil engineer of Somerville, Mass.

Mr. Andrew J. Gavett, engineer of the sewerage system of Plainfield, N.J., has completed his work for the Sewer Commissioners, and will open an office in the Codington Building, 152 Park Ave., Plainfield, N. J., for practice as a civil engineer. A description of the sewerage and sewage disposal system of that city, written by Mr. Gavett, appeared in our issue of Sept. 10, 1896.

Mr. W. E. Howley, of the contracting firm of W. E. Howley & Co., Pittsburg, Pa., was seriously injured at the work of grading Marshall Ave., Allegheny, Pa., Dec. 11. The construction cars are hauled up a trestle by a cable, and on the trestle there is a curve. While a train was being hauled up the cable came off the guide pulleys, striking Mr. Howley and throwing him against some cars standing on a side track.

Mr. Kennedy Park has accepted a position with the Aultman & Taylor Machinery Co., of Mansfield, O., to take charge of the erecting department for Cahall vertical and Cahall-Babcock & Wilcox boilers in New England. He was for ten years in the erecting department of the Babcock & Wilcox Co., of New York, and for the past five years has been superintendent of the New England erecting department for that company.

Mr. L. T. Brown, formerly Superintendent of the Upper Union Mills, of the Carnegie Steel Co., Pittsburg, Pa., has been appointed General Superintendent of both Upper anl Lower Union Mills. Mr. Joseph Schwab, who was superintendent of the blooming mill at the Homestead Steel Works, has been appointed to succeed Mr. Brown at the Upper Union Mills, and Mr. J. G. Hunter has been appointed Superintendent of the Lower Union Mills to succeed Mr. Joseph Wrigley, resigned.

Mr. Henry Jacobs, formerly Master Mason of the Philadelphia & Reading R. R., died at West Manayunk, Pa., Dec. 9. He was born in 1817, and after learning the trade of stone mason, he entered the employ of the P. & R. R. R. He was Master Mason of the upper section until 1856, when, after the death of Mr. Christian Swartz, he was given charge of the entire line. He built the Peacock bridge, above Reading, and the Schuylkill Haven bridge, and helped to construct the Flat Rock tunnel. He invented a brace derrick or crane, which soon became extensively used. He also built the stonework of the Flat Rock and Conshohocken dams for the Schuylkill Navigation Co.

Mr. Alfred Nobel, the manufacturer of explosives, and the first to attempt the practical use of nitro-glycerine, died at San Remo, Italy, Dec. 9. His first experiments began in 1863, but they were only partly successful until he employed the plan first used by Gen. Pictet in 1854 for developing the force of gunpowder in the most rapid manner, by means of an initiative detonation. The liquid nature of the substance constituted the serious obstacle to its safe transport and it was not until Nobel had hit upon the expedient of mixing it with absorbent material that the future of nitro-glycerine as a blasting agent was assured. He first used charcoal as an absorbent, but finally selected the siliceous earth known as "kieselguhr."

Mr. J. R. Kendrick, Third Vice-President of the New York, New Haven & Hartford R. R., died suddenly at Boston, on Dec. 11. He was born at Lebanon, N. H., in June, 1852. He began railway work in the office of the Superintendent of the Sullivan R. R., at Charlestown, N. H., and shortly after this he went to the Vermont Central R. R. as Paymaster. In 1854 he accepted a position on the Concord Railroad, at Concord, N. H., and was successively Paymaster, General Ticket Agent, Chief Clerk or Auditor, Master of Transportation, General Freight Agent and Assistant Superintendent—up to June, 1865. Then his services were secured by the Boston & Lowell R. R. as General Freight Agent and Freight Agent at Boston. In June, 1866, he returned to Concord, N. H., as General Superintendent of the Concord R. R. In 1870 he went south to take charge of the reconstruction of the line between Mobile and New Orleans. After finishing that he returned north, and in 1871 was made Superintendent of the Old Colony R. R. One of the shrewdest of its operations was securing a controlling interest in the steamers between Fall River, Newport and New York, and placing the management of the same within the control of its own board. In 1893, when the Old Colony R. R. and the New York & New Haven R. R. were consolidated, Mr. Kendrick was made Vice-President of the consolidated lines, having charge of the Boston end of the line, including the boat service.

Mr. David Leonard Barnes, Mechanical Editor of the "Railroad Gazette," died in New York city, Dec. 15, after an illness of many months. He was born at Smithfield, near Providence, R. I., Aug. 23, 1858, and was a student at Brown University, from which in later years he received the degree of Master of Arts, and at the Massachussets Institute of Technology. From 1879 to 1882 he was engaged in the machine shops and drawing rooms of the Hinckley Locomotive Works at Boston and the Rhode Island Locomotive Works at Providence, and his advancement was so rapid that in 1882 he became Chief Draftsman at the latter works. He remained at these works as Chief Draftsman and Mechanical Engineer until 1887, with the exception of a short time when he held the same position at the New York Locomotive Works, at Rome, N. Y. During this time he also carried on more or less work as a consulting engineer, and in 1887 he resigned his position to give his entire time to this work. In December, 1888, he became connected with the editorial staff of the "Railroad Gazette," having special charge of the department of mechanical engineering. He carried on at the same time his private consulting practice with offices in New York and Chicago, and devoted his attention especially to the subject of railway rolling stock. Among the important works with which he was connected was Chicago's first elevated railway, the "Alley" road, of which he was consulting engineer. When an agreement was formulated a year or more ago, between the Westinghouse Electric Co. and the Baldwin Locomotive Works, for the construction of large locomotives for electric railway service, Mr. Barnes was selected by the two companies as consulting engineer for the work. His most important labors, however, were in the field of technical literature. It is safe to say that no one during the past half-dozen years has made such valuable contributions to technical literature upon the subjects of railway rolling stock and locomotive engineering as has Mr. Barnes. He was too busy a man to find time for the writing of treatises and text-books, although he edited and was joint author of a treatise on compound locomotives, but as a contributor to the transactions of the numerous engineering societies of which he was a member, his pen was a most prolific one, and his papers of this class as well as his editorial articles in the "Gazette" were of uniformly high character. We can take space to mention but one of his writings, a paper contributed to the Civil Engineering Section of the International Engineering Congress of 1893, on "The Distinctive Features and Advantages of American Locomotive Practice," and this we allude to merely as an example of one of his best pieces of work. His services on the committees of the Master Mechanics' and Master Car Builders' Association deserve also the highest commendation. The list of technical societies of which Mr. Barnes was a prominent member, includes, besides the two just named, the Western Society of Engineers and Western Railway Club, the American Society of Mechanical Engineers, the American Society of Civil Engineers, and the Institution of Civil Engineers of Great Britain. He was also a member of the Union League Club of Chicago, the Manufacturers' Club of Philadelphia, and the Engineer's Club of New York.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

TACOMA SOCIETY OF CIVIL ENGINEERS AND ARCHITECTS.
Dec. 18. Secy., 201 Washington Bldg., Tacoma, Wash.
CHICAGO ELECTRICAL ASSOCIATION.
Dec. 18. "Decorative Lighting," by E. J. Jenness. Secy., J. R. Cravath, 810 Old Colony Bldg.
ENGINEERS' CLUB OF COLUMBUS.
Dec. 19. Secy., M. S. Hopkins, 14½ N. High St., Columbus, O.
ENGINEERS' CLUB OF PHILADELPHIA.
Dec. 19. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERS' CLUB OF MINNEAPOLIS.
Dec. 21. Secy., Elbert Nexsen, 1620 S. E. 4th St., Minneapolis, Minn.
WISCONSIN POLYTECHNIC SOCIETY.
Dec 22. Secy., W. K. Means, Loan and Trust Bldg., Milwaukee, Wis.
ENGINEERING ASSOCIATION OF THE SOUTH.
Dec. 24. Secy., L. P. Brown, Nashville, Tenn.
INDIANAPOLIS ENGINEERING CLUB.
Dec. 26. Secy., C. C. Brown, Indianapolis, Ind.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Dec. 31. Annual meeting, Jan. 12, in Montreal. Secy., C. H. McLeod, Montreal, Can.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Jan. 1. Secy., O Von Geldern, 819 Market St, San Francisco, Cal.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Jan. 4. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF WESTERN NEW YORK.
Jan. 4. Secy., Carleton Greene, Library Bldg., Buffalo.
COLUMBIAN ENGINEERING SOCIETY.
Jan. 5. Secy., F. W. Hart, 15th and H Sts., N. W., Washington, D. C.
WESTERN SOCIETY OF ENGINEERS.
Jan. 6. Secy., N. L. Litton, Monadnock Block, Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
Jan. 6. Secy., Wm. H. Bryan, Turner Bldg.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 6. Annual meeting, Jan. 20, 21, in New York city. Secy., C. W. Hunt, 127 E. 23d St., New York.
BROOKLYN ENGINEERS' CLUB.
Jan. 7. Secy., A. J. Provost, Jr., 149 Pierrepont St., Brooklyn, N. Y.
CENTRAL RAILWAY CLUB.
Jan. 8. Secy., H. D. Vought, Buffalo "Courier," Buffalo. N. Y.
MONTANA SOCIETY OF ENGINEERS.
Jan. 9. Secy., Forrest J. Smith, Denver Block, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
Jan. 11. Secy., F. W. Tuttle, Baird Bldg.
RAILWAY SIGNALING CLUB.
Jan. 12. Secy., Geo. M. Basford, The Rookery Bldg., Chicago.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Jan. 12. "Some Problems in Street Railroading," by C. H. Short. Secy., F. A. Colburn, Case Library Bldg.
DENVER SOCIETY OF CIVIL ENGINEERS.
Jan. 12. Secy., Walter Pearl, 36 Jacobson Bldg.
NORTHWEST RAILWAY CLUB.
Jan. 12. Secy., T. A. Foque, Soo Line, Minneapolis.
NEW ENGLAND RAILROAD CLUB.
Jan. 13. Secy., Edwd. L. Jones, P. O. box 1158, Boston.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Jan. 14. Secy., James K. Zollinger, Norton Bldg.
ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
Jan. 19. Secy., Daniel Carhart, 410 Penn Ave., Pittsburg.
WESTERN RAILWAY CLUB.
Jan. 19. Secy., W. D. Crossman, The Rookery, Chicago.
ENGINEERS' AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Jan. 20. Secy., F. Van Vleck, Los Angeles, Cal.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Jan. 20. Secy., J. A. Pilcher, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Jan. 20. Secy., S. E. Tinkham, City Hall.
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Jan. 20. Secy., R. W. Pope, 26 Cortlandt St., New York city.
WESTERN FOUNDRYMEN'S ASSOCIATION.
Jan. 20. Secy., A. Sorge, Marquette Bldg., Chicago.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Jan. 21. Kimball House, Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
ENGINEERS' CLUB OF CINCINNATI.
Jan. 21. Secy., J. F. Wilson, P. O. box 333.
NEW YORK RAILROAD CLUB.
Jan. 21. Secy., W. W. Wheatly, 168 Montague St., Brooklyn.
NATIONAL ASSOCIATION OF MANUFACTURERS.
Jan. 26, 27, 28. Annual meeting in Philadelphia. Secy., E. P. Wilson, Cincinnati, O.
AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 16. Annual meeting at Chicago, Ill. Secy., R. W. Raymond, 13 Burling Slip, New York city.
NORTHWESTERN TRACK AND BRIDGE ASSOC.
Mar. 12. Secy., D. W. Meeker, St. Paul, Minn.

CIVIL ENGINEERS' CLUB OF CLEVELAND.—At the meeting of Dec. 8, Mr. Jos. W. Willard read a paper on "Explosives." He gave a brief history of explosives, their adaptation to the arts and to engineering and the possible future use in warfare of the so-called high explosives.

WESTERN FOUNDRYMEN'S ASSOCIATION. — The regular monthly meeting of the association was held at the Great Northern Hotel, Dec. 16, and the reports of the committees on "Apprenticeship" and "Cores" were discussed at some length. There was also discussion on a number of topical questions relating to foundry practice.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.—At the regular meeting held Dec. 7, Messrs. Wm. Danforth and C. A. Forbes asked the co-operation of the society with the Minnesota Association of Surveyors and Engineers, the Minneapolis Engineers' Club and the Engineering Department of the State University, in the endeavor to secure legislation in the matter of licensing land surveyors. Mr. Max Toltz read a paper on "Paint Tests at the Great Northern Railway Laboratory." The result of the experiments pointed to graphite paints as best adapted for preservation of iron and steel structures.

C. L. Annan, Secy.

WESTERN RAILWAY CLUB.—The regular monthly meeting of the club was held Dec. 15, at the Auditorium Hotel, Chicago. The paper presented at the November meeting by Mr. J. H. McConnell, entitled "Some of the Uses and Advantages of Compressed Air," was discussed and there were also topical discussions on the questions: "What Can be Done to Further the Use of Correct M. C. B. Standards?" and "What Additional Parts of Cars is it Wise and Feasible to Standardize?" The paper presented for discussion at the January meeting was by Mr. A. M. Waitt, and was entitled "Suggestions on Specifications for the Construction and Inspection of New Rolling Stock." Owing to the continued illness of Mr. W. D. Crossman, the Secretary of the Club, Mr. G. M. Basford, has been appointed Acting Secretary.

NEW JERSEY SANITARY ASSOCIATION. — The twenty-second annual meeting of the association was held at Lakewood, N. J., Dec. 11 and 12. We give below a report of those portions of the proceedings most interesting to engineers.

The fallacy of the idea so often advanced that the spread of diphtheria is caused by sewerage systems, defective or otherwise, was brought out by Dr. Samuel H. Durgin, Health Officer of Boston, in a paper entitled, "Influence of Schools on the Spread of Diphtheria." The Boston Health Board has investigated all cases of diphtheria which have occurred in that city since 1878. Negative results have followed attempts to connect diphtheria with filth. The influence of public schools on the spread of the disease is marked.

An interesting address was made by Col. Geo. E. Waring, Jr., on "The Influence of Clean Streets on Health," in which some of the benefits resulting from the change from dirty to clean streets in New York city were described. The change has been greatest in the crowded districts of the city, where the streets had been shamefully neglected. More than half of these streets were well asphalted, but that fact was not evident to the eye, except when rain washed off the heavy coating of mud. These streets are now largely used by children at play, and during the summer evenings almost their whole space is taken up with children and grown people seeking fresh air.

Owing to the inability of Mr. J. C. Smock, State Geologist of New Jersey, to be present, the paper on the programme, entitled, "Improvement of the Newark Meadows," was presented by Mr. C. C. Vermuele, Engineer of the Geological Survey. These meadows extend along the Hackensack River from Newark Bay some distance to the north, comprising an area of 27,000 acres. They are made up of 7 to 15 ft. of peat and blue clay, beneath which is a hard bottom of red sandstone and drift. This low, marshy land is thought to be productive of malaria and is known to produce mosquitoes. Similar land has been reclaimed in other parts of the state, 15,000 acres in Salem Co. and 6,000 in Warren Co.

East of the Orange Mountains and adjacent to or not far from these meadows is a population of some 900,000 people, and 12 railways cross the meadows, carrying large numbers of commuters. All these people, the paper urged, would be benefited by the improvement of the meadows. Filling in would be too expensive as a means of reclamation, the estimated cost of filling 6 ft. being $2,500 an acre. Drainage by ditches and pumping was recommended. The land reclaimed could be used for grazing purposes and market gardens, and might subsequently be built upon.

It is a fact not generally known that the Hackensack River affords a fine waterway for 18 miles from its mouth, besides having a number of navigable branches. With a little dredging, the main channel could be given a depth of 15 ft. In connection with meadow improvement, manufacturing establishments might be placed on the banks. Water frontage will soon be needed in this section. In fact, Jersey City already suffers from lack of it. Embankments 300 to 400 ft. wide and 4 ft. above mean high tide were suggested, under the ownership of the several municipalities, to be leased to private parties.

The meadow improvement should be carried out as a public undertaking, and as a whole, and not by sections, in order that the interest of none be neglected. If left to private enterprise, all but the most favorable portions of the work would be carried out, leaving untouched some sections most in need of improvement, especially from a sanitary standpoint.

The objection to simple drainage, without pumping, is that the meadow lands shrink with drainage, a condition to which pumping can be easily accommodated. Meadow land drained 27 years ago is 3 ft. lower now than it was then.

It was suggested that the work be done by a drainage commission, and that the reclaimed land be sold in small plots at auction. The estimated interest charges and operating expenses attendant on the improvement was put at $6 to $7 per acre.

The remaining paper to be noticed was on "River Pollution," by Dr. E. J. Marsh, of Paterson. Dr. Marsh is chairman of the commission appointed last spring to investigate the pollution of the Passaic River, and a large part of his paper was devoted to the Passaic River problem. The stream is divided into two parts, so far as pollution is concerned. The portion above Little Falls, which place is not far from Paterson, is little contaminated as yet, but at some points the population is increasing so that it needs to be watched to prevent the upper portion from gradually approaching the lower in character. Below Little Falls the river receives so large an amount of sewage as to render it a nuisance. Above Little Falls an effort should be made to keep the river pure enough so the water may be used for domestic purposes. Below this point the effort should be to prevent pollution giving offence to the eye and nose. This means that all sewage must be either excluded from the river, or purified before going into it, the preferable method at any point depending upon local conditions. As a general proposition, Dr. Marsh considered disposal into tide water the best means of disposal, where feasible. The idea that sewage has a manurial value is exploded, he said. River pollution problems should be delegated by the state to either an existing or a new commission, and not left to the separate municipalities. Rivers like the Passaic should, perhaps, have special guardians, but all streams should be protected from pollution by some centralized power, backed by proper legislation.

The committee on the protection of public water supplies, consisting of Messrs. J. L. Leal, M. D., Health Officer of Paterson; James Owen, M. Am. Soc. C. E., of Montclair, and Henry Mitchell, Secretary of the New Jersey State Board of Health, reported a resolution recommending that the necessary powers to prevent stream pollution be conferred on the State Board of Health, and on local boards.

The principal officers elected for the ensuing year were: Mr. James Owen, M. Am. Soc. C. E., President; Mr. John C. Smock, First Vice-President; Mr. W. G. Hoopes, Atlantic City, Corresponding Secretary; and Mr. Geo. P. Olcutt, Treasurer.

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CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Dec. 17.	Sewers, paving, etc.,	New York, N. Y.	Dec. 10
Dec. 17.	Water bonds ($48,000),	Asbury Park, N. J.	Dec. 3
Dec. 17.	Dredging,	New London, Conn.	Nov. 19
	Advertised, Eng. News, Nov. 19 to Dec. 10.		
Dec. 16.	U. S. building work,	Pueblo, Colo.	Nov. 26
Dec. 18.	U. S. building work,	Allegheny, Pa.	Nov. 26
	Advertised, Eng. News, Nov. 26 and Dec. 3.		
Dec. 18.	Tower and tank, at	Port Royal, S. C.	Nov. 26
Dec. 18.	Water pipe,	Cleveland, Ohio	Nov. 26
Dec. 18.	Light plant,	Frankfort, Ind.	Nov. 19
	Advertised, Eng. News, Nov. 19 to Dec. 3.		
Dec. 18.	Electric lighting,	Pittston, Pa.	Dec. 3
Dec. 18.	State armory work,	Brooklyn, N. Y.	Dec. 10
Dec. 18.	Water bonds ($400,000),	New Bedford	Dec. 17
Dec. 19.	Water pipe (162 tons),	Providence, R. I.	Dec. 17
Dec. 19.	Gas lighting plant,	Schenectady, N. Y.	Dec. 17
	Advertised, Engineering News, Dec. 17.		
Dec. 19.	Hire of dredging plant,	Mobile, Ala.	Nov. 19
	Advertised, Eng. News, Nov. 19 to Dec. 10.		
Dec. 19.	Lighting fixtures,	Auburn, Cal.	Nov. 12
Dec. 20.	Metal work (18 beacons),	New Orleans, La.	Nov. 26
Dec. 21.	Sewer construction,	Waukesha, Wis.	Nov. 26
Dec. 21.	Bridge, near	Manzanola, Colo.	Nov. 26
	Advertised, Engineering News, Nov. 26.		
Dec. 21.	Dredging,	Grand Rapids, Mich.	Dec. 3
Dec. 21.	Concrete wall,	Tompkinsville (S. I.), N.Y.	Dec. 10
	Advertised, Engineering News, Dec. 10.		
Dec. 21.	Cement,	Providence, R. I.	Dec. 17
Dec. 21.	Fire pumps,	Chicago, Ill.	Dec. 17
Dec. 21.	Sidewalks,	Omaha, Neb.	Dec. 17
Dec. 21.	Pipe sewer,	Rochester, N. Y.	Dec. 17
Dec. 21.	City supplies,	Philadelphia, Pa.	Dec. 17
Dec. 21.	Removal of telegraph system,	Baltimore.	Dec. 17
Dec. 21.	Fire equipment,	Philadelphia, Pa.	Dec. 17
Dec. 21.	Iron fence, mold, etc.,	New York, N. Y.	Dec. 17
Dec. 21.	Bridges (2),	Duluth, Minn.	Dec. 17
Dec. 21.	Street cleaning,	Indianapolis, Ind.	Dec. 17
Dec. 21.	Brick and pipe sewers,	Jersey City, N.J.	Dec. 17
Dec. 21.	Wagon road (25 miles),	Duluth, Minn.	Dec. 17
Dec. 22.	Paving and grading,	Pittsburg, Pa.	Dec. 17
Dec. 22.	Pedestal,	Philadelphia, Pa.	Dec. 17
Dec. 22.	County bridges,	Urbana, Ill.	Dec. 17
Dec. 22.	Excavating U. S. building,	Philadelphia, Pa.	Dec. 17
Dec. 22.	Heating and ventilating,	Boston, Mass.	Dec. 17
Dec. 22.	Asphalt paving,	Buffalo, N. Y.	Dec. 17
Dec. 22.	Boulevard,	Port Richmond, N. Y.	Dec. 10
Dec. 22.	Street railway,	Hamilton, Ohio	Dec. 3
Dec. 22.	Jetty at	Coquille River, Ore.	Nov. 26
	Advertised, Eng. News, Nov. 26 to Dec. 10.		
Dec. 22.	Heating, etc.,	Port Townsend, Wash.	Nov. 19
Dec. 23.	Dredging in	Connecticut	Nov. 26
	Advertised, Eng. News, Nov. 26 to Dec. 17.		
Dec. 23.	Electric light franchise,	Millville, N. J.	Dec. 3
	Advertised, Eng. News, Dec 3 and 10.		
Dec. 23.	Macadam paving, etc.,	West Hoboken, N. J.	Dec. 10
Dec. 23.	Highway bonds ($50,000),	Pascoag, R. I.	Dec. 10
Dec. 23.	City bonds,	Hoboken, N. J.	Dec. 17
Dec. 23.	City supplies,	Philadelphia, Pa.	Dec. 17
Dec. 23.	Gas main, etc.,	Plattsburg Barracks, N. Y.	Dec. 17
Dec. 24.	Sewer work,	Brooklyn, N. Y.	Dec. 17
Dec. 24.	Gas lighting,	New York, N. Y.	Dec. 17
Dec. 24.	Boilers (3),	Brooklyn, N. Y.	Dec. 17
Dec. 24.	Electric lighting,	Portland, Ore.	Dec. 3
	Advertised, Eng. News, Dec. 3 and 10.		
Dec. 24.	Water bonds ($200,000),	Cleveland, O.	Dec. 3
Dec. 26.	Electric lighting,	Cleveland, Ohio	Dec. 3
Dec. 26.	Officers' qtrs,	Governor's Island, N.Y.H.	Dec. 3
Dec. 26.	Electric light plant,	Newark, O.	Dec. 10
Dec. 26.	Electric light fixtures, etc.,	Chicago, Ill.	Dec. 10
Dec. 28.	Batteries,	Key West, Fla.	Dec. 10
	Advertised, Eng. News, Dec. 10 to 24.		
Dec. 28.	School bonds,	St. John, N. B.	Dec. 10
Dec. 28.	Brush and stone jetty,	Wilmington, Del.	Dec. 3
	Advertised, Eng. News, Dec. 3 to 24.		
Dec. 28.	Street railway franchise,	Los Angeles, Cal.	Dec. 3
Dec. 28.	Grading, curbing, etc.,	New York, N. Y.	Dec. 17
Dec. 28.	Gas, heating, etc.,	Providence, R. I.	Dec. 17
Dec. 28.	Plumbing (5 bldgs),	New York, N. Y.	Dec. 17
Dec. 28.	Electric wiring,	Providence, R. I.	Dec. 17
Dec. 28.	Air compressors,	Asbury Park, N. J.	Dec. 17
	Advertised, Eng. News, Dec. 17 and 24.		
Dec. 29.	Sewer pipe, etc.,	San Francisco, Cal.	Dec. 17
Dec. 29.	Bonds ($25,000),	Rockaway, N. J.	Dec. 17
	Advertised, Eng. News, Dec. 17 and 24.		
Dec. 30.	Electric plant (320 arc lights),	Montreal	Dec. 17
Dec. 30.	Steel rails (150,000 tons),	Sydney, N.S.W.	Aug. 6
	Advtsd, Eng. News, Sept. 3, Oct. 1, Nov. 5.		
Dec. 30.	Hire of dredge, etc.,	New Orleans, La.	Dec. 10
Dec. 30.	Vessels and tenders (5),	Washington, D.C.	Dec. 10
Dec. 31.	Water and light bonds,	Okolona, Miss.	Nov. 26
Dec. 31.	Electric lighting,	Saginaw, Mich.	Dec. 17
Jan. 1.	Brick paving (6,600 sq. yds.),	Athens, Pa.	Dec. 3
	Advertised, Eng. News, Dec. 3 and 10.		
Jan. 4.	Water-works,	Abbeville, Ga.	Dec. 10
	Advertised, Eng. News, Dec. 10 and 17.		
Jan. 4.	Water-works,	Scottville, Mich.	Dec. 17
Jan. 4.	Church building,	Harrisburg, Pa.	Dec. 17
Jan. 4.	Lighthouse work,	Cleveland, O.	Dec. 17
Jan. 5.	Monument,	Chickamauga, Ga.	Dec. 17
Jan. 5.	Dredging in	Peekskill Harbor, N. Y.	Dec. 17
	Advertised, Eng. News, Dec. 17 to 31.		
Jan. 5.	Laying water main,	Western Springs, Ill.	Dec. 17
Jan. 5.	Pipe sewers, etc.,	Western Springs, Ill.	Dec. 17
Jan. 5.	U. S. building work,	Omaha, Neb.	Dec. 10
	Advertised, Eng. News, Dec. 10 and 17.		
Jan. 5.	Steel or iron bridge (450 ft.),	Elkton, Va.	Dec. 10
Jan. 5.	Bridges (2),	Atchison, Kan.	Dec. 3
Jan. 5.	Terra cotta for bridges,	Milwaukee, Wis.	Dec. 3
	Advertised, Eng. News, Dec. 3 and 10.		
Jan. 6.	Electric wiring, etc.,	Massillon, O.	Dec. 10
Jan. 6.	Postoffice building,	Lynn, Mass.	Dec. 10
	Advertised, Eng. News, Dec. 10 and 17.		
Jan. 7.	Steel bridges (7),	Golconda, Ill.	Dec. 17
	Advertised, Engineering News, Dec. 17.		
Jan. 8.	Wooden bridge (220 ft),	Tillamook, Ore.	Oct. 8
Jan. 11.	Iron bridge (280 ft),	Albany, Ga.	Nov. 26
Jan. 11.	Water-works,	Momence, Ill.	Dec. 10
	Advertised, Eng. News, Dec. 10 to 24.		
Jan. 11.	Asphalt paving,	Toledo, O.	Dec. 17
Jan. 11.	Pipe sewers,	Springfield, O.	Dec. 17
Jan. 11.	Grading, curbing, etc.,	Springfield, O.	Dec. 17
Jan. 11.	Breakwater at	Marquette, Mich.	Dec. 17
	Advertised, Eng. News, Dec. 17 to Jan. 7.		

Jan. 12.	Dredging, Wilmington, Del.	Dec. 17
	Advertised, Eng. News, Dec. 17 to Jan. 7.	
Jan. 12.	County court house, Lewistown, Ill.	Dec. 17
Jan. 14.	Dredging, Portland, Me.	Dec. 17
	Advertised, Eng. News, Dec. 17 to Jan. 7.	
Jan. 14.	Water bonds ($1,695,000), Duluth, Minn.	Dec. 17
Jan. 14.	College building, Iowa City, Ia.	Nov. 19
Jan. 14.	County roads, Eureka, Cal.	Dec. 3
Jan. 14.	Steel lining for jail, Roseberg, Ore.	Dec. 3
Jan. 14.	Repairing wood bridge, Roseberg, Ore.	Dec. 3
Jan. 15.	Steel or wood bridge, Silver City, Idaho.	Dec. 3
Jan. 20.	Stone road, Woodbury, N. J.	Dec. 17
	Advertised, Engineering News, Dec. 17.	
Jan. 25.	County court house, Decatur, Ga.	Dec. 10
Feb. 16.	Pumping engines, St. Louis, Mo.	Dec. 17
Mar. 31.	R'y terminal plans, Christiana, Norway.	Dec. 17

RAILWAYS.

East of Chicago.

BRIDGTON & SACO RIVER.—This company has completed a preliminary survey of the extension from Bridgton to Harrison, Me., and later from Harrison to Norway. Pres., W. F. Perry, Bridgton, Me. A party of capitalists has been over the same route for an electric road.

CHICAGO, BLUFFTON & CINCINNATI.—It is stated that the proposed route for this railway is from Union City, Ind., to a point on the Baltimore & Ohio, near Milford Junction, traversing Blackford, Wells, Jay, Randolph, Huntington, Whitley, and Kosciusko counties. It is practically the same line as the old Cincinnati, Union City & Chicago. Hugh Dougherty and A. L. Sharpe, Bluffton, Ind., and Judge N. W. Bliss and F. W. Short, of Chicago, are said to be interested.

CHESTER COUNTY CENTRAL.—This company has been incorporated to operate a railway between Philadelphia and West Chester, Pa., with branches, in all 23 miles long. The capital stock of the company is $600,000, commencing with $60,000; incorporators: Pres., Wm. S. Kirk, West Chester, Pa.; John S. Dove, Jr.; Archibald R. Denney, Fred W. Rush, Joseph B. Willitts, George H. Fetter, Philadelphia.

DAYTON NORTHERN.—This railway, the incorporation of which was noted in our issue of last week, is projected to extend from Franklin to Lima, O., a distance of 125 to 150 miles; incorporators, James B. Townsend, W. B. Richie, C. N. Haskell, Edward R. Thomas, W. C. Brown and J. R. Megrue; capital stock, $10,000,000.

GRAND TRUNK.—It is reported that this company is considering the building of a branch from Norway to Bridgton, Me. Ch. Engr., Jos. Hobson, Montreal, Que.

HUDSON RIVER & BERKSHIRE.—It is stated that this company proposes to build from the New York state line to Springfield, Mass., via Mount Washington, Egremont, Great Barrington, Monterey, Otis and Sandisfield, in Berkshire county, and Tolland, Granville, Blandford, Russell, Southwick, Westfield and West Springfield, in Hampden county. Ch. Engr., H. F. Keith.

LAKE SHORE & MICHIGAN SOUTHERN. — The Youngstown, O., "Telegram" says that this company has decided to establish a new yard at that place. Ch. Engr., E. A. Handy, Cleveland, O.

LAKE SUPERIOR & ISHPEMING.—A press dispatch from Ishpeming, Mich., says that this company has decided to begin the extension of its line to the Ishpeming mines immediately after the holidays. Over five miles of track, including sidings, will be put in. Pres., Wm. G. Mather, Cleveland, O.

LEHIGH VALLEY.—It is reported that this company will in the spring construct a branch, beginning at Quakake, Pa., and running through the valley to East Mahanoy Junction; thence to Tamaqua, Pa. Ch. Engr., C. E. Webster, South Bethlehem, Pa.

MASSILLON & WOOSTER.—It is reported that a railway from Wooster to Massillon, O., a distance of 40 miles, will probably be built in the spring. It will tap extensive coal fields. W. J. Mullins, Wooster, is said to be interested.

MONONGAHELA CONNECTING.—It is stated that this railway, at McKeesport, Pa., is to be extended. It now connects with the Pennsylvania and extends through the plants of the W. Dewees Wood Co. The extension will not be made until next spring. It will be extended by the National Tube Works. Horace Crosby, Asst. Gen. Mgr. of the tube works, is president of the railway company.

MONTREAL & OTTAWA.—P. A. Peterson, Ch. Engr., Montreal, Que., writes us that this railway is projected through Rigaud, St. Eugene, Vankleek Hill, Caledonia Springs and Alfred. The line has been graded and track laid from Rigaud to Alfred, a distance of 27 miles, during 1896. The portion from Vandreuil to Rigaud, a distance of 17 miles, has been operated for five years. A line is projected and under survey from Alfred to Ottawa, a distance of about 50 miles. Construction has been done by day's work under supervision of the chief engineer. Pres., W. C. Van Horne, Montreal, Que.

ONTARIO & PACIFIC.—A press dispatch from Cornwall, Ont., says that the town council has decided to submit a bylaw to the taxpayers granting $35,000 as a bonus to the Ontario & Pacific Ry. for the construction of its road from Ottawa to Cornwall to connect with the Northern New York Ry. on the American side, the company to build its repair shop in Cornwall and build a freight shed and station in the town limits.

PEMIGEWASSET VALLEY.—The supreme court of New Hampshire has granted the petition of this company for permission to extend its line from Lincoln to a point one mile north of the Flume House. Work on the extension has been commenced, and it is the intention to have it completed and in operation in the early spring.

PENNSYLVANIA.—It is said that this company proposes to build a line from Mount Carmel to Shenandoah, Pa. Ch. Engr., W. H. Brown, Philadelphia, Pa.

PHILADELPHIA, BUSTLETON & TRENTON.—Jos. Crawford, Ch. Engr., Broad St. Station, Philadelphia, writes us that this line will extend from North Penn Junction to Bustleton, Pa., a distance of eight miles. Work will be finished in a few days on the first 3½ miles. Chas. M. Fadden, 122 Arch St., Philadelphia, contractor. Pres., Samuel Rea, Broad St. Station, Philadelphia.

PITTSBURG & LAKE ERIE.—Reports from Pittsburg state that negotiations are pending which may result in the Pittsburg & Lake Erie building a branch from its main line across Neville Island. The estimated cost of the road is $150,000. It would be seven miles long. Two bridges would have to be built. Ch. Engr., J. A. Atwood, Pittsburg, Pa.

PITTSBURG, BESSEMER & LAKE ERIE.—It is announced that Andrew Carnegie's consolidated lines are to be called by his name, indicating the terminals of the road and emphasizing the fact that the system is essentially an ore line. The work on the Butler & Pittsburg is being pushed rapidly, as noted Dec. 10, and it is thought that tracklaying will begin next month. The Carnegie Steel Co. is now filling the first order of 2,500 tons of 100-lb. steel rails. The tracklaying will commence at the Butler end of the road, from which point there is a larger amount of trestling which is nearly completed. The initial tracklaying will consist of a single track from Butler to the first large culvert, and it will be used for hauling the heavy material for viaducts. This tracklaying will be done by workmen of the Pittsburg, Shenango & Lake Erie. As fast as the viaducts are completed it is the intention of the company to continue the tracklaying until the Allegheny river is reached. It is estimated that 1,600 tons of rails will be used in laying the first 10 miles; the remainder of the 2,500-ton order will be used for terminal facilities at Butler.

QUAKERTOWN & EASTERN.—It is said that the stockholders intend to issue bonds for $180,000, with which to finish the new road, now in the course of construction. The line leaves the Reading Ry. at Quakertown, Pa., and connects with the Lehigh & Hudson River Ry. at Easton, Pa.

SOUTH HAVEN & EASTERN.—A report from South Haven, Mich., says that there is rumor to the effect that the management will put in a standard gage in the spring and extend the line to Holland. Pres., R. B. Dodson, New York city.

Southern.

BIG MOUNTAIN.—This company was incorporated Dec. 14 to build a railway from Cedar Grove, W. Va., up Kelley Creek and the Kanawha River to a connection with the Chesapeake & Ohio. Incorporators: G. S. Couch, C. B. Couch, L. W. Couch, R. T. Carmichael, S. L. Flourinoy, all of Charleston, W. Va.

BOWLING GREEN NORTHERN.—M. H. Crump, Lynden, Ky., is quoted as saying that the Illinois Central may become interested in this scheme to build a railway from Litchfield, Ky., to Bowling Green and Nashville, Tenn., a distance of 100 miles. Surveys have been completed from Bowling Green to a connection with the Illinois Central, and most of the right of way secured.

DURHAM & CHARLOTTE.—It is stated that work has been resumed on the five-mile extension to Charlotte. About 50 men are at work. Ch. Engr., J. T. Tull, Glendon, N. C.

FLORIDA WESTERN.—Reports state that the work of building from Apalachicola to Carrabelle, Fla., is being pushed as rapidly as possible. Three miles of the road have been graded. Contracts will soon be let for rails, also for bridging Crooked River, and building five miles of trestling across Apalachicola Bay. Two drawbridges will be required in the latter. Hopkins & Damond are the contractors. Pres., R. S. Burnett, Tallahassee, Fla.

KENTUCKY NORTHERN.—This company, it is reported, expects to construct a 28-mile extension during the coming year. The road is completed to a point 7¼ miles from its terminus. Ch. Engr., A. J. Thurber, Rodbourn, Ky.

MOBILE, JACKSON & KANSAS CITY.—Frank B. Merrill, Pres., Mobile, Ala., writes us that the projected length is 186 miles from Mobile via Hattiesburg, Miss., to Jackson. Entire line surveyed and right of way and terminals purchased; syndicate organized to take securities; contracts for entire line let to Gulf City Construction Co., Mobile, as noted in our issue of Dec. 10; work on grading began Dec. 1 and five miles of rail will be laid by Jan. 1; about 20 miles now under grading and right of way cleared 50 miles. Ch. Engr., J. H. Collins, Mobile, Ala.

NEW ROADS.—Melton Bros., E. C. Beardsley, and J. M. Guffey, Pittsburg, Pa., and White, Drake & Stratton, the projectors of the Cheat River R. R., which it is proposed to build from Point Marion, in Fayette county, W. Va., to a point in Preston county, W. Va., who recently closed a deal for the purchase of 50,000 acres of coal land in Preston county, W. Va., will, it is stated, build a railway into and through their tract, connecting probably with the Cheat River Ry., at an early date.

NORFOLK & SOUTHERN.—A press dispatch from Raleigh, N. C., says that this railway will soon be extended. At present it extends from Norfolk to Elizabeth City, N. C., 113 miles, and the proposed extension will be from Elizabeth City and Edenton south, possibly to Newbern, Wilmington and Washington, N. C. Pres., W. B. Dickerman, New York, N. Y.

NORTH CAROLINA LUMBER.—A press report from Weldon, N. C., states that J. F. Wrenn, of Richmond, Va., has secured the contract to build seven miles of standard gage railway for the North Carolina Lumber Co. at Tillery. Work will begin at once with a large force of hands.

TUSCOMBIA.—It is reported that T. A. Clark, Tuscombia, Ala., wants contractors to build a short railway.

WINDSOR & SKOSKIE.—The Browning Mfg., R. R. & Lumber Co., it is stated, will build a railway from Windsor to Skoskie, N. C., 15 miles, where connection will be made with the Atlantic Coast Line.

WEST VIRGINIA & PITTSBURG.—It is reported that work on an extension from Pickens to Addison, W. Va., 12 miles, will be commenced within two weeks. Webster county subscribed $15,000 to the road, provided operations were under way by Jan. 30. Pres., J. N. Camden, Parkersburg, W. Va.

Northwest.

CHICAGO, MONTELLO & NORTHWESTERN.—This company is said to have made a proposition to build a line from Princeton to Montello, Wis., and it is expected that it will be constructed in the spring.

CHICAGO & NORTHWESTERN.—The second track between Baraboo and Madison, Wis., 37 miles, has been completed by Winston Bros., contractors, Minneapolis. The work was begun about a year ago and has cost over $1,000,000.

DULUTH & SOUTHWESTERN.—A press dispatch from Duluth, Minn., says that this company has decided to ask St. Louis county for $250,000 to aid in extending the line from Red Wing to Duluth, and that the chamber of commerce of Duluth has considered the proposition favorably. The Duluth & Southwestern is planned to run from Duluth southwest to the Iowa line, connecting with the Duluth, Red Wing & Southern, and using that road's tracks for part of its line. Associated with the Duluth parties who are in the deal is ex-Governor Hubbard, of Red Wing. Engr., W. Danforth, Red Wing, Minn.

GREAT NORTHERN.—A press report from Grand Rapids, Minn., says that a preliminary survey is being made from Deer River to Hibbing Mines. Ch. Engr., J. F. Stevens, St. Paul, Minn.

EMERALD & SPRING VALLEY.—A report states that D. M. Sabin and E. D. Buffington, of Stillwater, Minn., are incorporators of a railway to be built from Emerald, St. Croix county, to Spring Valley, Pierce county, Wis., about 26 miles. The capital stock is $55,000.

LAKE MANITOBA RAILWAY & CANAL.—This company has completed its railway for 100 miles in a northerly direction, fully equipped; it was to have commenced operating about Dec. 15. The company has secured running powers for 50 years from the Manitoba & Northwestern Ry. between Portage la Prairie and Gladstone, Gladstone being the point of junction. It will therefore operate from Portage la Prairie to the end of the Dauphin Road, a distance of 136 miles. The contractors were Messrs. Mackenzie, Mann & Co., Gladstone, Manitoba; Ch. Engr., T. H. White, Gladstone, Manitoba; Pres., F. Nichols, Toronto, Ont.

QUINCY, OMAHA & KANSAS CITY.—It is stated that the contract for the construction of a railway between Trenton and Pattonsburg, Mo., 34 miles, which means the connection between the Quincy, Omaha & Kansas City Ry. and the Omaha & St. Louis, has been let to M. S. Cartter & Co., St. Louis. The preliminary survey of the road was made last spring. It is asserted that the work has begun, and will be completed within the next 60 days. Ch. Engr., C. M. Collins, Quincy, Ill. Theo. Gilman, 62 Cedar St., New York city, is president of the Quincy, Omaha & Kansas City Ry. Co.

SUBURBAN.—A press dispatch from Chicago says that a mortgage for $3,000,000 has been given on all its property, real and personal, by the Suburban R. R. Co., to the Chicago Title & Trust Co., in insure an issue of that amount of bonds to be dated Mar. 2, 1893, and to run for 20 years. The instrument provides for an immediate issue of $1,250,000 worth of bonds for construction of lines already begun or projected, while the remaining $1,750,000 will be used for the extension of the company's lines and feeders. It is the intention of the suburban company, after the lines now under construction have been completed, to extend the road as far as Western Springs and Hinsdale.

Southwest.

ATCHISON, TOPEKA & SANTA FE.—A press dispatch from Stillwater, Okla., says that the people of this city have secured the right of way and raised the $30,000 cash bonus asked by the company to build a branch line from Arnettville, six miles north of Perry, to this place. The work will begin on construction before Jan. 1, and trains be running by spring. Ch. Engr., J. Dun, Topeka, Kan.

GULF & BRAZOS VALLEY.—A press dispatch from Fredericksburg, Tex., says that this company may run a line immediately from the Texas & Pacific R. R. to Granby, Hamilton, Lampasas, Llano, Fredericksburg and Comfort on the Aransas Pass R. R.

GULF & SHIP ISLAND.—A branch of about four miles from Gulfport, on the coast, to Handsboro, Miss., has been finished. Herman Clark and John R. Westbrook, contractors, of New York city, are said to be considering contracts on the proposed extension of the road north to Pontotoc, Miss. Pres., J. T. Jones, Bradford, Pa.

KANSAS CITY, PITTSBURG & GULF.—It is reported that this company will build 16 miles of line between Dearborn & Smithville, Mo., and that the Winner bridge across the Missouri River is to be completed for railway purposes. Ch. Engr., R. Gillham, Kansas City, Mo.

ST. JOSEPH & GRAND ISLAND.—It is rumored that the St. Joseph & Grand Island Ry. will extend its line to Kansas City, Mo., and that the plan is to buy the Kansas City & Atlantic R. R., which extends from Kansas City to Smithville, and then extend the line to a connection with the St. Joseph & Grand Island in St. Joseph, Mo. Pres., S. H. H. Clark, Omaha, Neb.

Rocky Mountain and Pacific.

BEAR LAKE.—A press report says that this company has been granted a franchise in Idaho for railway tracks between Georgetown and Montpelier, and from the latter place through Paris, Bloomington and other places to the south line of Bear Lake county, on the west side of Bear Lake. The road is intended to continue into Rich county, Utah.

CUYAMACA.—The San Diego, Cal., "Sun" says that farmers living along the route propose to grade the roadbed of an extension of this railway from a point about midway between Santee and Lakeside, up through Sycamore canyon to Ramona, a distance of 17 miles. This route was discovered to be very feasible, being of easy grade, the heaviest only 2½%. It is expected to have the work completed by Sept., 1897. C. P. Fisher and Chester Gunn are interested.

COLORADO SPRINGS, PIKE'S PEAK & CRIPPLE CREEK.—This railway is projected from Colorado Springs, Colo., in a westerly direction up Bear Creek 3½ miles into Crystal Park, reaching the park in 13 miles, then passing Gog and Magog, one of the scenic points on the Cog road, and past the Seven Lakes, reaching this resort in 21 miles from Colorado Springs; through Gillett, Big Trachyte Mountain and thence into Cripple Creek This route places Gillett 35 miles from Colorado Springs and Cripple Creek 40 miles. It will be a scenic route, traversing beautiful scenery. The preliminary survey is completed as far as Crystal Park. Work is expected to begin about Jan. 1, and the line will be completed about Oct. 1. The company is having no difficulty in placing bonds. The grade will not exceed 4%. Ch. Engr., Eugene L. Robinson, Gillett, Colo.

GOLDEN CIRCLE.—Colorado papers announce that this road is to be extended immediately from Victor, Colo., through the Cripple Creek mining region, about 10 miles. This will give the line and its controlling company, the Florence & Cripple Creek, a connection with practically every important mine in the Cripple Creek District. Engr., R. D. Stewart, Florence, Colo.

MEXICO.—A San Diego, Cal., dispatch says that the government has annulled the concession given to Albert R. Owen and the Topolobampo Colony, in Sinaloa, which was granted six years ago. The concession gave about 1,000,000 acres on Rio Fuerte to Owen and his colony for a nominal sum, with the proviso that they build a railway and certain irrigating canals. Only a small remnant of the original colonists are now at Topolobampo, and they are too poor to move away.

REDDING & EUREKA.—The statement is made that the Iron Mountain Mining Co., an English organization, with local headquarters at Redding, Cal., has undertaken the work of building a railway between these towns in California.

SALMON CREEK R. R. EXTENSION.—This company was incorporated Dec. 3 to build a railway from Salmon Creek, Mendocino county, Cal., to a point seven miles north. The capital stock is $100,000, commencing with $10,000. Incorporators: W. H. White, Elk; J. H. Tate, San Francisco; James Townsend, N. W. Hall and J. M. Robinson, Oakland, Cal.

SILVER CITY & NORTHERN.—The Silver City, N. Mex., "Enterprise" says it is rumored that the Silver City & Northern R. R., together with the iron mines, owned and operated by the same company, and about 36,000 acres of patented coal lands, at the north end of the San Augustine plains, have been sold to a syndicate which represents the Atchison, Topeka & Santa Fe R. R. interests. The purchase price is said to be $1,000,000. It is said to be the intention to reconstruct the road. Pres., Silver City & Northern, C. L. Perkins, 66 Beaver St., New York city.

SALT LAKE & OGDEN.—This company has been incorporated as a reorganization of the Great Salt Lake & Hot Springs Ry., which was recently sold under foreclosure. The road, it is said, will be extended to Ogden, Colo., and operated by steam until the plant of the Pioneer Electric Power Co. is completed, when it will be equipped with electricity. Pres., C. K. Bannister; Vice-Pres. and Gen. Mgr., Simon Bamberger; Treas., E. W. Duncan.

Foreign.

NORWAY.—Plans for railway terminals at Christiana, Norway, are invited, and prizes of $2,500, $1,000, $500 and 250 are offered by the government for the best plans, all plans to be submitted by March 31, 1897. Address Railway Office, Dept. Pub. Wks., 6 Victoria Terrace, Christiana, Norway.

STREET AND ELECTRIC RAILWAYS.

ALBANY, ME.—An electric railway is projected connecting Norway with Stoneham, Waterford, Albany, and Harrison, 28 miles long. It will be principally a freight route, but will also have cars for passengers, mail and express.

BANGOR, ME.—The Penobscot Electric Ry. Co. has been formed to build from Bangor, up the Kenduskeag valley to the towns of that section, which now depend upon stages for communication. The road will pass through the towns of Glenburn, Kenduskeag, Levant, Corinth, Exeter, Charlestown and Garland. The capital stock is $250,000. E. O. Beal, of Bangor; I. C. Libby, of Waterville; A. F. Gerald, of Fairfield; Harrison F. Gould, of Kenduskeag; and C. E. Edmunds, of Corinth, are interested.

ATTLEBORO, MASS.—The Consolidated Ry. Corporation it is reported will adopt electricity on its lines. Vice-Pres., J. R. Kendrick.

MANSFIELD, MASS.—Articles of association for the Foxboro Union St. Ry., to connect the villages of Foxboro and Mansfield have been signed by subscribers to about $25,000 of stock; the capital stock is to be $60,000.

NORTHAMPTON, MASS.—W. D. Winter, Springfield, Mass., writes us that the Northampton St. Ry. Co. has applied for two miles of right of way. No capital has as yet been secured; it is expected, however, to let contracts in the spring. Pres., J. Olmsted, Springfield.

WAREHAM, MASS.—It is reported that a company has been organized and the route surveyed for an electric railway connecting the extremity of Cape Cod with Chatham, Harwich, Dennisport, Hyannis, Yarmouth and Falmouth. Then the contemplated line runs north to Buzzard's Bay, connecting with the trolley road to New Bedford, via Mattapoisett and Marion.

BERLIN, CONN.—It is said that contracts have been signed for the construction of an elecertic power station at Berlin. The new plant will, from a central point, operate the Berlin and Middletown branches and the New England tracks from New Britain to Hartford, of the New York, New Haven & Hartford Ry. It will also operate the electric system in Meriden and light all the railway stations, including the one at Hartford.

HARTFORD, CONN.—The Hartford St. Ry. Co. will apply soon for privilege to extend its lines.

MERIDEN, CONN.—Gilbert E. Norton, Charles F. Hamlin, Wheaton S. Plumb, Augustus M. Lewis and others will apply to the next legislature for a charter for a trolley line from Meriden to Southington and Plainville.

WINSTED, CONN.—A. B. Hill, Engr., Benedict Bldg., New Haven, writes us that several prominent citizens in Torrington and Winsted have petitioned the legislature for a charter for an electric railway in the principal streets of the two boroughs and for connecting them. They are about ten miles apart and the total length asked for is about 20 miles. The company is not organized yet. O. R. Fyler, of Torrington, is the chief promoter.

WATERTOWN, CONN.—A line of electric railway is projected from Watertown, the terminus of the Watertown branch of the New York, New Haven & Hartford R. R., to Bantam Lake and Litchfield, a distance of about 12 miles. A line is also proposed from Litchfield, through Goshen to Norfolk, a distance of about 16 miles. Surveys, it is said, are being made by T. H McKenzie, Hartford. Ex-Senator O. N. Pierce is interested.

WESTVILLE, CONN.—Surveys are said to have been made for a trolley road from Westville to Naugatuck, running via Woodbridge and Seymour, a distance of 15 miles. The cost of the proposed line is estimated at $200,000. The enterprise is backed by Morris F. Tyler, Dr. Thomas H. Russell, Dwight N. Clark, Robert Payne, Stiles Williams, Charles F. Walker, Rollin C. Newton and Nathan P. Merwin.

ELMIRA, N. Y.—C. H. Baldwin, Gen. Mgr., writes us that the projected length of the Elmira & Seneca Lake Ry. is 16 miles from Elmira, via Horsehead, Millport and Havana, to Watkins. The surveys are completed and right of way secured; capital not fully secured; contracts will probably be let in the spring. Pres., John E. Mulford, Havana, N. Y.

GREENWICH, N. Y.—The state railroad commission has granted the application of the Greenwich & Schuylerville Electric R. R. Co. for permission to construct its road.

GARDINER, N. Y.—It is said that Charles E. Johnston, 43 John St., Kingston, N. Y., is looking over the ground between Pancake Hollow and Jenkintown with a view of building a trolley line. The road will run through Gahow, Tuttletown, Ireland Corners, connecting the above places. He expects to form a stock company and would have contractors correspond with him.

BRISTOL, PA.—The town council has granted the Langhorne Trolley Co. the right to build a trolley belt line about the town.

CHESTER, PA.—John B. Robinson, House of Representatives, Washington, D. C., writes us that the projected length of the Media, Middletown, Aston & Chester Electric Ry. is 16 miles, connecting the towns named. About $6,000 has been subscribed to secure franchises and right of way. John E. Burnby and S. L. Kent have been appointed a committee to finance the road. Ch. Engr., Geo. D. Howell, Chester, Pa.

PHILADELPHIA, PA.—An ordinance has been passed granting the Holmesburg, Tacony & Frankford Electric Ry. Co. the right to equip its lines with electricity.

WASHINGTON, D. C.—Work on the division of the Columbia & Maryland Ry., from Washington to the District of Columbia line, has been resumed. The contract for the completion of the division has been awarded to Maurice Tolty, of Washington. The work is commenced under an order of the court of the District of Columbia authorizing the issuing of $75,000 in receivers' certificates. The section of track to be finished includes about six miles and, by the charter, must be ready for operation by March 2 next.——It is reported that the construction of a recently surveyed electric railway from Washington to Gettysburg, by way of Frederick, Md., will be begun next spring, or probably this winter, if the weather will permit. The company is working under a charter known as the Baltimore & Washington Transit Co., and under this it has the right to construct and operate throughout the State of Maryland. Its capital stock is $1,000,000, commencing with $110,000. The route, as surveyed from Washington, is via Tacoma Park, Sandy Springs, Olney, Laytonsville, Frederick City, Hansonville, across the ridge to Thurmont, Emmittsburg, and State Line to Gettysburg. Gen. Mgr., Frank C. Draue, Tacoma Park, D. C.

BALTIMORE, MD.—An ordinance has been introduced in the city council to authorize the City & Suburban Ry. Co. to agree with the City Passenger Ry. Co. for the joint use of the latter's tracks on Broadway, between Eastern Ave. and Thames St., or to lay rails inside and outside the City Passenger tracks in case of failure to come to an agreement. The line is to be an electric one and authority is given for the erection of poles and stringing of wires.

GEORGETOWN, MD,—It is rumored that the Georgetown & Tenallytown Electric Ry. will be extended to Rockville in the spring.

CHATTANOOGA, TENN.—The power house and station of the Lookout Mountain & Lulu Lake Incline Ry. Co., located on the eastern brow of Lookout Mountain, was completely destroyed by fire Dec. 12. The loss will reach $25,000; insurance, $15,000. The cable holding the upper car snapped in the midst of the excitement and the car, a mass of flames, bounded down the steep incline. The road is operated by electricity, and was completed last April at an outlay of $100,000. This incline is a straight track over a mile in length, and near the summit a climb is made at an angle of 68°.

ASHLEY, O.—A. S. Shoemaker is said to be interested in projecting an electric railway to connect Mount Vernon, Ashley, Prospect and Richwood. Subscriptions are being taken to defray the expenses of a survey.

EAST LIVERPOOL, O.—It is stated that preliminary lines have been run for a street railway from East Liverpool to Smith's Ferry, Pa., five miles east. Agents are at work securing the right of way, and negotiations have begun for the purchase by the syndicate of Columbiana Park, a pleasure resort.

LOCKLAND, O.—The Main Street Electric Ry. of Cincinnati will, it is said, be extended to this place. The cost of the extension will be about $10,000.

MARIETTA, O.—The Marietta St. Ry. Co., it is said, will build five miles of additional track to be operated by electricity.

PIQUA, O.—Work on the Piqua, Sidney & St. Mary's Electric R. R. is being pushed. The second assessment is being paid, and a complete survey of the line is being made.

MASON CITY, IA.—L. H. Ong, Ch. Engr., writes us that the projected length of the Mason City Clear Lake Traction Co.'s lines is 16½ miles to connect Mason City and Clear Lake. Survey made and right of way secured; 55% of the capital advanced by the promoter; will cost, when completed, $210,000; grading and pole setting is being rapidly pushed; it is expected that cars will be running by June 1, 1897. Equipment will be bought within a few days. Pres., W. E. Brice.

KANSAS CITY, MO.—The Northeast Electric Ry. Co. has filed a certificate of incorporation.

NEW ORLEANS, LA.—Robert R. Zell and others are said to be considering the construction of an electric line in Jefferson parish. It is to extend to Lake Pontchartrain.

SONORA, CAL.—J. Q. App and others have been granted the privilege to erect and maintain an electric system along public roads in this county.

SACRAMENTO, CAL.—The Sacramento Electric Gas & Ry. Co. has been incorporated with J. W. Hall, L. T. Hatfield, Albert Gallatin, Jr., L. P. Drexler and Charles R. Lloyd as directors.

ELECTRIC LIGHT AND POWER.

CONCORD, N. H.—The council voted Dec. 8 to appropriate $1,000 for the purchase of a storage battery plant for the fire department. W. B. Howe, Cy. Engr.

PROVIDENCE, R. I.—Bids are asked until Dec. 28 for the electric wiring of two school buildings. Lewis & Claftin, Elec. Engrs., 146 Westminster St., Providence; B. E. Perkins, Chn. Com., City Hall.

CAMBRIDGE, MASS.—The aldermen have voted to appropriate $3,000 for an electric light plant for the city hall. Aldermen Bleiler, Rourke, Saunders, Geogins and Chaplin can be addressed.

MARION, MASS.—It is stated that Benj. Waters, of Brockton, Mass., will build an electric light plant in this city to be completed by May 1.

SANDWICH, MASS.—The construction of an electric light plant is proposed for this place by E. C. Bourne, according to reports.

TAUNTON, MASS.—The city has voted in favor of constructing a municipal electric light plant. J. W. Fish, Mayor.

ANGELICA, N. Y.—The construction of a city electric light plant is being discussed, according to reports.

MASSENA, N. Y.—Press reports state that work will probably soon be begun on a proposed power plant between the St. Lawrence and the Grass Rivers in this town. The St. Lawrence is to be tapped two miles below the southern end of Long Sault Island, and the canal will run over a comparatively level plateau till it reaches a drop of about 40 ft. at Massena, on the Grass River. Here the turbines will be put in, and an electric plant will be erected. The canal will be about four miles long, 300 ft. wide and 25 ft. deep, if it is decided to obtain only 100,000 HP. John Bogert, Consult. Engr., 50 Wall St., N. Y., is said to estimate the cost of such a waterway at $1,000,000. Stewart & Co., 40 Wall St., New York, have bought about 1,800 acres of land through which the canal will run, and will manage the enterprise. Lieut. James Patton is designing the electrical plant.

MOHAWK, N. Y.—The court has granted a temporary injunction restraining Albert M. Day and other members of the water and light commission from constructing the proposed electric light plant, according to reports.

MORRISVILLE, N. Y.—It is stated that work will be begun at once on the reconstruction of the electric light plant, destroyed by fire in October. M. E. Pulver, of the Westinghouse Electric & Mfg. Co., Bastable Bldg., Syracuse, N. Y., is said to be the owner. He has secured a lighting franchise for this place.

TROY, N. Y.—It is reported that the Troy Electric Light Co. is making arrangements for the immediate extension of its plant. John F. Cahill, Gen. Supt.

ATLANTIC CITY, N. J.—The Atlantic Electric Light & Power Co. has been granted a franchise for constructing conduits, pipes, etc., for supplying the city with light, power and heat; bond, $25,000. The work is to be completed in a year. F. P. Stoy, Mayor; J. D. Southwick, Pres. Council.

CAMDEN, N. J.—Phillips Anns, of Woodbury, N. J., has been awarded the contract for erecting a boiler and engine house for the Camden Lighting & Heating Co., to cost $30,000. Arch., H. D. Dagit, 706 Walnut St., Philadelphia.

BOILING SPRINGS, PA.—The Carlisle Electric Light, Heat & Power Co., Boiling Springs, will commence work on the erection of a plant about Jan. 1, and expect to have it in operation by April 1. This company was recently granted a charter. Treas., M. P. Quinn, Pottsville, Pa.

PITTSBURG, PA.—The following bids were received Dec. 9, by J. O. Brown, Dir. Pub. Safety, for constructing an electric light plant for the public safety building: Fisher Foundry & Machine Co., to supply the Westinghouse system, $14,950; Western Electric company system, $14,500; Triumph Electric company system, $13,500. Westinghouse Electric Co., Pittsburg, for its own entire system, $13,173. Westinghouse, Church, Kerr & Co., 26 Cortlandt St., New York (awarded contract), for their own system, $12,845.

CUMBERLAND, MD.—The council is considering the question of submitting the question of issuing $20,000 of 4% bonds, for an electric light plant, to the voters at the election in May.

CAPE CHARLES, VA.—It is stated that the construction of an electric light plant for this place is proposed.

LENOIR, N. C.—The construction of an electric light plant, water-works, etc., for this place is being considered by the board of trade, according to reports. S. T. Pender, Secy.

WASHINGTON, N. C.—This town will probably soon put in an electric light plant. Stephen C. Bragaw, Chn. Water-Works and Electric Light Com.

WELDON, N. C.—The construction of a power plant on the canal of the Roanoke Navigation & Water Power Co. is proposed, according to reports.

BAINBRIDGE, GA.—The construction of an electric light plant by a company is proposed, according to reports.

ORLANDO, FLA.—Mr. Hugbert, of Zellwood, Fla., is said to be making arrangements for the construction of an electric light plant for this city.

THIBODAUX, LA.—We are informed that this city is projecting a system of electric lights, but nothing has been done as yet. Address R. J. Naquin, Thibodaux.

GREENUP, KY.—An electric light franchise is reported to have been granted to Wilson Bros. of this place.

EAST PALESTINE, O.—The council is reported to have rejected all the bids received recently for constructing an electric light plant and has decided to ask for new ones.

MARTIN'S FERRY, O.—The council is reported to have decided, Dec. 5, to advertise for bids for operating the electric light plant.

XENIA, O.—An electric light company has been organized to build an electric light plant. John P. Martin, Pres., Xenia.

ANDERSON, IND.—The county commissioners are considering the cost of an electric light plant for the jail and courthouse, according to reports.

NORTH LIBERTY, IND.—A citizens' committee has been appointed to secure estimates for an electric plant of 10 arc and 200 incandescent lights.

BELLEVILLE, ILL.—Adam Gintz, of Belleville, is reported as proposing to build an electric light plant here.

SAGINAW, MICH.—Bids are asked until Dec. 31 for lighting the streets and parks with electricity for three and five years from Sept. 30, 1897. The plant will need 13 towers of four lights each, and 146 pole and mast-arm lights. Arthur F. Lewis, Controller.

CHICAGO, ILL.—The village trustees of Cicero have rejected bids recently received for lighting Oak Park and Ridgeland with incandescent lights, and have asked for new bids on arc lighting.

CORRECTIONVILLE, IA.—An election was held Dec. 14 to vote on the question of constructing an electric light plant and water-works.

ROCK RAPIDS, IA.—We are informed that bids will soon be asked for constructing an electric light plant in this city. J. K. Medberry, Recorder.

MINNEAPOLIS, MINN.—The Stilwell-Bierce & Smith-Vaile Co., Dayton, O., is reported to have been awarded the contract for 14 pairs of horizontal waterwheels for the new power plant of the St. Anthony Falls Water Power Co., at about $40,000. It is hoped to complete the dam by July 1. Engr., Wm. de la Barre, Minneapolis.

GRAND FORKS, N. DAK.—The question of granting a franchise for lighting the streets is under discussion.

EMPIRE, COLO.—The construction of an electric light plant for this place is being considered. Frank L. Peck, Mayor.

MANITOU, COLO.—F. L. M. Smith, owner of the Hiawatha Club House, has decided to put in a complete electric light plant, with a capacity for 300 incandescent and five arc lights, to cost about $7,000.

OPHIR, COLO.—Press reports state that an electric light plant is to be established here. Surveys have already been made. Power will be brought from the Nunn power plant at Ames, which supplies the power for the surrounding country and the Telluride district. It is the intention also to supply power for the Carribeau, Suffolk, Globe, and Ilium mills in case it is desired.

GUTHRIE, OKLA.—We are informed regarding the reported electric lighting of this city that as other arrangements have been made the city will not erect any plant at present. Geo. M. De Graff, Cy. Clk.

SKAMOKAWA, WASH.—An electric light plant for the sawmills, etc., is proposed, according to reports. W. W. Bollen. Elec. Engr., Portland, Ore.

OAKLAND, ORE.—The Roseberg Electric Light Co., Roseberg, Ore., is said to be making estimates for lighting this town with electricity.

MARTINEZ, CAL.—Orders are being secured by Max Kuhn, of San Francisco, and D. W. Weisenberg & Co., for a proposed electric light plant.

GALLUP, N. MEX.—Fred Ramsay, of Waltonburg, Colo., is said to contemplate putting in a complete system of electric lights for the city.

RENO, NEV.—E. R. Dodge, Dr. W. A. Phillips and Geo. Lacombe have been appointed a committee to secure data relative to electric lighting in this city.

QUEBEC, QUE.—Bids are asked until Dec. 30 for constructing an electric plant of 320 arc lights and for lighting this city from Aug. 1, according to reports. W. D. Baillarge, Asst. Cy. Inspector.

CHATHAM, ONT.—It is reported that the council will soon want bids for the construction of an electric light plant.

NEW COMPANIES.—Battery Power & Light Co., New York, N. Y.; $3,000,000, with $1,000 paid in; incorporated in West Virginia, Dec. 8; T. L. McConchie, Passaic, N. J.; J. H. Root, 150 Nassau St.; M. W. Conkling, 174 East 62d St.; G. I. Dean, 150 Nassau St.; and N. H. Millard, 401 Broadway, all of New York city.

St. Louis Electric Construction Co., St. Louis, Mo.; $600,000; Pres., Ellis Wainwright; First Vice-Pres., Charles H. Turner; Second Vice-Pres., Henry Nicolaus; and Wm. F. Nolker, Wm. T. Haarstick and others.

Cucamonga Land & Town Co., Cucamonga, San Bernardino county, Cal.; $50,000, with $22,700 paid in; to construct electric light and power plant, reservoirs, etc.; Thos. Feron, Wm. J. Mayer, Cucamonga; Fred W. Anntiage, Ontario, Cal.

George Washington Lighting Co., Jersey City, N. J.; $2,000,000; the company will manufacture gas and handle petroleum, electricity, and other illuminating materials; James C. Maguire, of Brooklyn, N. Y.; Maurice J. Power, 218 East 25th St., New York; Charles U. King, of Jersey City.

Watsonville Water & Light Co., Watsonville, Cal.; $500,000, with $2,500 paid in; Francis Smith, Santa Clara, Cal.; W. W. Montague, San Francisco; F. W. G. Moebus, Alameda, Cal.; F. W. Lougee, Daniel Wilson, San Francisco, Cal.

BRIDGES.

SOMERVILLE, MASS.—The construction of an iron bridge over the railway tracks at Kent St. is being considered by the council. E. W. Bailey, Cy. Engr.

BRIDGEPORT, CONN.—The New York, New Haven & Hartford R. R. Co. has been granted permission by the war department to construct a new drawbridge over the harbor about 300 ft. south of the present bridge. F. S. Curtis, Ch. Engr., New Haven.

NEW HAVEN, CONN.—Local papers state the finance board has decided to recommend the issuance of $335,000 in bonds for the following bridge work: Chapel St., railway crossing, bridge and approaches, $45,000; Mill River, drawbridge and approaches, Chapel St., $150,000; Derby Ave., city's half, $10,000; Edgewood Ave., city's half, $8,000; Orange St., $30,000; Tomlinson's bridge, west span and retaining wall of approach, $30,000; Barnesville, west span, $11,000 to $23,000; Washington St., city's half, $9,000, and Kimberly Ave., city's half, $30,000. Mayor Hendrick and Alderman Forsyth can be addressed.

BUFFALO, N. Y.—The last contract, that with the W. N. Y. & P. R. R. has been secured by the Grade Crossings Commissioners. Our correspondent writes that all is now ready for the $2,500,000 of work. Geo. E. Mann, Ch. Engr.

LYONS, N. Y.—The Wayne county supervisors are considering a resolution introduced by Mr. Ford, of Galen, authorizing the issuance of $6,000 in bonds for repairing the bridge over the Clyde River.

NEW YORK, N. Y.—Local papers state as follows: A change from a masonry approach to a dirt causeway for the new bridge across Spuyten Duyvil Creek is under consideration by the board of estimate. The law providing $100,000 for the construction of the bridge to connect the Kingsbridge Road with Broadway requires that the structure be built of steel, iron or masonry, and that the approach shall be of masonry. Chief Engineer McLean, of the Controller's office, has reported that a dirt causeway, with a retaining wall of masonry and a steel span, will meet the necessities of the case, and Corporation Counsel Scott has now been asked by the board of estimate to give an opinion as to whether the law will be complied with if such an approach is constructed.

NIAGARA FALLS, N Y.—Our correspondent states that a new bridge will be built over Gill Creek by the Erie R. R. Co. J. Healy, Supervisor, Buffalo.

ANNANDALE, N. J.—It is proposed by the Central R. R. of N. J. to lower the highway near this place, which now crosses its tracks and also to construct a steel bridge to cost $7,000. J. H. Thompson, Engr. of Construction, Jersey City.

MANASQUAN, N. J.—Press reports state as follows: The new iron and steel drawbridge over the Manasquan River will be 1,910 ft. in length, and will include a draw span of 135 ft. over all, with a 50-ft. opening. The bridge will have a roadway 20 ft. wide and a sidewalk 5 ft. in width on one side. The cost of the bridge will be equally divided between Monmouth and Ocean counties.

OXFORD, PA.—It is said that the trestle bridge over Big Elk Valley, between Elk View and Lincoln will be replaced by an iron structure.

AUGUSTA, GA.—The Charleston & Western Carolina Ry. Co. is reported as about to build a steel bridge over the Savannah River, about 17 miles above this city; estimated cost, about $70,000. H. Wilkins, Ch. Engr., Augusta.

WASHINGTON, D. C.—The district commissioners have petitioned Congress to construct a bridge over the Eastern Branch of the Potomac River.

SPRINGFIELD, O.—It is proposed by the park board to construct a $9,000 concrete bridge over the creek at Snyder Park, according to reports.

YOUNGSTOWN, O.—The county board has decided to build the first of the three proposed county bridges at Spring Common, Youngstown. The committee will soon advertise for objections and in 30 days will ask for bids for its construction. John M. Davis, James S. Price and C. T. Agnew compose the committee.

CHICAGO, ILL.—Local papers state that a steel and stone bridge at Jackson and Lincoln Parks, is proposed in connection with the new south shore drive, which is estimated to cost about $20,000. Pres., James W. Ellsworth.

GOLCONDA, ILL.—Bids are asked by the county commissioners until Jan. 7 for building seven steel highway bridges for Pope county; 20,000 cu. yds. of embankment and 2,000 cu. yds. of masonry for the same, as stated in our advertising columns. O. R. Rauchfuss, County Bridge Engr.

RUSHVILLE, ILL.—Press reports state that the county bridge committee has asked for bids for constructing two iron and steel bridges in Schuyler county. R. T. Briggle can be addressed.

URBANA, ILL.—Bids are asked by the county commissioners until Dec. 22 for constructing the following highway bridges complete on masonry abutments: One 160-ft., two 70-ft., one 48 ft., and one 32 ft. Bids may be addressed to the county clerk, Urbana, and further information may be obtained of Prof. Ira O. Baker, Champaign, Ill.

DULUTH, MINN.—Bids are asked until Dec. 21 for constructing a 150-ft. and a 120-ft. bridge besides approaches, on the Swan Lake Road. O. Halden, County Audr.

HEBRON, WIS.—It is stated that Hebron and Cold Spring have voted to build an iron bridge across Bark River at Prince's Point, and will receive bids for the same at the Hebron town hall.

GLENWOOD SPRINGS, COLO.—County Surveyor Rosenberg has submitted plans and estimates for a steel bridge at New Castle. The river span will be 235 ft. long and the two end spans of 80 and 38 ft. respectively; estimated cost, $7,500. The county commissioners will probably soon ask for bids for the work.

PORTLAND, ORE.—Wolff & Zewicker, of Portland, have been awarded the contract for the iron work for repaving and improving the drawbridge at Madison St. Wakefield & Co. have the contract for the wood work.

BUILDINGS

BOSTON, MASS.—Bids are asked until Dec. 22 for a heating and ventilating plant for the school building at South and Hewitt Sts.; bond, $3,000. Archs., Walker & Kimball, 29 Devonshire St., Boston; E. H. Dunn, Chn. Com.

HOLYOKE, MASS.—The aldermen have voted to ask for bids for erecting a new high school building. Arch., Gay Doran.

MALDEN, MASS.—The aldermen are considering the question of appropriating $45,000 to purchase a site on Pine St. for a new 12-room brick school building. Aldermen Warren, Robinson and Savage can be addressed.

CRANSTON, R. I.—The council is considering the question of appropriating $30,000 for two school buildings.

PROVIDENCE, R. I.—Bids are asked until Dec. 28 for gas piping, heating and ventilating the east side high school building. Archs., Martin & Hall, 502 Industrial Trust Bldg.; R. E. Perkins, Chn. Com.——The Wm. H. Low Estate Co. is to erect a 6-story store building on Westminster St. It is stated that work will not be begun until March.

HARTFORD, CONN.—The Brown school district has voted to appropriate $25,000 for erecting an extension to the Brown school building. Frank C. Sumner, A. L. Hunt and J. H. Parker are on the committee.

ALBANY, N. Y.—The council railway committee and the citizens' committee recently appointed by the mayor have conferred with the three railway companies whose roads enter this city in connection with the construction of a new union passenger station. John G. Myers, John D. Wasson and F. M. Danaher and Councilmen Cox, Hogan and Collins can be addressed.

BROOKLYN, N. Y.—Mayor Wurster Dec. 8 approved the resolutions passed by the aldermen recently giving its consent to the establishment of a free library. The bill under which the aldermen acted authorizes the city to issue $600,000 in bonds for the library. Mrs. Mary E. Craigie, Miss Annie W. Stephens, Mrs. Cornelia H. Corz, and R. Ross Appleton, of the library association, presented a petition to the mayor asking him to appoint a board of directors, which he must do under the law.——Arrangements are reported as being made for the construction of a 12 or 15-story apartment hotel at Montague, Pierrepont and Hicks Sts., to cost about $600,000 for David G. Leggett. It is probable the building will be completed by the fall of 1897.

BUFFALO, N. Y.—The mayor has signed a resolution passed by the council for the purchase of a lot 140 × 140 ft. on Ontario St. near Tonawanda St., on which it is proposed to erect a new 16-room school building.——E. P. Brink, 816 Olive St., St. Louis, Mo., has prepared plans for a 12-story brick hotel at Wells and Carroll Sts., for the Buffalo Hotel Co. noted in our issue last week. The hotel will have 250 guest rooms and is estimated to cost $700,000. R. H. Cole, of New York, has taken a 20-year lease.——The supervisors are considering the question of making repairs to the county court house, at a cost of $26,000. The repairs will include four new boilers, machinery for elevators, etc. Supervisor Chas. P. Brandel, Buffalo, can be addressed.

BUFFALO, N. Y.—Our correspondent writes us that St. Joseph's College will erect a building for a permanent home on Elmwood Ave. Several architects have submitted plans, but no decision has been made. The building will be four stories high and will cost $40,000.——Louis H. Eckert and Geo. More of this city, with L. Streuber, Chas. Schenk and W. P. Fisher of Erie, Pa., will incorporate with a capital stock of $100,000, and build a $75,000 theatre on Main St. Archs., L. H. Lempert & Son, 31 Pearl St., Rochester, N. Y.——A 10-story hotel and theatre is to be erected on the site of the Tifft House. R. A. Waite, German Insurance Bldg., drew the plans, and Joseph Gavin and A. Clark have secured the money, amounting to $1,700,000. The theatre will seat 2,000. and the hotel will have 275 guest rooms.

NEW YORK, N. Y.—Bids are asked until Dec. 28 for plumbing five hospital buildings, on Ward's Island and at Central Islip. J. G. Perry, State Arch., Albany; H. E. Howland, Pres. Bd. Manhattan State Hospital, 1 Madison Ave., New York.

NEW YORK, N. Y.—Plans have been drawn for a new Methodist Episcopal Church, at Willis Ave. and 141st St., to take the place of the old building on that site. Two lots adjoining have been purchased. The new North New York Church will cost about $60,000, and the plans include church and parsonage. The work will probably be begun about April 1. W. H. Barton, Pastor.

ROCHESTER, N. Y.—The question of petitioning the legislature for permission to construct a new arsenal, to cost about $100,000, is being discussed. A lot has been selected which is 480 × 158 ft. Capt. L. Bordman Smith, of the First Separate Company; Capt. H. B. Henderson, of the 8th Company, and Lieut. E. N. Walbridge are interested.

ATLANTIC CITY, N. J.—It is reported that the city is to grant certain land to the Pennsylvania R. R. Co. on which it is proposed to erect a new passenger station. Arrangements are also rapidly being made for a new city hall, to cost about $300,000. F. P. Story, Mayor; Geo. Long, Chn. Com.; J. R. Champion, Chas. Evans and F. P. Cook, City Hall, Comrs.

ELIZABETH, N. J.—The Consolidated Traction Co. purchased, Dec. 11, a tract of land at North Broad and Chestnut Sts., which will be used for storing the electric cars operated in this city. It is stated that an office building will also be erected on the property, which is 300 × 100 ft. The company's Elizabeth headquarters will be in the office building in North Broad St., and the car barns will be on Chestnut St.

PRINCETON, N. J.—Ground was broken Dec. 11 for Blair Hall, a new dormitory, estimated to cost $131,120. The contract has been awarded to Stacy Reeves & Sons, the building to be completed by Oct. 1, 1897. The structure will be 750 × 50 ft., and two stories in height. Archs., Cope & Stewardson, 314 Walnut St., Philadelphia.——The board of trustees of Princeton University is reported to have taken definite action towards enlarging the college buildings. A graduate college building is also proposed.

ALLEGHENY, PA.—The construction of a new city hall for this city is being actively considered by the citizens. John Heckert, Bldg. Inspector.

HARRISBURG, PA.—Bids are asked until Jan. 4 for constructing a church building for the St. Paul M. E. congregation. Archs., Miller & Hast, 219 Market St., Harrisburg.

PHILADELPHIA, PA.—Bids are asked until Dec. 22 for excavating for the U. S. Mint building in this city. Wm. M. Aiken, Supervising Arch., Washington, D. C.

PITTSBURG, PA.—The Pennsylvania R. R. Co. is said to be considering sites for a combined passenger and freight station in this city.

BALTIMORE, MD.—It is stated that four 6-story warehouses, two of them 64 × 204 ft., are to be built by the Baltimore & Ohio R. R. Co., in Baltimore.

WHEELING, W. VA.—The Vance Shoe Co. has awarded contracts for constructing a 5-story building on Main St. Archs., Franzheim, Gilsey & Faris, Library Bldg.

BEAUFORT, S. C.—The Charleston & Western Carolina Ry. Co. will build a combination passenger and freight depot and warehouse at this place at an early date, the same having been decided on last week. J. B. Cleveland, Pres., Spartanburg, S. C.

CLEVELAND, O.—Bids are asked until Jan. 4 for constructing an iron tower and pile foundation for the Maumee light station, O. Lt. Col. Jared A. Smith, U. S. Engr., Cleveland.——The following bids were received by Col. Smith Nov. 17 for furnishing the iron tower and beacons for the Maumee light station:

T. H. Brooks & Co., Cleveland (accepted)	$7,740
Russel Wheel & Foundry Co., Detroit, Mich.	8,880
The Van Dorn Iron Works, Cleveland	9,979
John P. McGuire, Cleveland	10,250
Chamblin & Scott, Richmond, Va.	12,400
Michael Rabbitt, Toledo, O.	13,888
Forest City Iron & Wire Co., Cleveland	13,900

DAYTON, O.—The council is considering sites for a new city building near Library Park. Chas. E. Pease, Chn. Com.

TOLEDO, O.—Local papers state that a new passenger station is to be built for the Ohio Central Lines. Plans have not yet been selected. J. M. Ferris, Gen. Mgr., Toledo; C. Buxton, Ch. Engr., Toledo.

URBANA, O.—It is reported that a fire at this place Dec. 12 destroyed a high school building, causing a loss of $80,000.

ROME CITY, IND.—Plans are being perfected for the opening at Rome City of a Chatauqua. A syndicate of churchmen, headed by Bishop J. H. Vincent, of Buffalo, N. Y., proposes to expend $100,000 in improving the assembly grounds at Rome City and in the erection of buildings.

PORT HURON, MICH.—Western and southern capitalists are reported as negotiating for the purchase of a site in this city on which to erect a new elevator.

CHICAGO, ILL.—Chas. M. Palmer, 1207 Monadnock Bldg., Chicago, has prepared plans for a 3-story apartment house on Grand Boulevard, 97 × 50 ft., for P. J. Ryan Pres. Ryan & O'Brien Woolen Co.——Jennings & Ross, 737 Dearborn St., Chicago, are preparing plans for a station at Edgebrook, for the Chicago, Milwaukee & St. Paul R. R. Co.——Plans are reported as also being prepared for a $20,000 brick school building and also for a church, etc. Wm. A. Merigold & Co., 156 La Salle St., Chicago, can be addressed.

LEWISTOWN, ILL.—Bids are asked until Jan. 12 for erecting a new county court house to cost about $40,000. The building it is reported is to be paid for by the people of the city by popular subscription and when completed the county board will accept it. Archs., Bell & Kent, 232 Merriam Block, Council Bluffs, Ia.; H. V. V. Clute, Chn. Com.; M. P. Rice, Secy., Lewistown,

COUNCIL BLUFFS, IA.—Henry Voss, Ware Bldg., Omaha, Neb., is said to be preparing plans for a 7-story office building on Broadway for Robinson Bros.

DES MOINES, IA.—The board of supervisors is reported as about to secure plans for an insane asylum to cost $50,000.

ST. PAUL, MINN.—It is reported that the Yellowstone Park Association, of St. Paul, is considering the question of erecting four hotels and several other buildings in Yellowstone Park, making a total cost of $225,000. W. B. Casey, of Boston, Mass., and C. E. Gibson, of St. Louis, Mo., are said to be interested.

SAN ANTONIO, TEX.—Jul. de Horvath, 119 Dearborn St., Chicago, Ill., is reported by Chicago papers as preparing plans for the Grand Hotel in this city to cost about $300,000. The structure is to have eight stories and will be 126 × 100 ft., containing 200 guest rooms. Mr. de Horvath is also preparing plans for a $150,000 bank and office building here. This building will be 220 × 120 ft. and four stories high.

COLORADO SPRINGS, COLO.—Weston & Trost, Colorado Springs, have prepared plans for a new $150,000 office building at Nevada and Pike's Peak Aves., for W. S. Stratton. Bids for the work are reported as now being received.

SANTA ANA, CAL.—The construction of a $50,000 county court house in this city is reported as being considered.

OAKLAND, CAL.—Plans have been prepared for a $40,000 theatre at San Pablo Ave. and 17th St. Geo. W. McNear and W. M. Watson are interested.

HEALDSBURG, CAL.—It is stated that an election will be held Jan. 4 to vote on the question of issuing $25,000 in bonds for constructing a new school building. W. W. Moreland, W. H. Barnes, C. H. Pond, Trustees.

MEXICO, MEX.—It is stated that the Larralde Bros. have purchased the site of the Teatro Progreso, which burned recently, and will erect on it a 3-story brick and granite building to cost $100,000.

WATER-WORKS.

LEBANON, N. H.—Chas. E. Lewis, J. L. Spring and C. D. Smith, Water Comrs., have visited several cities investigating the question of filtration. It is thought that a well system of filtering the water supply of this place can be constructed for about $1,000.

WATERBURY, VT. — The Burlington "Free Press" states that this village has closed a contract with the state for furnishing water to the state asylum; state to pay $500 a year for 50,000 gallons a day, or $800 if 100,000 gallons are used. C. F. Clough, Village Pres.

MIDDLEBORO, MASS.—It is expected that the fire district will take action this week in regard to the proposed issue of $16,000 in bonds for a standpipe.

NEW BEDFORD, MASS.—Bids are asked until Dec. 18 for the purchase of $400,000 in 4%, 30-year water bonds. James H. Hathaway, Cy. Treas.

PROVIDENCE, R. I.—Bids are asked until Dec. 19 for furnishing about 162 gross tons of 12 to 4-in. cast-iron water pipe. Robt. E. Smith, Comr. Pub. Wks.

MIDDLETOWN, CONN.—An election was called for Dec. 15 to vote on the proposed appropriation of $215,000 for a new reservoir, as noted last week. W. F. Borrows, Pres. Comrs.

BROOKLYN, N. Y.—The committee on water of the board of aldermen has decided to recommend an appropriation of $217,000 from the water budget for new water mains in New Utrecht.

CASTLETON, N. Y.—It is reported that the water commissioners have received several applications for a franchise to put in a gravity water system; no action yet taken, DE RUYTER, N. Y.—At a special election Dec. 8 it was voted to issue bonds for new water-works to be owned by the village; supply by gravity from springs; plans and specifications will be prepared in the near future; population 800. A. W. Francis, Pres.; Edwin N. Coon, Secy. Water Comrs.

NEW BRIGHTON (S. I.), N. Y.—The board of trustees is expected to take action this week in regard to a new contract with the Staten Island Water Supply Co. The contract expired a year ago and the water company is anxious for a new 5-years contract before this place becomes a part of Greater New York. The Good Government Club has for some time agitated the question of municipal ownership of the works.

SHARON SPRINGS, N. Y.—The question of water-works is reported as being agitated in this village.

TUPPER LAKE, N. Y.—It is reported probable that works will be constructed in the near future.

ASBURY PARK, N. J.—A public meeting of the township committee was held Dec. 9 to consider the granting of a franchise to a water company to supply the township. It is said that many residents of West Park and West Grove are in favor of the project.

ASBURY PARK, N. J.—Bids are asked until Dec. 28 for furnishing one duplex and one straight line air compressor, as stated in our advertising columns. Geo. H. Coffin, Supt.

PERTH AMBOY, N. J.—The board of aldermen has voted to issue $25,000 in 20-year 5% water bonds to pay for the repairs to the pumping engine, purchase of a new one and the extension of the water mains.

ROCKAWAY, N. J.—Bids are asked until Dec. 29 for the purchase of $25,000 in 4% gold bonds, as stated in our advertising columns. Morford B. Strait, Mayor, writes us that the contract for constructing works has been awarded to S. M. Neff, of Dover, N. J., at $25,000; supply by gravity from White Meadow Brook.

COATESVILLE, PA.—It is reported probable that an election will be held in February to vote on an issue of $20,000 in bonds for increasing the water supply, as noted several weeks ago.

HARRISBURG, PA.—Mayor Patterson has approved the ordinance appropriating $10,000 for the extension of the influent pipe at the water-works. The work will be started at an early date.

IRWIN, PA.—The 5-year contract with the Westmoreland Water Co. expired in August, and it is stated that the council has purchased a site near Jeannette, where municipal works will be erected. The water company will not renew its contract for a shorter period than five years.

LEBANON, PA.—Dr. J. R. Beckley, Pres. Water Dept., writes us that an ordinance is in course of passage by council authorizing the water and light commission to advertise for bids to increase the present water supply to 2,000,000 gallons daily of soft water, as noted in our issue of last week.

MARCUS HOOK, PA.—It is reported that works may be constructed at this place; supply by gravity to a reservoir. Walter Wood, Borough Engr.

McKEESPORT, PA.—Charters were granted Dec. 10 to the following three water companies, each having an authorized capital stock of $5,000, with $500 paid in: Jefferson & Mifflin Water Co., to operate south and west of the Monongahela River, bounded by lines of townships of Baldwin, Snowden and Union in Allegheny county; Yough Valley Water Co., to operate just outside the limits of city of McKeesport; Lincoln Water Co., to operate in Forward Township, Allegheny county; Treas., J. P. McIntyre, of McKeesport; other directors, D. W. Courtney, R. R. Chester, C. Biggs, R. Stevenson and Frank Chester.

ORELAND, PA.—This village is reported as planning to construct water-works.

PHILADELPHIA, P.—Charles F. Warwick, Mayor, has signed the ordinance providing for a loan of $3,000,000 for a filter plant or plants to connect with the several pumping stations embraced in the water supply of this city.

PITTSBURG, PA.—J. O. Brown, Dir. Pub. Safety, has awarded the New York Filter Mfg. Co. of New York, the contract for a filter plant at the Public Safety Building, at $1,250.

RIDGWAY, PA.—The board of health is reported to have decided to recommend to council that the water supply be filtered and that a new source of supply be obtained as soon as possible.

ROCKVILLE, MD.—This city has sold its $20,000 in 20-year 4% water bonds, to Thos. S. Grimke, 80 Broadway, New York, at 101⅛. Joseph Reading, Mayor.

WASHINGTON, D. C.—The "Evening Star" states that Architect Clark of the capitol has submitted a report to the house, estimating that a filtration plant for the capitol will cost $11,050 for the house wing and $10,900 for the senate wing; plant to furnish 300,000 gallons daily to each wing.

HARRISONBURG, VA.—N. Wilson Davis, of Atlanta, Ga., has been engaged to make plans for a gravity system of water-works at this place; surveys now in progress.

LENOIR, N. C.—The board of trade is reported as endeavoring to secure water-works and other improvements. S. T. Pender, Secy.

FORSYTHE, GA.—J. N. Hazlehurst & Co., Norcross Bldg., Atlanta, have the contract for constructing works at this place and expect to begin work the last of this month; plant is to be completed by April 1, 1897; bonds for the works were recently sold.

UNION, S. C.—A press report states that several engineers are in town consulting with the water-works commission in regard to the erection of works. It is thought that construction will be commenced in the near future.

ATLANTA, GA.—The water board has voted to lay a 6-in. main from Curran St. to the Fulton county barracks; county will pay cost of construction and city will furnish water free of charge.

CONYERS, GA.—M. H. Plunket, Cy. Clk., writes us that no steps are being taken for works at this place.

HAWKINSVILLE, GA.—S. A. Way, Mayor, writes us that as soon as the $30,000 in bonds are sold the city will be ready to construct works.

OXFORD, MISS.—The contract for constructing works is reported to have been awarded to Sanders & Porter, of Louisville, Ky., at $11,577.

WEST POINT, MISS.—This city has authorized the board of selectemen to issue $20,000 in bonds for the construction of water-works; system will be constructed the coming summer, provided bonds are sold at satisfactory prices. C. W. Gibson, Chn. Com.

NATCHITOCHES, LA.—It is reported that this place has voted to construct works.

FRANKLIN, KY.—The contract for constructing works has been relet to the original contractors, Guild & White, of Chattanooga, who were the only bidders.

LOUISVILLE, KY.—The board of public works has decided to place fire hydrants all over the city to take the place of the fire cisterns now in use, according to local papers.

MADISONVILLE, KY.—M. W. Bishop and Samuel Powers have been apponited a committee with power to employ an engineer to investigate the cost of a system of water-works, and to report same to council as soon as possible; population, 3,500. C. U. Osburn, Cy. Clk.

BRADNER, O.—It is reported that this village contemplates the construction of water-works.

CHAGRIN FALLS, O.—S. L. Wilkinson, Mayor, writes us that it is hoped to commence the construction of works within 60 days; estimated cost, $32,000 to $34,000; preliminary surveys were made by Burton J. Ashley, Opera House Block, Chicago.

HUNTINGTON, IND.—Draper & Werling have been awarded the contract for connecting wells and rebuilding pumping station, as advertised in Engineering News, at $15,497; and Fulton & Fulton the contract for sinking tubular wells at $1.35 a ft. Sturtevant & Todd, Engrs., Association Bldg., Chicago; E. Q. Drummond, Cy. Clk.

JACKSON, MICH.—Bids are asked until Dec. 17, according to reports, for constructing certain water extensions. J. K. Bogert, Supt. Pub. Wks.

SCOTTVILLE, MICH.—Bids are asked until Jan. 4 for a deep well pump, tower 70 ft. high with wooden tank 18 ft. in diameter and 20 ft. high, 8 hydrants, 13-HP. gasoline engine, and nearly a mile of 6 and 4-in. pipe. Alexander & Shaw, Engrs., 907 Chamber of Commerce, Chicago; G. H. Reader, Chn. Com.

TRAVERSE CITY, MICH.—A committee of six, including J. W. Milliken and E. J. Fulgeum, has been appointed to prepare plans and specifications for municipal works, plans to be ready Feb. 1. The contract with H. D. Campbell for a water supply does not expire for five years. H. F. Northrup, Cy. Engr.

GROSSDALE, ILL.—The council is reported as considering the construction of the proposed works. Hill & Enricht, Engrs., Chicago.

BELLEVILLE, ILL.—It is reported that Henry Leschens, of St. Louis, and others have been granted a franchise for the construction of new works in this city.

MOMENCE, ILL.—Bids are asked until Jan. 11 for constructing works, as stated in our advertising columns. C. B. Astle, Cy. Clk., writes us that it is proposed to lay the mains this winter and to complete stand-pipe, pumping engine, etc., as early in the spring as possible.

WESTERN SPRINGS, ILL.—Bids are asked until Jan. 5 for laying water supply pipes and drains in Walnut St., from Ashland to Grand Ave. F. A. Johnson, Village Clk.

KAUKAUNA, WIS.—The proposed works noted last week will cost about $80,000, consisting of 11 miles of pipe, 90 hydrants, artesian well, reservoir, pumps, etc.

CORRECTIONVILLE, IA.—An election was held Dec. 14 according to reports, to vote on the construction of water-works and an electric light plant.

ADA, MINN.—Councilman Andrews is reported as wanting bids on a 1,000-bbl. tank.

DULUTH, MINN.—Bids are asked until Jan. 4 for the purchase of $1,695,000 in 4½% 30-year water and light bonds, according to reports. F. J. Voss, Cy. Treas.

MABEL, MINN.—We are informed that nothing will be done until spring in all probability in regard to constructing works at this place. The work was advertised several months ago. The plans were prepared by Fred H. Pickles, Cy. Engr., Winona.

ROCHESTER, MINN.—Burt. W. Eaton, of Rochester, has been appointed by the court to sell the water-works on mortgage foreclosure.

GOTHENBURG, NEB.—There is some talk of constructing water-works; town voted $10,000 in bonds two years ago but could not sell the bonds at that time. C. A. Edwards, Mgr., Gothenburg Power & Irrigation Co., can probably give information.

HASTINGS, NEB.—An election will be held Dec. 21 to vote on an issue of $8,000 in bonds for extending the water-works. G. J. Evans, Mayor. E. A. Francis, Cy. Clk.

ST. LOUIS, MO.—Bids are asked by the board of public improvements until Feb. 16, according to reports, for two new pumping engines at the Chain of Rocks.

BENTONVILLE, ARK.—It is reported that a special tax has been voted for the construction of works, to cost $30,000.

SEARCY, ARK.—Ross & Carnis are said to have petitioned for a franchise to construct works.

HILLSBORO, TEX.—O. J. Morris, Supt., writes us that the proposed extensions noted Dec. 3, will include a 500,000-gallon pump, with boiler and about $11,000 worth of 10 to 4-in. water mains; supply from artesian wells.

McKINNEY, TEX.—J. M. Pearson, Mayor, writes us that this city needs water-works, but under the law cannot establish the plant until the present municipal debt is reduced; population 5,000.

ORANGE, TEX.—B. C. Miller, Mayor, writes us that owing to the burning of the high school building, which will have to be replaced at a cost of about $15,000, water-works cannot be constructed for a year at least.

PITTSBURG, TEX.—F. H. Goodjohn, Mayor, writes us that is is the intention of the council to contract next spring for a combined water-works and electric light plant, provided the cost will not be too great.

EMPIRE, COLO.—A press report from Georgetown states that a movement is on foot to construct water-works and an electric light plant at Empire. Frank L. Peck, Mayor.

PALISADES, COLO.—We are informed that a wooden tank or stand-pipe will be erected and a water supply obtained from the Grand River; only a small plant and no contracts to be awarded.

NEWBERG, ORE.—This city has not yet sold the $15,000 in bonds voted for a gravity system of water-works. J. G. Hadley, Cy. Recdr.

SHERIDAN, ORE.—The city is reported as now out of debt and in a condition to warrant the construction of water-works.

ETNA, CAL.—Works are being constructed at this place.

LAKEPORT, CAL.—A. L. Adams, Engr., has recommended a water supply from wells with a 200,000-gallon reservoir at an elevation of 100 ft. above Main St.; estimated cost of works, $17,250.

SANTA BARBARA, CAL.—The city engineer has been directed to prepare estimates for a pipe line from the tunnel to that city. J. K. Harrington, Cy. Engr.

WATSONVILLE, CAL.—The Watsonville Water & Light Co. was incorporated Dec. 5, with a capital stock of $500,000, commencing with $2,500, by Francis Smith, of Santa Clara; F. W. G. Moebus, of Alameda, and F. W. Longee, W. W. Montague and Daniel Wilson, of San Francisco.

SANTA MONICA, CAL.—The City Water Co. was incorporated Dec. 4 with a capital stock of $20,000, commencing with $400, by J. H. Claudius, E. J. Vawter, D. M. Clark and D. R. Green, all of Santa Monica.

RENO, NEV.—It is thought that water-works can be constructed for about $75,000, and that an election will be held to vote on the question. R. L. Fulton, E. R. Dodge and Henry Ruhe can give information.

SALMON CITY, IDAHO.—J. W. Birdseye, Chn. Trustees, writes us that R. W. Faris, of Idaho Falls, prepared plans and was awarded the contract in September for constructing works, $15,000 in bonds at par to be taken in payment for the plant complete. The bonds were not to be made payable in gold, and the contractor could not place them, and was unable to go on with the work. Since the election a proposition has been received to take the bonds as originally intended and go on with the work, but owing to the cold weather the matter has been postponed for the present. The supply will be by gravity from a creek.

ST. MARYS, ONT.—It is reported that the plans of Wiliam Newman, of Windsor, for works at this place have been accepted.

IRRIGATION.

WACO, TEX.—Press reports state that the people of this city propose to build a dam sufficient to irrigate 40,000 acres of land. The dam will be about 4 ft. high. I. T. Arnold can be addressed.

FORT COLLINS, COLO.—Press reports state as follows: The Larimer & Weld Reservoir Co., owner of the Terry Lake reservoir, one mile north of Fort Collins, advertised for bids about Dec. 5 for making improvements on the dam and outlet of the reservoir. The work will consist in reinforcing the embankment on the outer side, both east and west of the outlet riprapping, the inside of the dam near the outlet and the extension of the masonry of the discharge works by 100 ft. of stone archway with cement flooring.

MISSOULA, MONT.—Bids are being received, according to reports, for extending the Canon ditch, 1,500 ft., requiring 6,500 cu. yds. of earth excavation. E. S. Hathaway.

SAN LUIS POTOSI, MEX.—It is stated that the construction of an irrigation system is proposed near this place. A dam is now being built, and it is proposed to build six others. C. H. McClure, of San Luis Potosi; H. Carter, of London, England, and B. F. Jones, formerly superintendent of the Kansas City (Mo.) Water-Works.

NEW COMPANIES.—Cucamonga Land & Farm Co., Cucamonga, Cal.; $50,000, with $22,700 paid in; to build reservoirs, pipes, mains etc., buildings, electric light plants, etc.; Thos. Feron, B. H. de Jersey, Cucamonga; Fred W. Armitage, H. O. Maynard, Ontario, Cal.

SEWERAGE.

DANVERS, MASS.—Surveys are being made by J. J. Van Valkenburgh, of South Framingham, Mass., for a system of sewage disposal by filtration for the state lunatic asylum at this place. The institution has about 1,000 inmates.

MALDEN, MASS.—The construction of a 72 × 96-in. brick drain in Saugus Branch Creek has been planned; estimated cost, $75,000. G. A Wetherbee, Cy. Engr.

WATERBURY, CONN.—Press reports state as follows: Waterbury has applied to the superior court for an order of notice that the city proposes to petition the next legislature for legislation to enable it to dispose of its sewage by a trunk sewer through the Naugatuck Valley to Long Island Sound. Judge Elmer has approved the application. The proposed work will be 31 miles long, and will cost $1,500,000. It is expected opposition will be met in towns along the valley toward the sound.

BROOKLYN, N. Y.—Bids are asked until Dec. 24 for strengthening the twin main sewers in Hendricks St., between Wortman Ave. and the sewage purification building; surety, $1,900. T. B. Willis, Comr. Cy. Wks.

JAMAICA, N. Y.—We are informed that the board of sewer commissioners of Jamaica, at its meeting Dec. 8, approved plans for a chemical precipitation plant for the disposal of the sewage. J. J. McLaughlin, Engr., Jamaica.

LYONS, N. Y.—It is proposed to construct a system of sewers 15 miles in length, to cost $50,000, according to reports.

NEW ROCHELLE, N. Y.—J. K. Wilkes is engineer to the sewer commission at this place, and not Horace Crosby, as noted last week.

ROCHESTER, N. Y.—Bids are asked until Dec. 21 for constructing a sewer in University Ave. The sewer will be of 24-in. pipe and 2,100 ft. long, and is to drain the proposed subway under the N. Y. C. & H. R. R. R. tracks; estimated cost, $13,000. E. A. Fisher, Cy. Engr. ——It is proposed to construct a sewer in Jay St. to cost $5,750. T. S. Pulver, Cy. Clk.——Local papers state that W. J. Stewart, Asst. Cy. Engr., is preparing plans for outlet sewers in five streets. T. J. Neville, Clk. Executive Bd.

SANDY HILL, N. Y.—Plans have been completed and approved for the proposed sewer system for this place.

BURLINGTON, N. J.—The question of constructing a sewer system to cost about $75,000 is being considered by the council. John W. Davis, Chn. Com.

JERSEY CITY, N. J.—E. W. Harrison, Fuller Bldg.; Dennis Fowler and W. W. Ruggles, civil engineers, Jersey City, have been appointed to prepare plans for reconstructing the Ravine road sewer.

JERSEY CITY, N. J.—Bids are asked until Dec. 21 for constructing 550 ft. of 24-in. brick, and about 4,300 ft. of 18 to 12-in. pipe sewers. The work will include about 600 cu. yds. of rock excavation, 20 cu. yds. of concrete, etc. J. C. Kaiser, Chn. St. Com.

ERIE, PA.—It is proposed to extend the Liberty St. main sewer from 12th to 17th St., at a cost of $8,500. George Platt, Cy. Engr.

SCRANTON, PA.—The council is considering an ordinance providing for the extension of sewers in the second district, at a cost of $36,000. J. P. Phillips, Cy. Engr.

CINCINNATI, O.—Plans are being prepared for sewers in about 20 streets; work to be done next year.——The board of administration has decided to advertise for bids for constructing 2,300 ft. of the trunk sewer in Bloody Run, at a cost of $51,000. Aug. Herrmann, Pres.

MARION, O.—It is proposed to construct a sewer ditch with a brick cover in Silver St., at a cost of about $45,000. Councilman Shutt and City Engineer Scott can be addressed.

SPRINGFIELD, O.—Bids are asked until Jan. 11 for constructing 1,400 ft. of 30-in. pipe sewer in an alley, and 2,200 ft. of 24 and 30-in. pipe sewer in Farlow and Warden Sts. D. F. Snyder, Cy. Engr.; S. J. Wilkerson, Cy. Clk.

TOLEDO, O.—Bids are asked until Dec. 28 for constructing 24-in. brick sewers in three streets and pipe sewers in two others. L. P. Harris, Cy. Clk.

AUBURNDALE, O.—It is reported that work will soon be begun on seven miles of sewers in Auburndale, to cost $33,200. W. G. Clark, Engr., Toledo.

YOUNGSTOWN, O.—Press reports state that the board of health has notified the state board to send a commission to this city to examine the sewer system of the place. The changes needed, it is stated, will involve an expenditure of $200,000 or $300,000.

CRAWFORDSVILLE, IND.—We are informed that plans have been completed for the proposed sewers in this city; money has been raised and the work arranged for. S. C. Hutton, W. N. McCampbell, B. F. Hutchings compose the committee. Alvord & Shields, Consult. Engrs., The Rookery, Chicago, Ill.

CHICAGO, ILL.—Cogan & Pound have been awarded the contract for constructing a 42-in. brick sewer in Indiana Ave., at $49,335.—The commission of expert engineers, appointed to prepare a plan for diverting the sewage now flowing into the lake, has decided that intercepting sewers are the best means of solving the problem, and as the Lake View territory is suffering most, it has been taken up first. According to the plan practically agreed upon, an intercepting sewer will be built from Fullerton Ave. north to Lawrence Ave., and another sewer south from the north boundary of the city to Lawrence Ave. A pumping station will be located at the foot of Lawrence Ave., and a sewer built from the lake to the north branch of the river in Lawrence Ave. The sewage from the two intercepting sewers will be pumped into the Lawrence Ave. sewer and carried to the river. Joseph Downey, Comr. Pub. Wks.

WESTERN SPRINGS, ILL.—Bids are asked until Jan. 5 for furnishing the labor and materials and laying pipe sewers, drains, etc., in two streets. F. A. Johnson, Village Clk.

MILWAUKEE, WIS.—The board of public works has submitted estimates for the construction of sewers during 1897, which will cost about $310,000. Geo. H. Benzenberg, Cy. Engr.

RIPON, WIS.—We are informed that a committee of citizens has been appointed to investigate and report on the proposed sewer system for this place. No further steps have been taken. W. W. Robinson, Chn. Com.; S. E. Mason, Cy. Clk.

HILLSBORO, TEX.—We are informed that about two miles of 10 and 8-in. sewers are proposed.

HOUSTON, TEX.—We are informed that Alderman Cronan on Dec. 8 introduced a resolution to authorize the city engineer to prepare a profile, etc., for pipe sewers in Washington St. for a distance of 1¼ miles. It is also proposed to pave this part of the street, the total work to cost about $100,000.——Plans and specifications have been prepared and referred to the board of public works for putting in a 36-in. double ring brick sewer in Heiner St. for a distance of 1,965 ft. L. A. Gueringer, Cy. Engr.——W. E. Humphreyville has been awarded the contract for constructing a sewer in Elysian St. at $2,289.

COLORADO CITY, COLO.—Press reports state that the citizens of this place are discussing the question of constructing a sewer system to drain this city, Colorado Springs and Manitou. Committees are being appointed by the different cities to consider the proposition. H. D. Morse, Mayor, Colorado City; L. A. Humphrey, Chn. Sewer Com., Colorado City; Mayor Plumb, Colorado Springs.

LAJOLLA, CAL.—The construction of a sewer system is being urged by the LaJolla Improvement Society, according to reports.

SAN FRANCISCO, CAL.—Bids were asked until Dec. 29 for furnishing the Mare Island navy yard with sewer pipe, Portland cement, etc. Edwin Stewart, Paymaster General, Navy Dept., Washington, D. C.——Thos. O'Neil, R. Riechenbach and J. Touhey have been appointed a committee by the Holly Park and Five Mile Improvement clubs to prepare a bill for the legislature authorizing an appropriation of $300,000 for a sewer system in the district between 30th St. and the county line. Behrend Joost can also be addressed.

SAN FRANCISCO, CAL.—The supervisors have adopted resolutions for constructing 54 to 30-in. brick and 20 to 12-in. pipe sewers in about 15 streets. J. A. Russell, Clk.

SAN JOSE, CAL.—The city engineer is reported to have been directed by the council to prepare plans for sewer in San Carlos St., to cost $6,000. Councilmen Nolting, Hogan, Jarman, Main and Mangrum can be addressed.

LACHINE, QUE.—It is reported that the construction of a sewer system to cost about $150,000 is under discussion.

LONDON, ONT.—The following bids were received Dec. 7, for constructing Section C of the new sewer system; Ormsby Graydon, Cy. Engr.:

Harding & Leathorn, London	$10,900
C. Barfitt, London	14,863
Simpson & Murray, London	14,335
Wm. F. Grant & Co., Toronto (accepted)	9,112
J. W. Cawrse, London	9,973
A. J. Brown, Toronto, Ont	10,915
Clark & Connolly, Toronto	10,180
Geo. D. Cameron & Co., London	11,368
J. S. Fallows, London	16,272
J. S. Fallows (with hydraulic cement)	15,092
George F. Webb, Hamilton, Ont	17,389

GARBAGE DISPOSAL—STREET CLEANING.

CHICOPEE, MASS.—The board of health is reported as to recommend to the new city government that some kind of a garbage gathering system be introduced into the city.

GLOUCESTER, MASS.—The special committee on garbage removal has reported against a garbage crematory as too expensive and has recommended that the garbage be dumped into the ocean by means of a scow.

INDIANAPOLIS, IND.—Bids are asked by the board of public works until Dec. 21 for street cleaning and sweeping of permanently improved streets.

MILWAUKEE, WIS.—Local papers state that bids will be asked in a few days for a 150-ton garbage crematory; the contract with the Wisconsin Rendering Co. expires March next. Geo. H. Benzenberg, Cy. Engr.

SAN FRANCISCO, CAL.—The Sanitary Reduction Co., office at northeast corner of Montgomery and Commercial Sts., as noted Oct. 1., is reported about to construct a 600-ton Thackeray plant. Chas. Thackeray, of Montreal, inventor of the system, will superintend the work. L. R. Ellert, Pres.

STREETS AND ROADS.

WARE, MASS.—The question of issuing $50,000 in bonds is being considered by the citizens.

BROOKHAVEN (L. I.), N. Y.—A committee has been appointed ot prepare plans and to advertise for bids for maintaining the highways throughout the township, for which $10,000 was recently appropriated, according to reports.

BROOKLYN, N. Y.—The committee has recommended the paving of portions of about 20 streets and avenues. T. B. Willis, Comr. Cy. Wks.

BUFFALO, N. Y.—Bids are asked until Dec. 22 for asphalt surfacing in two streets, and also for asphalt paving in one street. R. G. Parsons, Secy. Bd. Pub. Wks.

ELIZABETHTOWN, N. Y.—The county board of supervisors has voted to construct a highway in Ticonderoga. Garrison W. Foote, Samuel Root and Joseph Wright, Comrs.; M. C. Perry, Chn. Bd.

MOUNT VERNON, N. Y.—The following bids were received Dec. 1 by Geo. M. Jenkins, Cy. Clk., for grading and improving three streets and macadamizing Bridge St.; 1, for North 3d Ave.; 2, for Bridge St.; 3, for East Lincoln Ave.; 4, for Sidney Ave.:

	1.	2.	3.	4.
Daniel Murray	....	$8,659	....	....
Edgar Henriques	....	8,830	....	....
Cortright & Kenlon	$7,385	8,733	$25,623	$3,123
Johnson & Light	3,411	8,033	16,098	1,492
John Marion	....	....	....	3,582

NIAGARA FALLS, N. Y.—The contracts for asphalt paving for which bids were opened Dec. 11, as advertised in Engineering News, have been awarded to the Barber Asphalt Paving Co., at about $98,000. The itemized bids will be published next week. W. W. Read, Cy. Engr.

NEW YORK, N. Y.—Bids are asked by the department of public works, 150 Nassau St., until Dec. 28 for grading and curbing in three streets and altering sewers in two other streets.

OLEAN, N. Y.—The council has adopted resolutions to pave Union St. to the city line. E. E. Allen, Supt. of Streets; Aldermen Baker, Frazee, Ramsey, Sloan and Ward can be addressed.

MORRISTOWN, N. J.—It is reported that the county engineer has been directed to make surveys for a macadam road from Williams Corner on Long Hill to Johnson's Bridge, near Simmit, a distance of 3 1-5 miles. W. E. King, County Engr., Landing, N. J.

PATERSON, N. J.—The aldermen have agreed to ask the legislature to grant this city authority to issue $1,000,000 in bonds for permanent street paving. Aldermen Post, Wright, Delaney, Maguire, Durgett, Lang and Sturr, can be addressed. J. T. Pollitt, Cy. Clk.

PERTH AMBOY, N. J.—The county board of freeholders is considering the question of macadamizing roads between Metuchen and Perth Amboy; between South Amboy and the South River road and also for the macadamizing of the New Brunswick and Cranberry road.

WOODBURY, N. J.—Bids are asked until Jan. 20 for building a stone road in the townships of Glassboro and Washington, as stated in our advertising columns. Chas. N. Bell, Clk.; Chas. W. Starr, Dir. Bd. Freeholders.

PITTSBURG, PA.—Bids are asked until Dec. 22 for grading and paving portions of six streets. E. M. Bigelow, Dir. Pub. Wks.

BALTIMORE, MD.—The council is considering ordinances authorizing an appropriation of about $160,000 for Belgian block and asphalt paving in four streets. W. A. Hanway, Cy. Comr.

KEY WEST, FLA.—Local papers state that the city commissioners have instructed the engineer to prepare estimates for paving four streets in the lower part of the city.

SPRINGFIELD, O.—Bids are asked until Jan. 11 for grading, curbing, etc., in five streets. D. F. Snyder, Cy. Engr.; S. J. Wilkerson, Cy. Clk.

TOLEDO, O.—Bids are asked until Jan. 11 for paving Huron St. from Washington to Lafayette St. with asphalt on concrete foundation. L. P. Harris, Cy. Clk.

MONTICELLO, IND.—The treasurer of White county has been authorized to sell $22,500 in bonds for constructing a macadam road. W. P. Bushnell, County Surv.

EVANSVILLE, IND.—The board of public works has directed the city engineer to prepare plans and specifications for brick paving in Water St. from Walnut to Ingle St. Aug. Plaffiin, Cy. Engr.

ALTON, ILL.—Bids will be asked in March for 2,100 lin. ft. of brick paving on 6 ins. concrete in Front St. from Market to Wood St., and also for constructing a retaining wall; estimates not yet completed. This work is to be done by the Cleveland, Cincinnati, Chicago & St. Louis Ry. Co., W. M. Duane, Engr. Maintenance of Way, Mattoon, Ill.; G. W. Kittredge, Ch. Engr., Cincinnati.

CHICAGO, ILL.—Local papers state that the South Park commissioners are making arrangements for the construction of the South Shore Drive, to be five miles in length. Geo. H. Hess, Secy.; James W. Ellsworth, Pres.

DULUTH, MINN.—Bids are asked until Dec. 21 for constructing 25 miles of wagon road in Swan Lake, and also for a portion of the Nuttertrunk road between Virginia and the lower road. O. Halden, County Audr.

ST. PAUL, MINN.—The park board has received plans for a boulevard on the West Side to cost $25,000.

OMAHA, NEB.—Bids are asked until Dec. 21 for constructing such permanent sidewalks as are required during 1897. We are informed that there are prospects of considerable work under this contract. R. B. Howell, Cy. Engr.

GALVESTON, TEX.—The council is considering the question of macadamizing portions of certain streets. Frank Jones, Chn. Com.

HOUSTON, TEX.—We are informed that the council is considering a motion made by Alderman Cronan for paving in Washington St. and for constructing 1¼ miles of sewers in the same street. The work will cost about $100,000. L. A. Gueringer, Cy. Engr.

OAKLAND, CAL.—Press reports state that plans are being developed for a boulevard through the hills to the city cemetery. A. H. Breed, E. C. Sessions and J. J. Warner are interested.

SANTA CRUZ, CAL.—The committee on the Cliff drive is reported to have about completed plans and specifications for grading and improving the Cliff drive.

MANUFACTURING PLANTS.

KEENE, N. H.—The Frank T. Fowler Cycle Co of Worcester, Mass., will move to this city, it is said, as soon as factory buildings are erected.

BOSTON, MASS.—Land containing 8,000 sq. ft., and fronting on East 1st St., South Boston, near L St., has been sold by C. S. Judkins to E. W. Gilmore, who it is reported is to erect at once a large 3-story frame building, to be used for the manufacture of electrical supplies.

PROVIDENCE, R. I. — The Rhode Island Tool Co. has placed the contract for its new galvanizing room with the Berlin Iron Bridge Co., of East Berlin, Conn. The building will be a fire-proof structure throughout, no woodwork being used.

WOONSOCKET, R. I.—It is stated that parties connected with the Globe Yarn Mills, in Fall River, contemplate the erection of a large mill here, if the inducements are satisfactory.

BUFFALO, N. Y.—A. G. Scheson, of Monongahela, Pa., president of the Carborundum Co., which has a large plant in operation in this city, is quoted as saying that his company will build a plant on the Canadian side of the river next spring.

CORNING, N. Y.—The Wm. Bell Co., a steel manufacturing concern of New York city, is said to contemplate locating here. The plant would cost about $325,000, and employ 200 men.

LANCASTER, N. Y.—Frank Lass, Geo. Young and Henry Caldwell, of this place, will erect a 40 × 80 ft. brick factory for the manufacture of a patent tool.

NIAGARA FALLS, N. Y.—Our correspondent writes us that Dobbie & Stuart will build a foundry to consist of five buildings. The Cataract Construction Co. will build several factory buildings for renting purposes.——The Albright & Wilson Electro Chemical Co., of Oldbury, England, will build a plant on Buffalo Ave., consisting of seven buildings covering 2½ acres, to cost, exclusive of machinery, about $40,000.

NEW YORK, N. Y.—Brazier & Simonson, 156 5th Ave., are reported to be preparing plans for a factory to be erected at 203 Bowery for Henry C. Miner, to be 64 × 100 ft., six stories high; of brick and stone, with steel beams, galvanized iron cornice and skylight, fire-escape, passenger and freight elevators, steam heat, office fixtures, asphalt roof and stone sidewalk.

STANLEY, N. J.—It is reported that the New Jersey Felt Mill has been leased to a Boston company, which will overhaul the plant and put in new machinery at an expense of about $50,000, and operate it as a paper mill.

LATROBE, PA.—A company composed of Joseph C. Head, Charles M. St. Clare, Jos. Baumgartner, Martin Cesare and John V. Toner, Greensburg, Pa., proposes to erect a brewery at this place. The capital stock, it is stated, is $50,000.

LLOYDSVILLE, PA.—The Harbison & Walker Co., Pittsburg, Pa., is said to be having plans made for a large fire-brick plant to be erected here.

McKEE'S ROCKS, PA.—D. R. Speer & Co. will enlarge their planing mill plant, increasing its capacity about one-half, it is reported.

PITTSBURG, PA.—The Electric, Gas, Light & Power Co. has been organized with a capital stock of $1,000,000. It is stated that the company will erect a machine shop in some suburban town to cost $175,000, and employment will be given to about 300 men. The object of the company is to erect gas producers in small towns for light, heat and power. Henry Hubbard, a mechanical engineer, now connected with the Manchester Traction Co., is president of the concern, and Ralph Theophilus, of the Oliver Steel Co., is the secretary.

SCOTTDALE, PA.—The National Foundry & Pipe Works Co. has closed a contract, it is said, for the erection of a large machine shop in connection with its present works.

BALTIMORE, MD.—It is reported that the Baltimore & Ohio R. R. Co. has awarded to Walsh & Bro. the contract for building a large erecting plant at Mount Clare. The work has already been commenced, and it will be pushed forward with all possible speed, the idea being to have it completed by the middle of March. A large electric crane, with a capacity of 100 tons, has been ordered. The new plant will be 300 × 75 ft.

HAGERSTOWN, MD.—J. M. Hood, Pres. Western Maryland R. R., has announced, it is reported, that the company proposes building soon large repair shops in Hagerstown.

SISTERSVILLE, W. VA.—The Hays Iron & Steel Mfg. Co., which will make oil and gas well tools and supplies, was incorporated recently, and will build a plant at once. The capital stock is $65,000, commencing with $30,000.

GREENVILLE, S. C.—The New Mills Cotton Mfg. Co., which is now installing the machinery in its buildings, will also add in a short time an electric lighting plant.

ROCK HILL, S. C.—A cotton mill, to be operated by electricity, is to be erected at this place soon. The power will be furnished by the electric plant already in operation, but a new building and machinery will be required.

SPARTANBURG, S. C.—The Spartan Cotton Mfg. Co., which is just completing its second cotton mill, will as soon as the new mill is in complete operation, begin work on another, to operate about 50,000 spindles and to cost between $300,000 and $400,000.

CHARLOTTE, N. C.—Dr. J. H. McAden will build in Gaston county, on the Catawba River, a cotton spinning mlil to be run by water power, the equipment to include an electric light plant. The contract has not yet been awarded.

GIBSONVILLE, N. C.—The Minneola cotton mill at this place will enlarge its present capacity within 60 days.

WINSTON, N. C.—We are informed that Brown Brothers, whose large tobacco factory building was destroyed by fire last week, will rebuild and equip the same without delay. The main building will be of brick, 3 or 4 stories in height and about 250 × 100 ft., costing, with equipment, more than $100,000.

EASTMAN, GA.—W. M. Clement and a syndicate of Northern capitalists will build a cotton manufacturing plant at this place, work on which will begin early in the coming year.

MILLEDGEVILLE, GA.—The "Chronicle" says that a party has made the citizens the following proposition: If they will furnish stock to the amount of $100,000, he will put in a $600,000 cotton factory, and build 800 tenement houses. If the city will guarantee exemption from taxes for five or ten years he will build the entire plant himself.

KNOXVILLE, TENN.—Reports say that Edgar, George and A. A. Du Rocher will establish a knitting plant at Knoxville. The plant will be of considerable size, and will cost about $10,000.

PERU, ILL.—The plant of the Peru Plow & Wheel Works burned Dec. 12.

DULUTH, MINN.—A permit has been issued to Stevens & Gray for the erection of a sawmill at the foot of Garfield Ave., to cost about $30,000.

OMAHA, NEB.—The establishment of a beet sugar plant at this place is being talked of. The Commercial Club is interested.

TRINIDAD, COLO. — Paul Morton, Third Vice-Pres. Atchinson, Topeka & Santa Fe Ry., Chicago, is quoted as saying that the shops of this company may be removed from Raton, N. Mex., to Trinidad.

SAN FRANCISCO, CAL.—A fire on Dec. 10 in the paint and varnish store of W. P. Fuller & Co., destroyed property to the value of from $50,000 to $100,000. The loss is in part covered by insurance.

GAS PLANTS.

NEW YORK, N. Y.—Bids are asked until Dec. 24 for furnishing illuminating gas for lighting the public markets, armories, buildings and offices of the city, from Jan. 1 to Dec. 31, 1897. C. H. T. Collis, Comr. Pub. Wks.

PLATTSBURG, N. Y.—Bids are asked until Dec. 23, according to reports, for laying gas mains and furnishing gas fixtures in buildings at Plattsburg barracks. Capt. Geo. E. Pond, Asst. Q. M.

SARATOGA SPRINGS, N. Y.—The "Saratogian" states that the Home Gas, Electric Light & Power Co. is being organized by local business men to construct a plant for furnishing illuminating gas and incandescent electric lights. The franchise has not yet been secured, but will be as soon as the organization of the company is completed.

SCHENECTADY, N. Y.—Bids are asked until Dec. 19 for a complete gas lighting plant, as stated in our advertising columns. Geo. T. Ingersoll, Supt. W. W.; Geo. T. Bradt, Secy. Water Comrs.

JERSEY CITY, N. J.—The George Washington Lighting Co. was incorporated Dec. 10 with a capital stock of $2,000,000, all paid in, to manufacture burners for gas, petroleum, electricity, or other substances for producing incandescent or other light. John C. McGuire, Brooklyn, N. Y., 19,990 shares; Maurice J. Powers, New York, 3 shares: Chas. N. King, Jersey City, N. J., 7 shares.

HINTON, W. VA.—A press report states that preparations are being made for the erection of a large plant at New River Falls, near this city, for the manufacture of acetyline gas. The stock company is composed of eastern capitalists, and it is reported that the work is to be pushed vigorously.

INDEPENDENCE, KAN.—It is announced that the Enterprise Oil & Gas Co. has been chartered under the laws of Kansas. Pres., A. C. Stich, Pres. Citizen's National Bank; Treas., Geo. T. Guernsey, Cashier Commercial National Bank; Secy., C. L. Kimble. Capital stock, $1,000,000. The company is said to hold leases on 250,000 acres of land in the Creek reservation.

MOJAVE, CAL.—It is reported that $600 has been subscribed for new gas works and that Mr. James hopes to be able to light the town by the first of the year.

MISCELLANEOUS CONTRACTS.

STEAM ROLLER.—Colorado Springs, Colo.—Local papers are urging the purchase of a steam roller. H. I. Reid, Cy. Engr.

CEMENT.—Providence, R. I.—Bids are asked until Dec. 21 for furnishing cement to be used during 1897. Bond, $5,000. Robt. E. Smith, Comr. Pub. Wks.

FORTIFICATIONS.—Seattle, Wash.—Plans for fortifying three points on Admiralty Inlet, Wash., are in an advanced state, and it is hoped to ask for bids soon.

BOILERS.—Brooklyn, N. Y.—Bids are asked until Dec. 24 for furnishing and setting three 60-HP. boilers, carrying 100 lbs. steam pressure. T. B. Willis, Comr. Cy. Wks.

GUN EMPLACEMENTS.—Portland, Me.—The lowest bid received by Lieut. Col. A. N. Damrall, Dec. 12, for constructing gun emplacements, etc., on Great Diamond Island, Portland Harbor, as advertised in Engineering News, was that of Isaac T. Brown, of New York, at $68,683, or $76,080. The detailed bids will probably be published next week.

DREDGING.—Portland, Me.—Bids are asked until Jan. 14 for dredging Portland Harbor, as stated in our advertising columns. Lieut.-Col. A. N. Damrell, U. S. Engrs.

FIRE PUMPS.—Chicago, Ill.—Bids are asked until Dec. 21 for furnishing two 750-gallon fire pumps in the public library building. W. B. Wickersham, Secy., City Hall.

DREDGING.—New York, N. Y.—Bids are asked until Jan. 5 for dredging in Peekskill Harbor, N. Y., as stated in our advertising columns. Col. G. L. Gillespie, Army Bldg.

PEDESTAL.—Philadelphia, Pa.—Bids are asked until Dec. 22 for constructing a pedestal for the Grant statue in Fairmount Park. Russell Thayer, Ch. Engr. and Supt., Room 127, City Hall.

DREDGING.—Wilmington, Del.—Bids are asked until Jan. 12 for dredging in Wilmington Harbor and Christiana River, Del., as stated in our advertising columns. Maj. Wm. F. Smith, U. S. Agent.

CITY SUPPLIES.—Philadelphia, Pa.—Bids are asked until Dec. 23 for furnishing the department of public works with lumber, shovels, nails, steel, iron pipes, castings, pig lead, bolts, gas meters, etc. T. M. Thompson, Dir.

UNDERGROUND CONDUITS.—Allegheny, Pa.—Elmer E. Loomis, Cy. Electrician, has completed plans and specifications for putting city wires underground, and it is stated that bids will be asked at once for the conduits and cables.

IRON FENCE, ETC.—New York, N. Y.—Bids are asked until Dec. 21 for erecting an iron fence around the deer paddocks in Central Park; for furnishing 10,000 cu. yds of garden mold, etc. Department of Public Parks, The Arsenal, Central Park.

BONDS.—Hoboken, N. J.—Bids are asked until Dec. 23 for the purchase of $50,000 of 20-year library construction bonds; $90,000 of school building bonds; and $92,000 main outlet sewer bonds, all to be 20-year bonds at 5%. M. V. McDermott, Cy. Clk.

PARK WORK.—St. Paul, Minn.—The county commissioners have decided to purchase 51 acres of land adjacent to Thalen Park, to be used as an addition to the park.——The park superintendent has submitted plans for a boulevard along the bluff overlooking the river on the west side; estimated cost, $50,000.

TUNNEL.—Durango, Colo.—Pret, Teachsler & Co., Windsor Hotel Bldg., were to open bids Dec. 15 for running a crosscut tunnel a distance of 550 ft. for the working of the Small Hopes mine, about 3½ miles north of La Platta City. Blair Burwell, County Surv.

ENGINES, CASTINGS, ETC.—New York, N. Y.—We are informed that the following bids were received by the board of public parks Dec. 7 for engines, castings, etc., at the Madison Ave. bridge: Joseph Edwards & Co., 414 Water St., $7,940, and Augustus Smith, C. E., 39 Cortlandt St. (accepted), $6,470.

LIFT LOCKS. —Lockport, N. Y.—It is stated that plans are about completed for the proposed steel lift locks at this place for the Erie Canal; estimated cost, $500,000. The contract will probably be let early in January. C. W. Adams, State Engr.; G. W. Aldridge, Supt. Pub. Wks., Albany.

GRANITE AND BRONZE MONUMENT.—Chickamauga, Ga.—Bids are asked until Jan. 5 for furnishing and constructing a granite and bronze monument in Chickamauga National Military Park; bond, $20,000. Gordon Lee, Secy. State Memorial Board, Chickamauga; W. M. Everett, Chn., Atlanta, Ga.

RAILWAY EQUIPMENT.—Bangor, Me.—It is reported that at a meeting of the Bangor & Aroostook R. R., in this city, Dec. 9, it was voted to buy 408 flat cars, 180 box cars and 5 cabooses, all to be fitted with Westinghouse brakes and automatic couplers. Pres., A. A. Burleigh, Houlton, Me.; Gen. Mgr., F. W. Cram, Bangor; Ch. Engr., M. Burpee, Houlton.

FIRE DEPARTMENT.—Bayport (L. I.), N. Y.—The Bayport Hook & Ladder Co. and the Bayport Fire Department which includes all the fire companies in the place, have been incorporated by Charles A. Post, William K. Post, Regis H. Post, John O. Savercool, Moses W. McMath, M. H. Packer, William H. Squires, John R. Edwards, Stephen G. Hicks and Edward W. Gillette.

REMOVAL OF TELEGRAPH SYSTEM.—Baltimore, Md. —Bids are asked until Dec. 21 for the removal of the abandoned overhead lines of the police and fire-alarm telegraph system in that part of the city included in sections 2 and 3 of the underground conduits of said system, consisting of about 27 miles of copper and 38 miles of iron wire, about 70 poles, together with cross-arms, etc. N. S. Hill, Jr., Engr. Electrical Comn., 508 Equitable Bldg.; A. Roszel Carthcart, Chn.

CANAL.—Salt Lake City, Utah.—The committee recently appointed by the council to investigate the advisability of constructing the surplus canal recommended Dec. 2 that a 60-ft. canal be constructed immediately, half the cost to be paid by the county, and that the total be not more than $20,000. It was further recommended that bids be asked at once, and that none but citizens of Salt Lake be employed in its construction. The report was adopted and the work will begin as soon as possible.

CITY SUPPLIES.—Philadelphia, Pa.—Bids are asked until Dec. 21 for furnishing the department of public safety with the following: Plumbing supplies, lumber, hardware, bolts, nuts, iron and steel, iron and malleable castings, brass castings, oil, hubs, removal of ashes, roofing, patent pavement, bricklaying, plastering, dredging, chemicals, fire signal boxes, patrol, signal and telephone stations, telephones and transmitters, mast arms, iron posts, iron and copper wire battery supplies, cables, poles, cross arms, manhole covers, conduits, creosoted lumber and such other supplies as may be required by the several bureaus connected with the department. F. M. Riter, Dir., Room 217, City Hall.

TELEPHONE EXTENSION.—Spokane, Wash.—Local papers state that the Inland Telephone & Telegraph Co., 4th floor, Hazel Block, has decided to extend its system to Seattle and Tacoma, a distance of 290 miles, and to a number of other places, making the total extensions 536 miles. The estimates for this work call for 16,000 poles, 1,884 miles of No. 10 hard drawn copper wire, 15,000 cross arms and braces and 32,000 pins and insulators. The estimated cost of material and labor is $72,000. The work will be commenced March 1 if the weather will permit, and completed by the middle of the summer. C. B. Hopkins, Gen. Mgr.——It is also stated that Sunset Telephone Co., of San Francisco, Cal., and of Spokane, will extend its system.

FIRE EQUIPMENT, ETC.—Philadelphia, Pa.—Bids are asked until Dec. 21 for furnishing the following supplies to the department of public safety: Fire hose; hand fire extniguishers; one or more steam engines to weigh about 7,000 lbs., with pumps of sufficient capacity to discharge 700 gallons of water per min., and one or more steam fire engines with pumps of sufficient capacity to discharge 500 gallons per min.; combination hose wagons and chemical engines combined; chemical engines, with two 60-gallon horizontal tanks, nickel-plated sarvon wheels, with 500 ft. of hose; Duval water towers for aerial trucks; aerial extension ladders; general electrical supplies; bicycles; Pedrick & Ayer air compressor; radial head for milling machine and for coal hoist. Frank M. Riter, Dir.

DREDGES.—St. Louis, Mo.—The following bids are reported to have been received Nov. 11 by Capt. H. E. Waterman, U. S. Engr. and Secy. Missouri River Comn., for furnishing two hydraulic dredges, as advertised in Engineering News:

Item 1, for one dredge with water jet agitators; 2, for one dredge with mechanical agitators; 3, for two dredges with water jet agitators; 4, for two dredges with mechanical jet agitators.

Springfield Boiler & Mfg. Co., Springfield, Ill., 1, $105,508; 2, $109,981; 3, $102,000 each, accepted for one; 4, $106,000 each, accepted for one.

John S. George and H. P. Eells receivers Bucyrus Steam Shovel & Dredge Co., South Milwaukee, Wis., 1, $119,750; 2, $129,750; 3, $119,500; 4, $129,500.

New York Dredging Co., World Bldg., New York, 1, $200,000 and $105,000; 2, $200,000 and $105,000; 4, $100,000.

CONTRACT PRICES.

BREAKWATER.—Philadelphia, Pa.—Maj. C. W. Raymond received the following bids Dec. 10 for constructing the proposed new stone breakwater and harbor of refuge at the entrance to Delaware Bay, as advertised in Engineering News; contracts not to exceed $4,660,000 have been authorized for this work; estimates made several years ago, placed cost of stone in substructure at $3 a ton, and in superstructure at $4 a ton; contractor is required to deposit 200,000 tons of stone the first year, and 280,000 tons each subsequent year:

Bidder.	Stone per net ton. Structure, 1,210,665 tons.	Superstructure, 173,745 tons.
James McCarron, Philadelphia	$1.31	$1.39
National Contracting Co., New York	1.59	1.93
John L. Grim, Philadelphia	1.43	2.92
John M. Sharp, Philadelphia	2.37½	3.75
Hughes Bros.& Bangs,Syracuse,N.Y.	1.18⅜	1.18⅜
Geo. B. Christie & Lowe, Chicago..	1.50	2.50
William B. Gray, Baltimore, Md. ...	2.30	3.04
Andrew Onderdonk, New York	1.80	3.00
Gwilliam & Miller, Philadelphia....	2.46	3.90
William Bailey Thomas, Atlanta,Ga.	2.05	2.30
J. W. Hoffman & Co., Philadelphia.	1.89	1.89
Booth Brothers, New York	2.23	3.98
Venable Constructing Co., Atlanta..	2.76	3.80

GUN EMPLACEMENTS.—Portland, Me.—Lieut.-Col. A. N. Damrell received the following bids Dec. 10 for constructing gun emplacements at Fort Constitution, N. H., as advertised in Engineering News:

BIDS RECEIVED DEC. 10 FOR CONSTRUCTION OF GUN EMPLACEMENTS AT FORT CONSTITUTION, N. H.

Quantities.		Mairs & Lewis, 18 Broadway,N.Y.	Clark & Co., 100 Broadway, N. Y.	Gardner C. Luther, Providence,R.I.	Manhattan Concrete Co., N. Y.	A.W.Bryne ConstnCo., West Medford, Mass.	Hartford P'v'g & Const'n Co., Hartford,Conn.	Molloy & Shehan, N. Rochelle, N.Y.	T.W.Kinser & Sons, Waltham, Mass.	H. C. Moore, N.Y.	Scruton & Hett,Portsmouth, N.H.	Pennel & O'Hern, Yonkers,N.Y.	Wm. Morgan, Trent'n N. J.
Excavation, earth	100 cu. yds.	$0.30	$2.10	$1.25	$0.56	$0.40	$0.35	$0.50	$0.50	$0.50	$0.43	$0.40	$1.00
Excavation, ledge	9,000 " "	1.20	2.10	1.50	1.64	3.50	.74	1.65	2.50	1.10	3.18	2.00	3.00
Embankment	6,800 " "	.40	.30	1.35	.81	1.25	.70	1.00	1.00	.40	1.06	.50	1.25
Natural cement concrete	6,860 " "	4.85	4.00	4.00	4.86	5.00	4.65	4.85	4.70	4.85	5.95	3.80	7.50
Portland cement concrete	165 " "	7.50	12.00	8.00	8.50	9.00	....*	6.00	10.00	8.00	11.72	12.00	10.50
Steel beams, channels, etc.	35,000 lbs.....	.03	.05	.03	.03¾	.04	.03½	.03	.03	.02¾	.05	.04	.035
Anchor bolts	2 sets....	2.80	340.00	400.00	250.00	150.00	155.00	225.00	20.00	100.00	260.00	152.14	175.00
Trolleys	2 "	3.80	500.00	405.00	205.00	400.00	497.00	600.00	300.00	500.00	500.00	250.00	750.00
Doors, single	10........	.40	18.00	10.00	36.00	25.00	9.50	25.00	15.00	29.00	50.00	15.00	20.00
Doors, double	4........	.85	36.00	20.00	50.00	40.00	12.16	40.00	30.00	60.00	55.00	30.00	25.00
Bricks	10,000........	.15	26.00	20.00	20.00	30.00	12.00	18.00	25.00	20.00	24.00	30.00	18.00
6-in. vitrified pipe	140 ft......	.50	.40	.22	.38	1.00	.22	.60	1.00	.20	1.10	1.50	.50
8-in. " "	225 "	.75	.45	.38	.45	1.00	.27	.80	1.00	.25	1.15	1.50	.75
4-in. cast-iron pipe	160 "	.50	.60	.50	.50	1.50	.54	.40	.30	.60	1.30	1.50	1.25
Basin heads and gratings	2,000 lbs.....	.03¾	.05	.03	.04	.03	.03	.05	.05	.05	.05	.04	.03
Cranes	8........	1.90	60.00	130.00	58.00	75.00	78.00	250.00	100.00	200.00	136.00	50.00	250.00
Railing for platforms	2 sets....	200.00	50.00	130.00	100.00	50.00	23.00	25.00	100.00	50.00	27.00	25.00	25.00
Iron ladders	2 "	80.00	60.00	20.00	22.00	100.00	7.25	40.00	20.00	20.00	22.00	25.00	25.00
Iron steps to platforms	4 "	600.00	100.00	750.00	180.00	100.00	95.00	300.00	100.00	50.00	340.00	25.00	150.00
Iron steps to observatory station.....	1 set.....	100.00	60.00	900.00	180.00	100.00	85.00	100.00	150.00	50.00	340.00	25.00	100.00
Speaking tubes	100 ft......	.25	.30	.15	.30	.20	.10	.25	.10	1.00	.10	.15	.25
Quarry stone in concrete mass, per cu. yd.........		3.00	2.30	1.50	1.10	1.50	.59	1.50	2.00	1.20	2.00	1.60	1.50
Electric lighting, complete plant................		6,000.00	5,500.00	3,500.00	4,500.00	7,500.00	6,800.00	7900.00	7,000.00	3,000.00	2,040.00	6,000.00	3,000.00
Total		$62,317	$61,627	$63,716	$64,501	$88,620	$55,373	$71,034	$74,565	$55,523	$88,581	$59,770	$98,661
Time of beginning, all in 1897..................		Feb. 1.	Mar. 1.	Jan. 1.	Feb. 1.	Jan. 1.	Apr. 15.	Mar. 1.	Feb. 1.	Mar. 1.	Feb. 1.	10 dys.	Mar. 20.
Time of completion, all in 1897		Sept. 1.	Sept. 15.	1 year.	Dec. 1.	Oct. 1.	Oct.15.	Dec. 1.	Nov. 1.	Nov. 1.	Dec. 1.	Dec. 1.	Dec. 1.

*130 cu. yds at $5.74, and 35 cu. yds. at $7.95. Mairs & Lewis' bid for electric lighting was 100 lights to burn 12 hours ($4,000), and 100 lights to burn 6 hours ($2,000).

GUN BATTERY.—San Diego, Cal.—Maj. Chas. E. L. B. Davis, U. S. Engrs., San Francisco, received the following bids Nov. 30 for constructing a gun battery and torpedo casemate at Ballast Point, San Diego Harbor, Cal.:

Quantities.		William Osburn, San Diego, Cal.	William H. Healy, San Francisco,Cal.	Cal. Const'n Co., San Francisco,Cal.
Excavation	8,534 cu. yds.	$0.50	$0.50	$0.30
Earth fill	1,425 " "	.45	.30	.50
Concrete No. 1...	10,386 " "	10.50	10.50	8.40
" " 2...	570 " "	22.05	12.00	10.80
Paraffine covering.	3,550 sq. yds.	.30	.35	.30
Hard finish	1,250 " "	.30	.50	.50
Bricks, laid	23 M......	30.00	15.00	20.00
Stl beams & fitgs.	23,187 lbs.....	.07	.06	.055
Stl. tr'ly bms, etc.	4,500 "	.25	.20	.05
Ammunition lifts.	4 each....	650.00	1,000.00	1,300.00
Cranes, ...	4 " ...	500.00	500.00	320.00
Stl bolts,nuts, etc.	4,300 lbs.....	.18	.12	.06
Brass fitgs for drs	1,650 "	.35	.35	.30
Lumber, doors ...	2,000 ft......	.10	.03	.04
W't iron fitgs, drs.	3,500 "	.30	...	.12
Lmbr for elec fitgs	470 ft......	.05	.20	.04
C. i. pipe,8 × ⅜-in.	500 "	1.10	1.20	1.50
" " " 3 × ¼-in.	550 "	.30	.50	.30
Lids and gratings.	100 lbs.....	.50	.06	.05
Porous drain tile..	1,200 lin. ft..	.30	.10	.05
Speaking tubes ..	160 " "	.38	.25	.12
C. i. steps, flights.	2 each....	300.00	500.00	150.00
Total		$141,272	$134,380	$109,417

Contract Work Should Always be Advertised in a Paper Read by Contractors.

Nearly Every Prominent Contractor and Manufacturer of Contractors' Supplies in North America Reads Engineering News

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